



NATIONAL SECURITY SCIENCES

Geospatial Computing & Emerging Technologies

Bringing innovation to intelligent, geospatial systems from on-premise to the edge

INTRODUCTION

National security challenges often take place in diverse, austere environments. Geospatial computing and emerging technologies capabilities harness cutting-edge technologies and geospatial intelligence to promote effective responses from the home front to the edge. Transformative solutions strengthen our infrastructure and improve the well-being of communities.

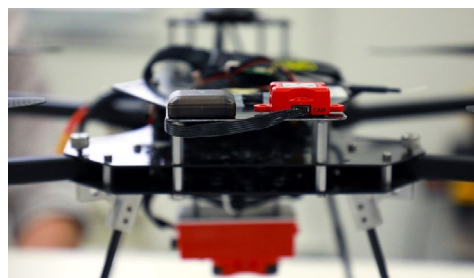
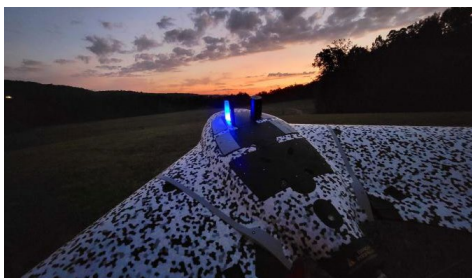
MISSION

Our mission is to transform how we gather and send information about the world through adaptable autonomous systems and geospatial technologies to provide real-time, dynamic answers to HPC-enabled geospatial challenges.

IMPACT

- ORNL's legacy in building world-leading supercomputers provides the expertise to integrate HPC with geospatial workflow challenges such as scale, complexity, observation and measurement. This helps operate across regional and global scales which requires massive amounts of data and computational power to process it expediently.
- Autonomous systems and geospatial computing expertise converge to enable edge computing capabilities for onboard processing. This expertise has provided disaster recovery effort assistance after hurricanes by assessing energy infrastructure damage, geolocating detected features of interest, and transmitting damage assessment results over constrained communication.





ORNL KEY DIFFERENTIATORS

Cutting-edge computing and autonomous systems and large-scale GIS

- ORNL teams develop **geospatial digital twins**, leveraging cutting-edge HPC technologies to create dynamic, real-time virtual representations of the physical world. Integrating diverse data sources and world-class computing enables rapid “what-if” analyses and informed decision-making across various domains such as urban planning, disaster response, and environmental monitoring. These innovative solutions enhance situational awareness and improve outcomes for communities worldwide.
- In addition to expertise in constructing and deploying ground, air, and submersible autonomous systems, ORNL’s teams developed technology platforms to enable these systems. ORNL UAV systems can deploy rapidly and autonomously with **onboard data processing power** to use machine learning on gathered information and transmit assessment results to decision-makers, even in constrained communication environments.
- ORNL researchers developed robust and resilient communications solutions that utilize **AI/ML techniques** at the edge allowing for real time radio frequency spectrum adaption in noisy environments.

Multidisciplinary teams working on the challenging problems with an emphasis on real-time, dynamic systems

- Within the **Autonomous Systems Group** are multiple FAA and manufacturer certified instructors with specialized experience in operating equipment in operationally relevant and austere environments as well as engineers and software developer.
- The **Resilient Communications** group includes electrical engineers, mathematicians, physicists, computer scientists, and RF engineers to solve problems with high-performance computing, edge devices, software-defined radios, and AI/ML techniques.
- The **Geoinformatics Engineering** group transforms world visualization through geodata—from population dynamics and land-use and transportation studies to emergency management and hazardous waste analysis. Core competencies include geospatial Data management through integrative GIScience and geospatial technologies; scalable applications and workflows achieved through novel technical approaches; and system architectures achieved through integrative research and development supporting cutting-edge geospatial data processes.

Access to unparalleled national laboratory resources

- High performance computing
- Autonomous systems and artificial intelligence
- Leading multidisciplinary teams across a wide variety of science fields, including national security, cyber resilience, and nuclear nonproliferation.

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