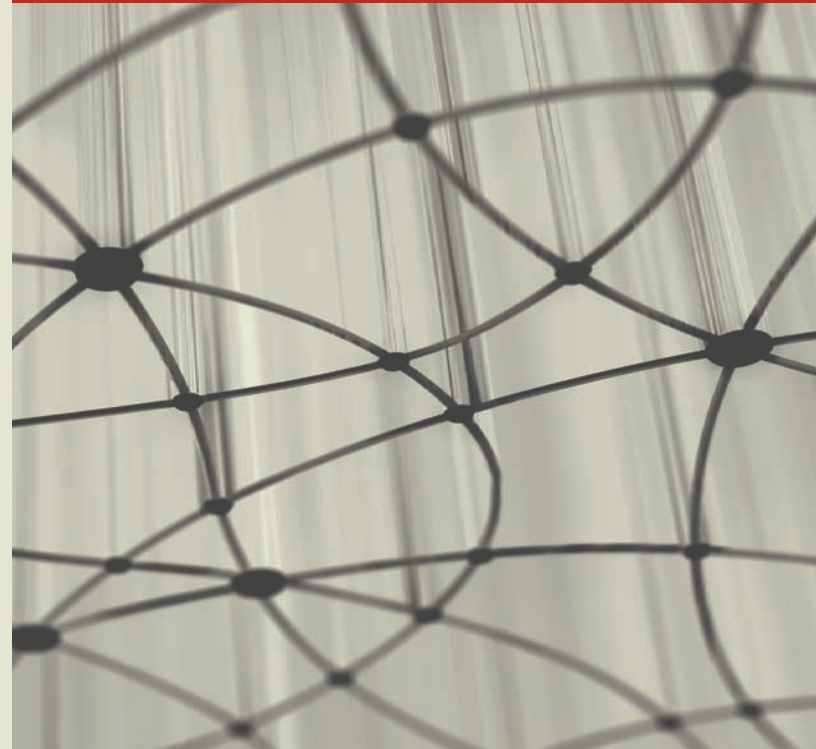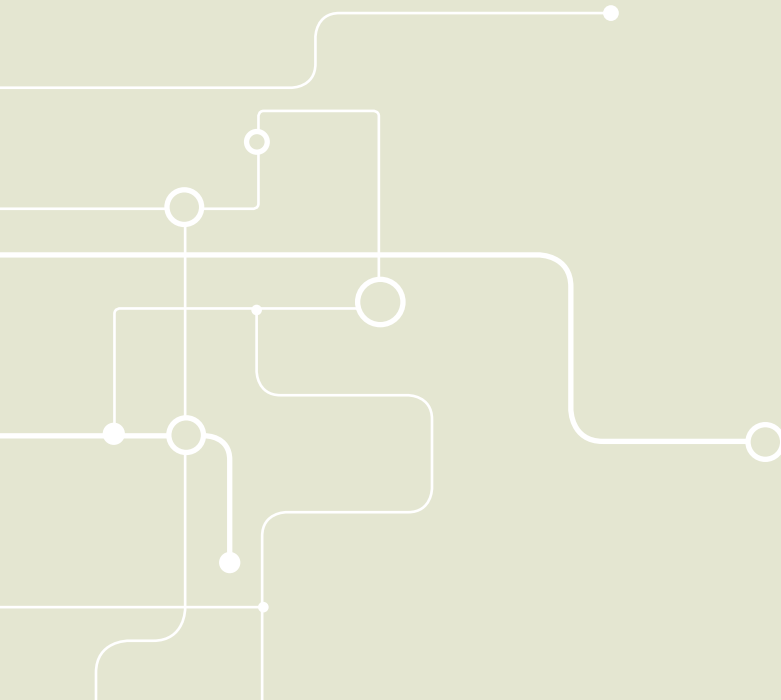# Duke | IGERT WISeNet

www.wisenet.pratt.duke.edu

Graduate Training in Wireless Intelligent Sensor Networks

The WISeNet program focuses on three interdisciplinary research areas:

1 Information-driven environmental sensing and prediction

2 Guidance and control of mobile sensor networks

3 Biologically-inspired intelligent sensor systems

What is the IGERT WISeNet Program?

