NCKU
NATIONAL CHENG KUNG UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING

Newton vs. Schrodinger

January 12, 2023 (Thursday)
Hui-En Auditorium/懷恩講堂, 10:00am-11:00am

Professor Yail Jimmy Kim, Ph.D., P.Eng., F.ACI

Speaker: Dr. Jimmy Kim is President of the Bridge Engineering Institute, An International Technical Society, and a Professor in the Department of Civil Engineering at the University of Colorado Denver, Colorado, USA. He has over 29 years of civil and structural engineering experience. He is Chair of American Concrete Institute (ACI) Subcommittee 440-I, FRP-Prestressed Concrete, and was Chair of ACI Committee 345, Concrete Bridge Construction and Preservation, from 2012 to 2018. Dr. Kim is an active member of several technical committees and scientific/organizing committees of renowned international conferences, as well as is an elected council member of the International Institute for FRP Composites in Construction (IIFC). He is the recipient of a number of awards from institutional, national, and international competitions, including the Centennial Research Award at North Dakota State University (two times), Intelligent Sensing for Innovative Structures Award of Merit, the Award of Excellence by the Ontario Ministry of Public Infrastructure Renewal, the Excellence in Research and Creative Activities Award by the University of Colorado Denver (highest recognition at the campus-level, awarded to one faculty per year), and the prestigious Chester Paul Siess Award for Excellence in Structural Research (the highest research award in structural concrete bestowed by the American Concrete Institute). His research interests encompass advanced composite materials for rehabilitation, structural informatics, complex systems, and science-based structural engineering, including statistical, interfacial, and quantum physics. He is the author of ten books and 188 journal papers, most of which have been published in top-tier journals such as those of ACI, the American Society of Civil Engineers (ASCE), and Elsevier. He serves as an Associate Editor and member of editorial boards of international journals. He is the sole author of *AASHTO Guide Specifications on Bridges under Light Rail Loading*, which are used in the United States and abroad. Dr. Kim is a Fellow of the American Concrete Institute.

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SEMINAR/演講通知

January 12, 2023 (Thursday)
Hui-En Auditorium/懷恩講堂, 11:00am-12:00pm

Digital Twins Enabled by Novel Nanocomposite Sensors

Ken Loh, Ph.D.
Professor
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Center for Extreme Events Research
Department of Structural Engineering, University of California San Diego

Abstract

There is no shortage of data in the world we live in today, especially considering the vast adoption of smartphones, Internet-of-Things technologies, environmental sensors, and security cameras, among many others. However, data on its own is often useless unless actionable information can be derived. This is certainly true in the field of structural health monitoring (SHM), where the goal of measuring structural response to ambient or forced excitations is not only to detect damage but also to make operational and maintenance decisions. Similarly, data from medical examinations need to be interpreted by clinicians before determining appropriate treatment plans. In both these examples, decisions are often made using people's subjective assessments, which can be inconsistent or even erroneous. Digital Twins, which are cyber representations of a physical or human asset, have emerged as a novel system that can fuse diverse sensing streams, accurately model the target, and run predictive analytics for optimal decision-making. However, optimal decisions can only be made if relevant and high-quality sensing streams that describe system performance are available to the Digital Twin. This presentation discusses the design and properties of nanocomposite-based stimuli-responsive materials that respond to structural response (or damage) features of interest. By coupling these materials with tomographic methods, rich, spatially distributed properties of the target can be acquired and then fed to a Digital Twin. These nanocomposite sensors were first demonstrated to identify the severity and location of structural damage, which directly supports SHM. Second, the sensors were also adapted to measure physical movements and muscle engagement for human performance assessment. A Human Digital Twin was developed by implementing a machine learning algorithm that was trained using nanocomposite sensing streams when subjects performed certain functional movements. The Human Digital Twin was able to identify incorrect or sub-optimal movements that led to poor performance. This information can be used as feedback to inform training, improve physical performance, and/or prevent musculoskeletal injuries from occurring.

Short Bio

Dr. Ken Loh is a Professor and was the former Vice Chair (2018-2021) of the Department of Structural Engineering at UC San Diego. He is the Director of the Active, Responsive, Multifunctional, and Ordered-materials Research (ARMOR) Lab and is the Director of the UC San Diego, Jacobs School of Engineering, Center for Extreme Events Research (CEER). He is also an affiliate faculty member of the Materials Science & Engineering Program and the Center for Wearable Sensors. Dr. Loh received his B.S. in Civil Engineering from Johns Hopkins University in 2004. His graduate studies were at the University of Michigan, where he completed two M.S. degrees in Structural Engineering (2005) and Materials Science & Engineering (2008), as well as a Ph.D. in Structural Engineering in 2008. He started his Assistant Professor career in January 2009 in the Department of Civil & Environmental Engineering at UC Davis, before joining UC San Diego in January 2016. His research interests are in multifunctional and stimuli-responsive materials, tomographic imaging techniques, wearable sensors, active metamaterials, and soft material actuators applied towards solving problems related to human performance, structural sustainment, and human-structure interactions.