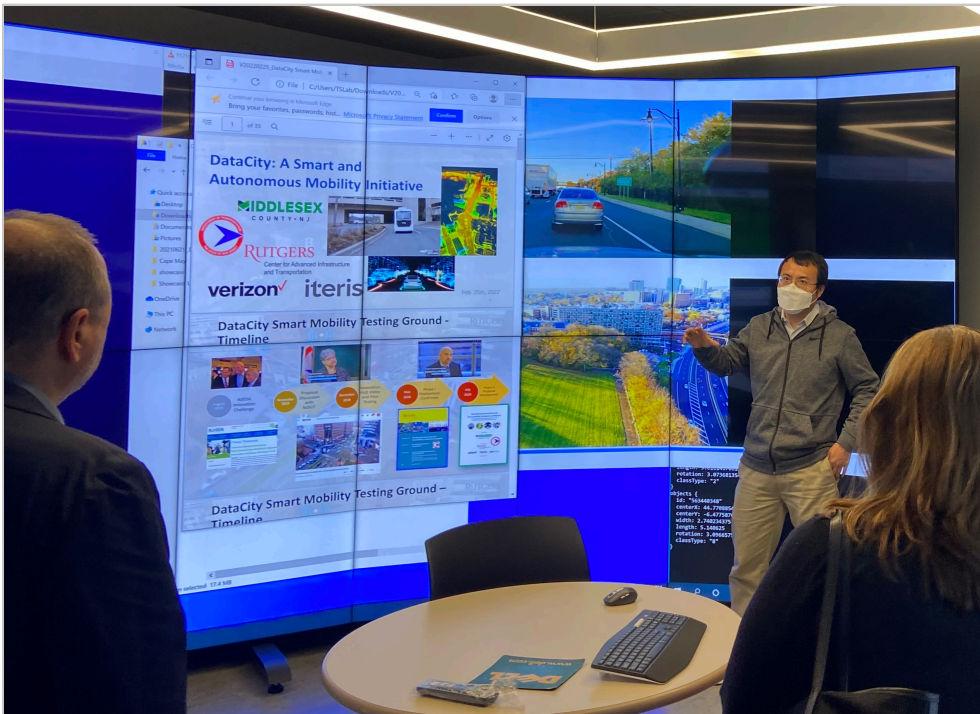
RUTGERS®

Center for Advanced Infrastructure and Transportation

Infrastructure Resilience Program



"To research new solutions that promote
resilient infrastructure systems
within the
natural and built environments"

Home to some of the busiest and most densely populated cities across the country, diverse and evolving coastal communities, and infrastructure that supports millions of tons of goods and thousands of jobs each year, region 2 is a complex environment that requires equally complex and diverse solutions. Aging infrastructure, deterioration, severe weather, and dense built environments can put all systems at risk. The region needs more resilient infrastructure that is built to last longer and withstand the natural environment, but also the human demands of the area, in order to protect its safety, economy, and wellbeing.

At the Center for Advanced Infrastructure and Transportation (CAIT), we have formed the Infrastructure Resilience Program (IRP) to research new ways to accomplish exactly that through our multi-faceted approach to resilience. Leveraging data collection and remote sensing, using our surroundings as a living test bed and engaging diverse, strategic partnerships, CAIT will develop and implement real-world resilience solutions.

The CAIT IRP has expertise in Data Collection; Data Management; Modeling, Predicting, and Decision Making; and Resiliency Planning and Policy.

The IRP, led by Executive Director Dr. Dan Barone, has experience in Modeling, Predicting, and Decision Making. Subject matter experts have led projects in remote sensing survey and analysis, hydrographic surveying, coastal zone management and resilience planning, and more.

"By leveraging collaborative research
IRP works to ensure that our
infrastructure rebounds
from potential disruptions"

Faculty Director Dr. Jie Gong leads the cluster in data collection through his past work performing large scale post-disaster reconnaissance missions. For example, after Superstorm Sandy he led missions designing and deploying remote sensing systems for rapid response to large-scale coastal events, and modeling data collected through these approaches, among other objectives.

The team also brings experience in data management and AI assisted data exploration, as well informed policy modeling through partnerships with the Bloustein School at Rutgers.

CAIT research focuses on preserving, rehabilitating, and improving infrastructure; boosting network resilience; reducing life-cycle costs; and increasing mobility and safety. By leveraging collaborative research, IRP can help ensure that our infrastructure rebounds from potential disruptions.