The WISeNet Integrative Graduate Education and Research Training (IGERT) program at Duke University prepares a new generation of Ph.D. students for interdisciplinary research in wireless sensor networks. Through the WISeNet training and certificate program, students contribute to the development of intelligent sensor systems that process, store, and learn from data so as to improve their ability to gather information over time. By participating in WISeNet laboratory and field experiments, trainees also contribute first hand to unprecedented observations of environmental and ecological processes, and more effective and reliable use of sensors for defense and national security.

What is its Focus?

The program's thematic basis is the development of intelligent sensors that process, store, and learn from data so as to improve their ability to gather information over time. Broader impacts include unprecedented observation of environmental and ecological processes, and more effective and reliable use of sensors for defense and national security.

What are the benefits of the program?

- Ability to work and network with an outstanding team of Duke University faculty and external collaborators who are world leaders in the WISeNet research areas.

- Interdisciplinary education and research experiences.

- Access to the Duke immersive Virtual Environment (DiVE) - a 6-sided CAVE-like virtual reality theater. The DiVE is one of only five systems in the United States.

- Opportunities to participate in research experiments located at research institutions in the Swiss Alps, the Venice Lagoon, and the Mediterranean Island of Sardinia, as well as in state-of-the-art facilities at partner institutions and government labs, including the EPA, Navy, and the Intelligent Systems Research Center at the University of Ulster, in Ireland.

- Opportunities to publish and present research at professional meetings and conferences.

- Lifelong mentorships.

- WISeNet Fellowships.

What does a WISeNet fellowship include?

The fellowship includes a 12-month living stipend, tuition, fees and health insurance for two years. It also provides a travel award to attend a professional meeting/conference as well as funds for research materials and supplies for the development and use of wireless sensors during the experimental research experience. Fellowships also include funding to participate in one 10-week international experimental research experience at partner institutions and to participate in workshops at international partner institutions.

For eligibility requirements, please visit: wisenet.pratt.duke.edu

What are the Certificate and Training Program Requirements?

WISeNet trainees are subject to the Ph.D. degree requirements of the University, their home department, and the WISeNet certificate and training program. Trainees undertake four cross-disciplinary courses, laboratory and field experiments at participating institutions, and specialized simulation, visualization, and virtual reality projects. These requirements are integrated with the trainees' specialization area, which may range from ecology and geosciences to robotics and artificial intelligence.

WISeNet courses cover the areas of computational intelligence, robotics, control and estimation, and statistical inference sensor design, environmental modeling, embedded systems, and ground verification. For a complete list of course descriptions please visit: **wisenet.pratt.duke.edu**

WHO ARE THE FACULTY?

The WISeNet faculty resides in the Pratt School of Engineering, the Nicholas School of the Environment, and the Trinity College of Arts and Sciences. Participating departments include Electrical and Computer Engineering, Mechanical Engineering and Materials Science, Civil and Environmental Engineering, Biomedical Engineering, Computer Science, Earth and Ocean Sciences, Environmental Sciences and Policy, University Program in Ecology, Psychology and Neuroscience, Statistical Science, and Biology/Ecology.

WISeNet lead faculty members at Duke:

SILVIA FERRARI, Program Director
Intelligent control, sensor networks, and robotic sensors

PANKAJ AGARWAL, Program Co-PI
Computational and discrete geometry and sensor networks

GABRIEL KATUL, Program Co-PI
Micro-meteorology and biosphere-atmosphere exchange

RON PARR, Program Co-PI
Machine learning, bayesian networks, and robotics

JOHN ALBERTSON, Program Co-PI
Hydrology, atmospheric science, and climate modeling

To see a complete list of participating faculty, please visit:
wisenet.pratt.duke.edu

WHO ARE THE WISENET COLLABORATORS?

