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The William G. Lowrie Department of Chemical and Biomolecular Engineering
Graduate Program

Cordially invites you to attend a seminar on

From Materials, Devices, Systems to Control of Complex Systems

Thursday, October 8th, 11:30 a.m.

Room 207 Koffolt Labs, 140 W. 19th Avenue
Reception before the Seminar in Room 336 Koffolt Labs, at 11:00 a.m.

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Abstract

A universal goal of technological development, including micro/nano technologies, is the enrichment of human lives. However, a disparity of nine orders of magnitude in length scales, from a human (a meter) to nanometer molecules, presents significant technical challenges. The developments of new material based devices and the integration of devices into an engineering system to interface/control a biological complex system are non-trivial tasks, but the seamless integrations from nano-, micro- to macro-scales are essential for scientific advancements.

A complex system is composed of a large number of interacting building blocks/elements which self organize, generating emerging properties that are usually not directly linked to those of the individual building elements. Biological systems, e.g. cells, are examples of complex systems.

In each living cell, the interactions among the bio molecules, proteins and nucleic acids intrinsically serve as the foundation of the extensive networks of signal and regulatory pathways. Emergent cellular functionalities are derived from the self-organization of these pathways and can not be easily related to individual bio-molecular interactions. As such, the sheer magnitude of pathway processes and pathway crosstalk presents significant challenges to their straightforward manipulation to direct cellular phenotypic and genotypic outcomes.

Frequently, we intend to control complex systems toward a desired state, with a key example being the application of pharmacological agents to treat diseased cells in medicine. Rather than laboriously mapping out the detailed cascade of signaling pathways, our approach has employed a feedback system control scheme to bypass the challenges associated with simultaneously considering/manipulating multiple cellular regulatory pathways in cellular complex systems. In addition, we have harnessed these control schemes to rationally design combinatorial drug therapy modalities to stimulate these cellular pathways with improved efficacy and low toxicity. This imposes another challenge which pertains to the large parameter space. For example, 6 drugs with 10 concentrations each would result in 1,000,000 potential search trials. With the feedback system optimization approach, we have demonstrated that only tens of searches instead of 1,000,000 cases are needed to identify the optimized drug cocktail.

Bio

Dr. Chih-Ming Ho received his Ph.D. from The Johns Hopkins University and holds the Ben Rich-Lockheed Martin Chair Professor in the UCLA School of Engineering. He is the Director of the Center for Cell Control (http://CenterForCellControl.org). He served as the UCLA Associate Vice Chancellor for Research from 2001-2005.

Dr. Ho is known for his work in micro/nano fluidics, bio-nano technologies and turbulence. He has published 260 papers and is ranked by ISI as one of the top 250 most cited researchers worldwide in the entire engineering category. In 1997, Dr. Ho was inducted as a member of the National Academy of Engineering. In the next year, he was elected as an Academician of Academia Sinica. Dr. Ho holds seven honorary professorships. He has delivered 18 named distinguished lectures and presented over 130 keynote talks in international conferences. Dr. Ho was elected Fellow of the American Physical Society as well as American Institute of Aeronautics and Astronautics.