CE 295 - RESEARCH SEMINARS in STRUCTURAL & GEOTECHNICAL ENGINEERING

A Wireless Cyber-Physical System Framework for Enhancing the Resiliency of Civil Infrastructure Systems

Date: Thursday, March 13th, 2014

Time: 4:00 – 4:50 pm

Room: EH 2430 – Colloquia Room

Guest Speaker: Prof. Jerome Lynch, PhD, Univ. of Michigan, Ann Arbor

Abstract:

Earthquakes and other natural hazards remain a serious threat to the safe operation of society's critical infrastructure systems. Further complicating the problem, many of these infrastructure systems are simultaneously approaching the end of their intended design lives with alarming levels of deterioration. Fortunately, the confluence of wireless communications and low-power embedded computing has led to the creation of a new generation of wireless sensing technologies that can be deployed at low cost and in high density to enhance the resiliency of critical infrastructure systems. The paradigm-shift associated with wireless structural monitoring goes well beyond serving as a cost-effective replacement for traditional tethered sensors. Rather, it is the embedded computational intelligence of wireless sensors that transforms them into an autonomous building block of future cyber-physical systems that can be used to monitor and control infrastructure. In this presentation, a wireless cyber-physical system framework is described and illustrated. Validation of the proposed framework is conducted using a permanent wireless monitoring system installed on the New Carquinez Bridge in Vallejo, CA. A dense network of wireless sensors have been installed on the suspension bridge and interfaced to an Internet-based cyberenvironment for the storage and processing of bridge response data. A key element of the proposed framework is an agent-based computational architecture that has been designed to decompose complex data interrogation tasks for ad-hoc distribution within the wireless sensor network itself. The framework is shown to provide a Pareto optimal allocation of scarce network resources (*e.g.,* communication bandwidth, battery power) while maximizing the speed and accuracy of the global algorithm. The presentation concludes with extensions of the framework for real-time feedback control of infrastructure.

Biography:

Dr. Jerome Lynch is an Associate Professor of Civil and Environmental Engineering at the University of Michigan; he is also holds a courtesy faculty appointment with the Department of Electrical Engineering and Computer Science. Dr. Lynch completed his graduate studies at Stanford University where he received his PhD in Civil and Environmental Engineering in 2002, MS in Civil and Environmental Engineering in 1998, and MS in Electrical Engineering in 2003. Prior to attending Stanford, Dr. Lynch received his BE in Civil and Environmental Engineering from the Cooper Union in New York City. His current research interests are in the areas of wireless cyber-physical systems, cyberinfrastructure tools for management of structural monitoring datasets, and nanoengineered thin film sensors for damage detection and structural health monitoring. Dr. Lynch has been awarded the 2005 ONR Young Investigator Award, 2009 NSF CAREER Award, 2009 Presidential Early Career Award for Scientists and Engineers (PECASE) and 2012 ASCE EMI Leonardo da Vinci Award.