The WISeNet Program collaborates with distinguished researchers from partner companies and government laboratories as well as international academic and research institutions. Our collaborators lead required laboratory and field experiments, and establish lifelong mentorship with the trainees, starting from when they join the program, to long after they enter the workforce.

For more information about these collaborators, please visit: **wisenet.pratt.duke.edu**

The WISeNet Collaborators:

LORENZO MARCONI, Professor, Department of Electronics, Computer Science and Systems, University of Bologna, Bologna, Italy
Nonlinear control and robotics

MARC PARLANGE, Professor and Dean, School of Architecture, Civil, and Environmental Engineering (ENAC), École Polytechnique Fédérale de Lausanne (EPFL), Switzerland
Alpine hydrology and sensor networks

STEFANO LANZONI, Professor, Department of Hydraulic, Maritime, Environmental and Geotechnic Engineering, University of Padova, Italy
Hydrodynamics, Fluvial Morphodynamics, Tidal Morphodynamics

MARTIN MCGINNITY, Professor and Director, Intelligent Systems Research Center (ISRC), University of Ulster, UK
Intelligent systems and sensors

CARYL JOHNSON, Systems Engineering Fellow, BAE Systems, ISR (Intelligence, Surveillance, and Reconnaissance), Nashua, NH
Littoral demining by unmanned aerial vehicles

Gayle Hagler, Research Scientist, US Environmental Protection Agency (EPA), Office of Research and Development, Research Triangle Park, NC
Geospatial monitoring of air quality and pollutants

Thomas Wettergren, US Navy Senior Technologist (ST), Naval Undersea Warfare Center (NUWC), Newport, RI
Undersea monitoring and surveillance

What are the Laboratory and Field Experiments?

The laboratory or field experiments are conducted over a period of approximately 10 weeks at Duke or at a partner institution. WISeNet trainees can pick from a menu of funded experiments in Environmental Science or in Engineering and Computer Science.

For more information about these experiments, please visit: **wisenet.pratt.duke.edu**

EXPERIMENTS IN ENVIRONMENTAL SCIENCE

Distributed sensing is crucial to understanding environmental change, and to protecting the health of humans. WISeNet trainees involved in the "environmental science" experiments apply emerging theoretical and computational tools for optimally collecting and assimilating sensor observations into distributed environmental forecasting models, and utilizing them for intelligent decision making. Also, trainees have the opportunity to apply sensor modeling, prediction, navigation and control methods to sensing problems on climate change, water quality, and drought monitoring and prediction.

Environmental science experiments:

- Aforestation, Climate Change Mitigation and Prediction
- Drought Monitoring and Prediction in Semiarid Climates
- Geospatial Monitoring of Air Quality and Pollutants
- Modeling and Prediction of Climate Impacts on Snow and Ice
- Sea-level Rise Mitigation and Adaptation Measures

EXPERIMENTS IN ENGINEERING AND COMPUTER SCIENCE

Unmanned ground, aerial, and underwater vehicles equipped with on-board wireless sensors are becoming crucial to both civilian and military applications because of their ability to replace or assist humans in carrying out dangerous yet vital missions. As they are often required to operate in unstructured and uncertain environments, these mobile sensor networks must be adaptive and reconfigurable, and decide future actions intelligently based on the sensor measurements and environmental information. WISeNet trainees involved in engineering and computer science experiments develop and validate interdisciplinary methods for sensor guidance, coordination, and control, and for biologically-inspired sensor fusion, learning, and adaptation.

