University at Buffalo
Department of Civil, Structural and Environmental Engineering
School of Engineering and Applied Sciences

ENGINEERING SEMINAR

Long-Term Management and Control of Critical Infrastructure Systems using Cyber-Physical System Architectures

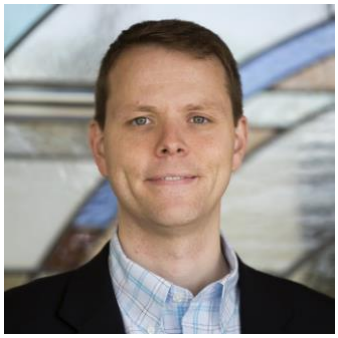
Jerome Lynch, PhD

Professor and Chair of Civil and Environmental Engineering
University of Michigan, Ann Arbor

Abstract

The economic prosperity of the United States is dependent on the well-being of extensive national networks of infrastructure systems. With many of these infrastructure systems rapidly aging, vigilant inspection and management methods are increasingly needed to ensure system safety. Fortunately, the confluence of sensing, wireless communications, low-power embedded computing and Internet-based computing has led to the creation of new technologies that can be deployed to monitor and control critical infrastructure systems. In this presentation, a wireless cyber-physical system framework for dynamically loaded civil infrastructure systems is described and illustrated. Validation of the proposed framework is conducted using a permanent wireless monitoring system installed on the Telegraph Road Bridge in Monroe, Michigan. A dense network of wireless sensors has been installed and interfaced to an Internet-based cyber-environment for the storage and real-time processing of bridge response data. The massive amounts of bridge response data acquired over years of operation requires scalable data processing methods. The work presented explores the adoption of Gaussian process regression (GPR) as a data-driven regression method that can model the baseline (healthy) relationships between bridge response parameters. GPR serves as a basis for the creation of a decision-making framework for bridge managers that adopt statistical process control (SPC) methodologies for asset management. The work presented also extends the cyber-physical framework to model the heavy truck loads that excite bridges. Connected vehicle (CV) technology is installed on a large truck to connect trucks to the cyber-physical system architecture. Time synchronized truck and bridge data collected by the bridge monitoring system is used to model vehicle-bridge interactions.

Biography



Dr. Jerome Lynch is the Donald Malloure Department Chair of Civil and Environmental Engineering at the University of Michigan; he is also Professor of Civil and Environmental Engineering and Professor of Electrical Engineering and Computer Science. Dr. Lynch completed his graduate studies at Stanford University where he received his Ph.D. in Civil and Environmental Engineering in 2002, M.S. in Civil and Environmental Engineering in 1998, and M.S. in Electrical Engineering in 2003. Prior to attending Stanford, Dr. Lynch received his B.E. 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), 2012 ASCE EMI Leonardo da Vinci Award and 2014 ASCE Huber Award.

Date: Friday, November 30, 2018 Time: 11:00 AM
Location: 140 Ketter Hall, North Campus, University at Buffalo