Department of Biomedical Engineering
The Chinese University of Hong Kong

Graduate Seminar – PhD Oral Defence

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Date	**:**	22 July 2026 (Wednesday)
Time	**:**	2:30 pm
Venue	**:**	Room 407, William M W Mong Engineering Building, CUHK

Title: Advancing High-Fidelity, and High-Resolution Diffusion Biomarker Mapping in the Brain and Spinal Cord

As core components of the central nervous system, the brain and spinal cord serve as critical relays for sensorimotor signaling, where preservation of their microstructural integrity is essential for precise integration and efficient transmission of neural information. Diffusion-weighted magnetic resonance imaging (DWI) has been an important non-invasive imaging tool for assessing white matter integrity and different neurological diseases with the measurement of advanced DWI-biomarkers, such as diffusion tensor imaging (DTI) and intravoxel incoherent motion (IVIM). However, conventional 2D single-shot DWI (2D-SS-DWI) is often plagued by low resolution, severe geometric distortion, and EPI-related artifacts, whereas 2D multi-shot DWI (2D-MS-DWI) remains challenged by limited through-plane resolution and prolonged acquisition time.

To address these limitations, this thesis focuses on developing effective methods to improve the acquisition efficiency and reconstruction quality for DWI images of the brain and cervical spinal cord (CSC) to ensure accurate DWI-biomarker mapping. First, a 3D-MS-DWI acquisition and reconstruction technique (3D-rFOV-MUSE) is developed by combining 3D multiplexed sensitivity encoding with two reduced FOV (rFOV) techniques, to acquire 3D CSC-DTI data using a single sagittal thin slab. The proposed 3D-rFOV-MUSE offers higher isotropic resolution, reduced geometric distortion, and enables multi-planar data reformation for CSC-DTI. Second, a novel data-sharing-guided deep learning (DL) framework is proposed for joint IVIM reconstruction and IVIM-biomarker estimation directly from highly-accelerated 2D-MS-DWI data. The proposed framework produces high-quality IVIM images and IVIM-biomarkers comparable to fully-sampled references, while significantly reducing acquisition time. Third, a flexible zero-shot self-supervised learning (SSL) joint framework is further introduced for joint DTI image reconstruction and DTI-biomarker estimation directly from highly-accelerated 2D and 3D-MS-DTI data, without requiring fully-sampled ground truths during DL model training.

In conclusion, this thesis provides robust and efficient tools for imaging high-fidelity, and high-resolution DWI, thereby advancing the clinical investigation of DWI-biomarkers in brain and CSC-related diseases and potentially expanding their applicability.

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

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