The Chinese University of Hong Kong
Department of Biomedical Engineering

Graduate Seminar – PhD Oral Defence

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Date	***:***	29 August 2023
Time	***:***	10:00 am
Venue	***:***	ERB 1122, William M W Mong Engineering Building, CUHK

Title: Development of Compact Morpho-molecular Microscopy and Depth-resolved Quantitative Phase Microscopy for Biomedical Imaging and Analysis

Quantitative phase microscopy (QPM) is a label-free and noninvasive optical imaging technique, through which specimen optical path difference distribution or surface profile map can be obtained. However, current interferometry-based QPM methods suffer from several limitations that hinder their application scenarios: (i) lack of portability and simplicity; (ii) single-wavelength QPM systems lack the molecular specificity which limits cell characterization functions; (iii) transmission-mode three-dimension (3D) QPM techniques have limited imaging depth, restricting for 3D imaging of thick tissues. In this talk, we will present our recent research on QPM methods to alleviate these issues. In the first topic, we will introduce Portable Optical Precision Profilometer (POPP). POPP has been realized a footprint size of 30 x 20 x 5 cm and we will show its capability for profiling gold electrodes morphology and quantifying the dry mass of flowing cells. Secondly, we will present Compact Morphology Molecular Microscopy (CM_3) platform, in which we realize multiplexing dual-wavelength information in a single interferogram. We deliver a refractive index dispersion model for the detection of dispersive materials and achieve a 5 times extension of the measurement range for steep structures. In the third topic, we will introduce a compact three-wavelength QPM (3λ-CQPM) system. We will show the dynamic characterization of red blood cell (RBC) morphological and molecular parameters, e.g., oxygen saturation, oxy/deoxyhemoglobin concentrations. Combining the system with microfluidic devices, we will show real time analysis of mice RBCs in a high-throughput manner, which are verified with existing hematology analyzers within 8% deviation. Finally, we will introduce the development of a reflection mode depth-resolved QPM. To realize in vivo tissue imaging, we will stress an epi-mode QPM design with near-infrared illumination around 1310nm. We further exploit broadband spectral illumination and add a dynamic speckle illumination to achieve depth selectivity around micron scale. I will conclude the talk and discuss the future work lastly.

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

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