Engineering and Computer Science experiments:

- Littoral Demining by Unmanned Aerial Vehicles
- Integrated Sensor Path Planning and Control
- Undersea Monitoring and Surveillance
- Robotic Saccadic Adaptation and Visually-guided Auditory Plasticity
- Intelligent Robotic Games

Aforestation, Climate Change Mitigation and Prediction

Duke Forest, Durham, NC

Sea-level Rise Mitigation and Adaptation Measures

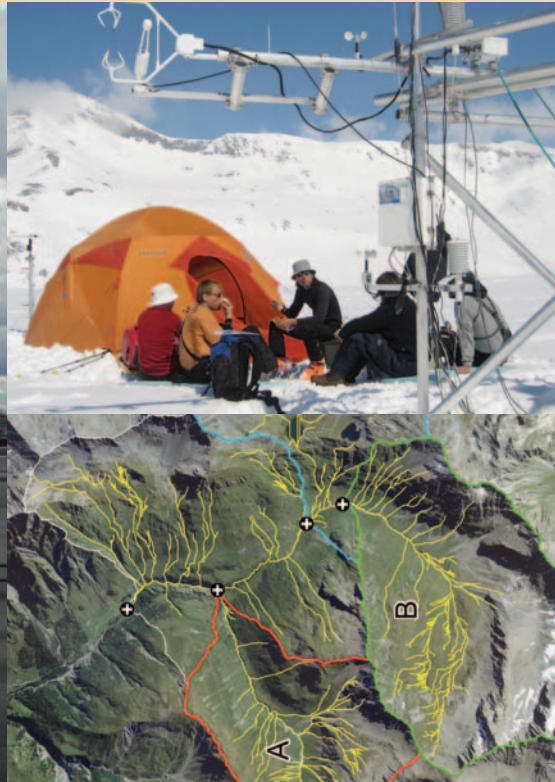**University of Padova, Padova, and Venice, Italy**

Geospatial Monitoring of Air Quality and Pollutants

EPA, Research Triangle Park, NC

Modeling and Prediction of Climate Impacts on Snow and Ice

EFLUM Laboratory, EPFL, Lausanne, Switzerland

Drought Monitoring and Prediction in Semiarid Climates

University of Cagliari, Sardinia, Italy

Integrated Sensor Path Planning and Control

CASY, University of Bologna, Bologna, Italy

Intelligent Robotic Games

Intelligent Systems Research Center (ISRC), University of Ulster, Magee Campus, Londonderry, UK (Ireland)
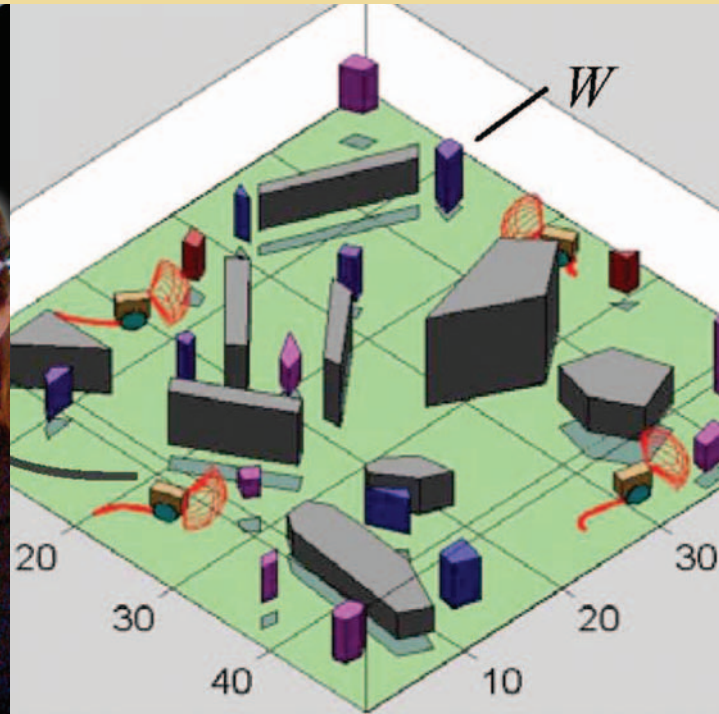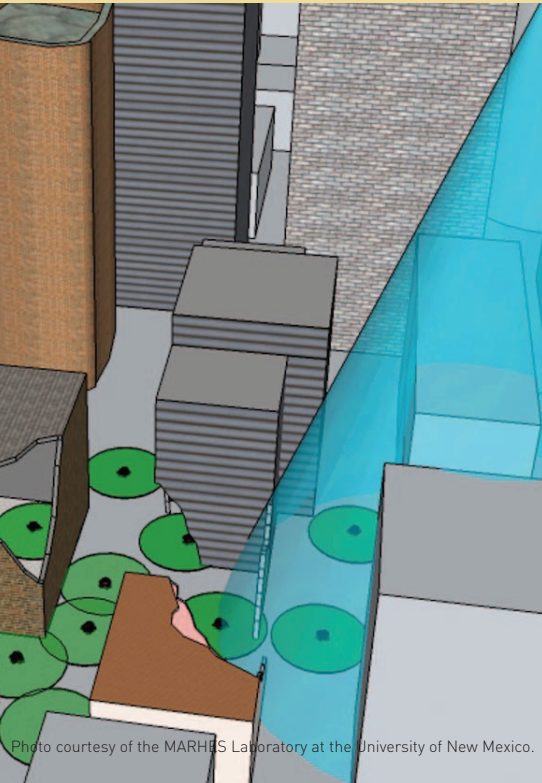

