How Deep Can Single-cell Biophysical Morphological Profiling Go? From Instrumentation To AI analytics

Kevin Kin-Man Tsia

[1] Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong, Hong Kong
[2] Advanced Biomedical Instrumentation Centre, Hong Kong Science Park, Shatin, New Territories, Hong Kong

Pairing up optical microscopy and computer vision becomes a common strategy adopted in a broad spectrum of biological and biomedical screening applications. The common rationale is to generate the characteristic "fingerprint" profiles of cell morphology that could underpin the cell states/functions, but obscured through visual inspection or even in the molecular assay. However, it remains not achievable or affordable with current technologies to record, integrate, and analyze all relevant cell morphological data. In this talk, I will introduce how the synergism between ultrafast imaging, microfluidics, and deep learning allows us to overcome some of these current limitations. Specifically, I will present a few high-throughput, deep-learning-powered imaging techniques and analytical cytometry pipelines developed in our laboratory over the past few years. These platforms allow us to significantly scale up the single-cell biophysical/mechanical phenotyping throughput (beyond millions of cells per run); to enrich the phenotyping content by integrating with the biochemical cell-based assay in a single platform. Indeed, these techniques have achieved biophysical/mechanical phenotyping specificity and sensitivity that were once inconceivable. They are now successfully employed in many biological research and clinical applications, including rare cancer cell detection in mouse blood, cancer and immune-cell sub-typing, targeted-drug sensitivity prediction, and more emerging applications.

Biography:

Kevin Tsia is currently a Professor in the Department of Electrical and Electronic Engineering and the Program Director of the Biomedical Engineering Program at The University of Hong Kong. His research interest covers a broad range of subject matters including ultra-fast optical imaging for imaging flow cytometry and high-speed in-vivo brain imaging, bioinformatics approaches for single-cell analysis. He is currently the HK Research Grants Council (RGC) Research Fellow (2020). He received Early Career Award 2012-2013 by RGC in Hong Kong. He also received the Outstanding Young Research Award 2015 at HKU as well as 14th Chinese Science and Technology Award for Young Scientists in 2016. He holds 11 granted and pending US patents on ultrafast optical imaging technologies. He is a co-founder of start-up company commercializing the high-speed microscopy technology for cancer screening and treatment monitoring applications. It was among the top 10 finalists in Falling Walls Venture in 2019, and awarded as Google Cloud Startup in 2024.