

Networked Infomechanical Systems (NIMS)

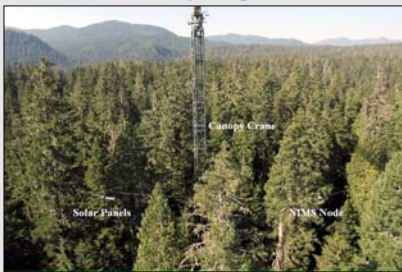
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Introduction: Robotic Networked Wireless Sensing for Environmental Monitoring

- **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

NIMS at the Wind River Canopy Crane Research Facility – September 2003



NIMS2 at the James Reserve



NIMS2 the James Reserve



NIMI at James Reserve



Imaging Phenology: Direct Growth Tracking



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