Photo courtesy of the Intelligent Systems Research Center, University of Ulster

Experiments in Engineering and Computer Science

Littoral Demining by Unmanned Aerial Vehicles

BAE Systems, Nashua, NH

Robotic Saccadic Adaptation and Visually-guided Auditory Plasticity

Sommer Laboratory, Duke University, Durham, NC

Undersea Monitoring and Surveillance
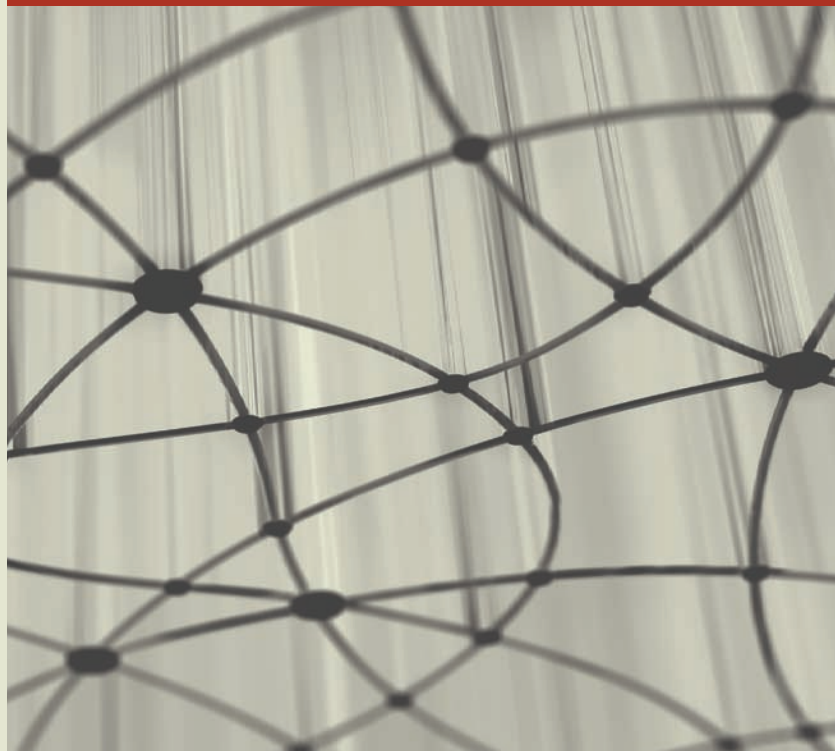
Naval Undersea Warfare Center (NUWC), Newport, RI

Photo courtesy of the MARHES Laboratory at the University of New Mexico.

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