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Information Science and Technology Seminar Series

David Mascareñas
Los Alamos National Laboratory

"Cyber-Physical Security for Forward-Deployed, Unattended, Measurement Systems and Mobile Robots"

Wednesday, May 30, 2012
3:00 - 4:00 PM
TA-3, Bldg. 1690, Room 102 (CNLS Conference Room)

Abstract: Cyber-physical systems featuring size, mass and energy that are potentially physically dangerous are on the verge of exploding into our everyday lives. On February 13, 2012 President Obama signed the FAA Modernization and Reform Act (2012) that contains important provisions to begin incorporating commercial, military, and privately-owned Unmanned Aerial Systems into the national airspace system by 2015. The introduction of Unmanned Aerial Systems into the national airspace system will introduce significant physical dangers as well as a threat to privacy. Ground-based robots are also making large advances. In 2011 the state of Nevada passed Assembly Bill No. 511 making it the first state authorizing driverless cars on their highways and requiring the development of regulations to do so by March 1, 2012. Lawmakers in California, Hawaii, Oklahoma, Florida, and Arizona are introducing bills following Nevada's lead. Now envision the threat posed by a driverless car capable of traveling at highway speeds that is hacked into or tampered with by unscrupulous individuals. In recent years complex cyber-physical systems such as the power grid as well as natural gas companies have been subjected to cyber-attacks. Recent legislative developments impacting cyber-physical systems will require that cyber-physical security challenges are both understood and addressed.

Los Alamos National Laboratory is currently focusing on the science of signatures. In order to advance the science of signatures the cyber-physical security challenges associated with the forward deployment of measurements systems such as wireless sensor networks or robotic swarms carrying measurement payloads must be addressed. Coupled cyber-security threats take on many complex forms including physical damage, data tampering, sensor spoofing, code injection, cyber-intrusion, theft, and vandalism. To date, very little work has been done to ensure the cyber-physical security of such systems deployed in unstructured, potentially adversarial environments. David Mascareñas, a directors-funded postdoctoral researcher at the LANL Engineering Institute began doing initial work to ensure the security of deployed cyber-physical systems. His work to date has focused on the cyber-physical security of car-like mobile sensor nodes. He started by understanding and addressing the problem posed by adversarial agents subjecting car-like mobile sensor nodes to the Precision Immobilization Technique (PIT Maneuver). The PIT maneuver was originally developed by law-enforcement to resolve high-speed chases in a semi-controlled manner, but could easily be adopted by adversarial agents wishing to capture and steal/vandalize/tamper-with a car-like mobile sensor node. Because cyber-physical security challenges are very complex, the next step was to develop a technique that could mitigate a wide variety of cyber-physical security challenges. "Varying paths and changing routines," is a time tested physical security practice. David collaborated with fellow researchers at the Engineering Institute to develop a non-deterministic path planner that could visit required goal points while taking into account penalizing elements in the environment and the uncertainty associated with their location and severity. Examples of cyber-physical security questions and challenges that need to be addressed will be presented.

Biography: David is currently a researcher at the Los Alamos National Laboratory Engineering Institute. His research is focusing on the applications of sparsity methods to cyber-physical research challenges in fields such as structural health monitoring, wireless sensor networks, and materials characterization. He is also involved in research to develop risk-based techniques for mitigating cyber-physical security threats posed by mobile sensor node technology such as driverless cars and drones. David received the PhD and MS from the department of structural engineering at the University of California San Diego. His research focused on the test, development and deployment of mobile-robots to wirelessly deliver energy to sensor nodes in a wireless sensor network.

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