Department of Biomedical Engineering
The Chinese University of Hong Kong

<u>Graduate Seminar – PhD Oral Defence</u>

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Date	**:**	28 July 2026 (Tuesday)
Time	**:**	2:30 - 4:30 pm
Venue	**:**	Room 404, William M W Mong Engineering Building, CUHK

Title: Collaborative Reconstruction for High-fidelity Non-Cartesian DW-EPI

Diffusion-weighted echo-planar imaging (DW-EPI) is widely used in clinical and research MRI for rapid assessment of tissue microstructure. However, image fidelity is often degraded by EPI-related artifacts, particularly in high-resolution or multi-shot acquisitions. PROPELLER-EPI provides a promising non-Cartesian strategy by acquiring multiple rotating EPI blades with repeated central k-space coverage, but its reconstruction remains challenging because of blade-dependent phase variation, off-resonance effects, and incomplete k-space coverage.

This thesis develops reconstruction strategies for high-fidelity non-Cartesian DW-EPI, with a focus on DW-PROPELLER-EPI. First, a collaborative reconstruction framework, CORPUSE, is proposed to jointly reconstruct PROPELLER-EPI data using phase, off-resonance, and coil sensitivity constraints. By extending POCSMUSE to multi-blade PROPELLER-EPI, CORPUSE improves geometric fidelity, suppresses Nyquist ghosting and off-resonance blurring, and increases SNR efficiency in reduced-blade and accelerated acquisitions. Second, CORPUSE is extended to high-resolution liver DWI. Respiratory-triggered DW-PROPELLER-EPI with CORPUSE is evaluated for image sharpness, artifact reduction, respiratory robustness. Compared with ssEPI- and msEPI-based liver DWI protocols, the proposed method improves image quality and shows preliminary improvement in ADC repeatability. Third, an AI-assisted reduced-blade reconstruction framework is developed using FieldNet-informed implicit neural representation (INR). By combining limited blade information, FieldNet-predicted field maps, and continuous coordinate-based representation, the framework improves reconstruction from limited k-space coverage and achieves better image quality than reduced-blade CORPUSE, UNet-based reconstruction, and denoising-based baselines.

Overall, this thesis advances DW-PROPELLER-EPI reconstruction by integrating multi-blade data consistency, phase and off-resonance correction, and field-map-informed learning-based representation. The proposed methods improve image fidelity in reduced-blade and accelerated acquisitions, supporting more robust and efficient high-resolution brain and liver DWI and contributing toward clinically practical non-Cartesian diffusion MRI.

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

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