The Department of Mechanical Engineering
College of Engineering and Applied Sciences
Stony Brook University

Mechanical Engineering Seminar

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Lecture Title: Multifunctional Materials and Tomographic Methods for Structural Damage Characterization

Friday, Nov 4th, 2016 at 2PM, Room 173 Light Engineering

Abstract

Structural health monitoring (SHM) is crucial for identifying damage initiation, directing repair, and ensuring system safety/reliability. This presentation outlines a new paradigm shift in SHM, where sensors are designed from a materials perspective stemming from a "bottom-up" design methodology. In doing so, one can engineer multifunctional materials that possess a diverse suite of engineering functionalities, such as sensing of specific external stimuli (e.g., strain and pH). A few examples will be highlighted. The first case examines multifunctional nanocomposite thin films engineered with electrical properties that are sensitive to strain (for monitoring deformation, impact, and cracks) or pH (for monitoring corrosion). A scalable fabrication method based on spray-coating is proposed so that it is amenable to large-scale implementation. In addition, by coupling the films with an electrical impedance tomography (EIT) algorithm, these "sensing skins" are able to localize and characterize damage severity. Its applications for SHM of composite structures (such as wind turbine blades), metallic systems, and cement composites will be presented. However, one limitation of EIT is that it requires a set of electrodes to be permanently installed at the boundaries of the sensing skin. Thus, the second example illustrates how one can leverage a different modality of electrical excitation to interrogate structures and characterize subsurface damage without requiring pre-installed electrodes. In that regard, nanocomposites embedded in structural components then serve as passive elements that accentuate damage occurring in the system through electro-mechanical or electro-chemical means.

Biography

Dr. Kenneth Loh is an Associate Professor in the Department of Structural Engineering and leads the Active, Responsive, Multifunctional, and Ordered-materials Research (ARMOR) Lab at the University of California-San Diego. Prior to this, he was at UC Davis in the Department of Civil & Environmental Engineering as an Assistant Professor from 2009 and then promoted to Associate Professor with tenure in 2014. Dr. Loh received his B.S. degree in Civil Engineering from Johns Hopkins University in 2004. He continued his graduate studies at the University of Michigan, where he completed two M.S. degrees in Civil Engineering (2005) and Materials Science & Engineering (2008), as well as a Ph.D. in Civil Engineering in 2008. His research interests include multifunctional materials, nanocomposites, scalable nano-manufacturing, and human performance sensing. His recent honors include the NSF CAREER Award, Achenbach Medal, Fulbright Scholar, Joseph Wang Award, and SPIE Senior Member honor.

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