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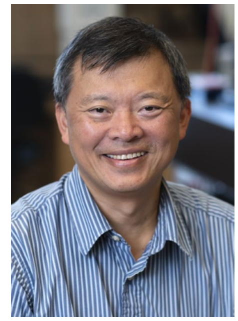
Biosketch of Presenter (150 word version)



Abraham (Abe) P. Lee is Chancellor’s Professor of Biomedical Engineering (BME), Pharm Sci and MAE at the University of California, Irvine (UCI). He served as department chair for BME from 2010-2019. He is Director of the “Center for Advanced Design & Manufacturing of Integrated Microfluidics” (CADMIM). Dr. Lee previously served as Editor-in-Chief for the Lab on a Chip journal (2017-2020). Prior to UCI, he worked for the National Cancer Institute (NCI), and was a Program Manager at DARPA. Dr. Lee’s current research focuses on microfluidic systems for precision medicine including liquid biopsy, microphysiological systems, cell engineering, and immunotherapy. He is inventor of over 70 issued US patents and is author of over 140 journals articles. Professor Lee was awarded the 2009 Pioneers of Miniaturization Prize and is fellow of the National Academy of Inventors (NAI), Biomedical Engineering Society (BMES) and several other professional societies (AIMBE, RSC, ASME, and the IAMBE.

Title of Presentation:
Microfluidic Cell Engineering for Precision Medicine

Presentation Abstract

Precision medicine is the paradigm to develop treatments for patients based on molecular-targets that are effective *in vivo* when administered. However, the complexity of constantly evolving diseases (cancer, autoimmune diseases, etc.) involves abnormalities that affect the mutated expression of tens of thousands of genes. Tremendous effort is required to link molecular information to more systemic health traits and ultimately to precision treatment options. The detailed morphological features of a cell that include size, shape, and topography, provide a more complete picture of the cell’s functional state. Advances in single cell morphologies will complement the powerful molecular sequencing and genotyping tools, as phenotype and function is inherently manifested in a complete “picture” of the cell. The Arrayed-droplet optical projection tomography (ADOPT) platform developed in my lab captures the 3D morphologies of single cells. ADOPT relies on flow-controlled, linear cell rotation of live, suspended cells (e.g. immune cells), to allow 360°-imaging of suspension cells with high lateral resolution using simple epifluorescence microscopy. ADOPT is akin to a “bio-GPU” (graphics processing unit) by rapidly producing 3D morphologies of single cells to form the basis of the collective health status of a population of cells. As the AI revolution was accelerated by the advent of the GPUs, bio-GPUs have the potential to serve a similar role for the BI (biological intelligence) revolution. Microfluidic cytometry processors capable of cell sorting, cell engineering, and cell characterization form the “cell processing units” (CPUs) for bioengineering. This is analogous to the CPU (central processing unit) for computer engineering. Bio-CPUs capable of precisely programming multiple cell functions is critical for the future development of precision cell therapies. In this talk I will introduce two bio-CPU microfluidic platforms in my lab. 1. Acoustic electric shear orbiting poration (AESOP) device to uniformly deliver genetic cargos into a large population of cells simultaneously. We demonstrate high quality transfected cells with controlled dosage delivery as well as serial delivery of different genetic cargos. 2. Artificial antigen presenting cells (aAPCs) based on droplet microfluidics for antigen-specific T cell activation as well as the induction of regulatory T cells with anti-inflammatory and immune suppression effects.

The current cell engineering paradigm typically focuses on a singular target or pathway, by adding, subtracting or replacing a single genetic code to program cells for targeted diagnosis or therapeutic functions.

A prime application for the bio-CPU and bio-GPUs is immunoengineering that involves the "reprogramming" of the immune system to overcome limitations of the innate or adaptive immune responses that the body naturally produces.