

Networked Infomechanical Systems (NIMS)

NIMS Undergraduate Students: Iman Ahmadi, Jamie Burke, Anita Chan, Ryan Fong, Vishwa Goudar, Gary Kao, Alex Liu, Chris Lucas, Richard Park, Kris Porter, Bryan Ribaya, Jade Sche, Rachel Scollans, Hassan Sharghi, Lisa Shirachi, Rocky Waugh, Shivesh Wangrungvichaisri, Eric Yuen. **NIMS Graduate Students:** Lisa Gruzdas, Aman Kansal, Steve Liu, Richard Pon, Mohammad Rahimi, Nithya Ramanathan, Jeffrey Tseng, Ashutosh Verma, Winston Wu. **NIMS Faculty:** Richard Ambrose, Deborah Estrin, Michael Hamilton, Tom Harmon, Jenny Jay, William J. Kaiser, Gregory J. Pottie, Mani Srivastava, Gaurav Sukhatme, John Villasenor

Introduction: Robotic Networked Wireless Sensing for Environmental Monitoring

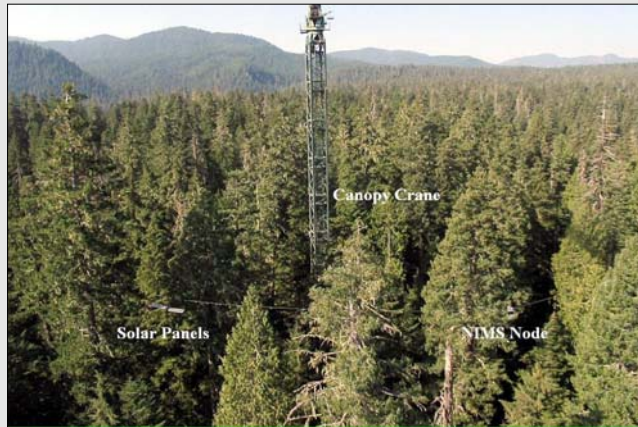
- **New Requirements**
 - Measurement and detection in complex environments
 - Sampling of air, water, and soil.
 - Coverage of large spatial and temporal scales
- **Fundamental Challenges**
 - Unpredictable and large sensing uncertainty
 - Limited energy and operating lifetime
- **Research Goals**
 - Enable Sensor Diversity and Coordinated Mobility for *self-awareness* of sensing uncertainty and autonomous adaptation to maximize sensing fidelity.
- **Application Goals**
 - Distributed sensing in Natural and Civil Environments
- **Education Goals**
 - High School, Undergraduate, and Graduate programs

Solutions: NIMS Nodes and Infrastructure

Horizontal and Vertical Transport



Deployment at the Wind River Canopy Crane Research Facility



NIMS Prototype



Information Technology Research, Applications, and Education

Information Technology Research

- **Information Theory Foundations**
 - Hierarchical *System Ecology* of fixed and mobile nodes with infrastructure.
- **Sensor Diversity**
 - Diversity in sensor node location, orientation, and sensor type.
 - Enables distributed mapping of sensing uncertainty.
 - Enables distributed calibration of sensing channel
- **Coordinated Mobility**
 - Physical transport of nodes and modification of infrastructure.
 - Enables proactive methods for reducing sensing uncertainty through optimized diversity and sampling.
 - Enables reactive methods that bring optimized sensing resources to bear.
- **NIMS Tools**
 - NIMS System emulation
 - NIMS System Operation Authoring

Environmental Science And Public Health

- **Natural Environment**
 - Fundamental studies of ecosystems
 - Focus on meteorology, phenology, carbon budget, global change indicators
 - Sensing, imaging, and spectroscopy.
 - Sampling of atmosphere, water.
- **Public Health Environment**
 - Constantly vigilant monitoring and distributed detection of pathogens
 - Focus on coastal wetlands and urban water resources



Education Programs

- **Undergraduate and Graduate Courses**
 - Embedded Computing
 - Sensing and Imaging
 - Networked Robotic Systems
- **Undergraduate Research Programs**
 - Multidisciplinary undergraduate research teams
- **Grade 7-12 Education Programs**
 - Engage student and teacher communities in science and engineering
 - Real-time, remote Web access to active, controllable NIMS systems

