Electrical & Computer ENGINEERING

ENERGY AND INFORMATION SEMINAR

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Mon, April 14

Porter Hall
Room B34
12:30 p.m.

Joel B. Harley

PhD Student (Prof. To Be)

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Using Sparsity-Based, Data Driven Models to Monitor Critical Infrastructures

Joel B. Harley received the B.S. degree in electrical engineering from Tufts University, Medford, MA, in 2008 and a M.S. degree in electrical and computer engineering from Carnegie Mellon University, Pittsburgh, PA in 2011. He is currently working toward a Ph.D. degree in electrical and computer engineering at Carnegie Mellon University, Pittsburgh, PA. Starting July 2014, he will be serving as Assistant Professor in electrical and computer engineering at the University of Utah, Salt Lake City, UT. His interests include the integration of complex wave propagation models with novel signal processing, machine learning, and big data methods for applications in cyber-physical systems, structural health monitoring, nondestructive evaluation, and other fields.
Mr. Harley is a recipient of the 2009 National Defense Science and Engineering Graduate (NDSEG) Fellowship, the 2009 National Science Foundation (NSF) Graduate Research Fellowship, the 2009 Department of Homeland Security Graduate Fellowship (declined), and the 2008 Lamme/Westinghouse Electrical and Computer Engineering Graduate Fellowship. He has published more than 30 technical journal and conference papers, including four best student papers. He is a student representative for the IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society, a member of the IEEE Signal Processing Society, and a member of the Acoustical Society of America.

Using Sparsity-Based, Data-Driven Models to Monitor Critical Infrastructures

In engineering and the sciences, there is considerable interest in technology to sense and monitor large-scale, physical environments. These systems have applications in many fields, including civil and aerospace engineering, medicine, oceanography, and seismology. For civil and aerospace applications, these technologies can be used to noninvasively monitor the structural integrity of bridges, pipes, airplanes, and other modern structures to reduce maintenance costs and prevent catastrophic failures in transportation, power, and resource distribution networks.
Ultrasonic guided waves (waves that are “guided” by the geometry of the environment) have been of particular interest for monitoring critical infrastructures due to their sensitivity to damage and capability to interrogate large areas at once. To detect, locate, and evaluate damage, ultrasonic guided waves are measured and analyzed using various signal processing strategies. However, successfully detecting and locating damage is challenging because complex propagation environments significantly distort the waves as they travel through the medium.
This talk presents a signal processing framework for overcoming these challenges by combining physical models of ultrasonic waves with novel computational methods and data-driven strategies to learn the complex characteristics of guided waves. We demonstrate how these characteristics can be learned from experimental data and how to leverage this information to improve the detection and localization of damage in critical infrastructures. We also briefly discuss how these strategies can be extended other applications.

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