Since 1998, CAIT has been a designated USDOT University Transportation Center (UTC) and is currently the Region II UTC consisting of 9 leading research institutions in New York, New Jersey and Puerto Rico.

By engaging partners at Rutgers University, the School of Engineering, and through its USDOT UTC program, CAIT has assembled a cluster of expertise, resources, and researchers to address resilience in the region.

Partner Directory

Polytechnic University at Puerto Rico	Héctor J. Cruzado, Department Head
Rutgers Institute of Earth, Ocean, and Atmospheric Sciences	Robert Kopp, Director
New Jersey Institute of Technology	Matthew Bandelt, Assistant Professor
Rutgers Climate Institute	Marjorie Kaplan and Anthony J. Broccoli, Co-Directors
University at Buffalo	Andrew Whittaker, Distinguished Professor
Rutgers Department of Marine and Coastal Sciences	Oscar Schofield, Chairman
Rutgers Department of Civil and Environmental Engineering	Nenad Gucunski, Chairman; Ali Maher; George Guo; and Roger Wang
Alan M. Voorhees Transportation Center	Jon Carnegie, Associate Director; and Jeanne Herb, Professor
Center for Remote Sensing and Spatial Analysis	Richard Lathrop, Director
Jacques Cousteau National Estuarine Research Reserve	Michael P. De Luca, Reserve Manager
Rutgers Department of Industrial and Systems Engineering	Mohsen Jafari, Department Chair

Our Approach

- Ubiquitous sensing and data collection
- Advanced computing for data management, analytics, and simulation; and Model-informed knowledge discovery for risk mitigation and resilient rebuilding
- Training and community partnerships
- Policy and planning

Program Leaders

Dr. Jie Gong, Faculty Director

An Associate Professor of Civil and Environmental Engineering at Rutgers, Dr. Jie Gong's research focuses on critical infrastructure protection, optimization and deployment of remote sensing systems for rapid response to large-scale coastal events, design and development of cyber-infrastructure to support coastal hazard analysis and modeling, and modeling of natural and man-made disaster impacts to coastal communities.

Contact Dr. Gong
E: jg931@soe.rutgers.edu

Dr. Dan Barone, Executive Director

An Associate Research Professor of Civil and Environmental Engineering at Rutgers, Dr. Dan Barone's research focuses on Spatial Analysis and 3-D Modeling, Hydrographic Surveying, Coastal Zone Management and Planning primarily.

Contact Dr. Barone
E: daniel.barone@rutgers.edu

Key Program Members

Jon Carnegie

Executive Director of the Alan M. Voorhees Transportation Center at Rutgers, Mr. Carnegie has more than 18 years of experience in the fields of land use and transportation planning and policy at the municipal, county and regional level.

Dr. George Guo

A professor of civil and environmental engineering at Rutgers University, Dr. Guo is a well-recognized water resources engineer. His research areas are hydraulics and hydrology, urban stormwater and flood management, water environment protection and restoration, and green and sustainable water infrastructure.

Jeanne Herb

Executive Director of a center of research and practice, the Environmental Analysis & Communications Group, at the Rutgers University Bloustein School of Planning and Public Policy, Ms. Herb leads applied research projects related to environmental sustainability and policy, health equity, and climate change.

Dr. Marjorie Kaplan

Associate Director of the Rutgers Climate Institute, Dr. Kaplan leads the Rutgers Climate Institute program office and manages the full portfolio of Rutgers Climate Institute activities in consultation with the Co-Directors. She also co-facilitates the New Jersey Climate Adaptation Alliance.

Dr. Robin Leichenko

Co-director of the Rutgers Climate Institute, Dr. Leichenko's current research focuses on the economic and social dimensions of climate change impacts, vulnerabilities, and adaptation change in U.S. cities and regions.

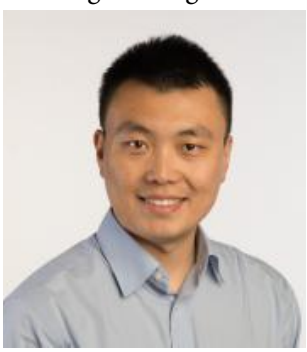
Knowledge & Resources

- 100 affiliated faculty from universities across the region.
- 10 unique labs covering earthquakes to virtual reality.
- A cluster of experts on infrastructure resilience.
- Strategic partnerships with industry and government.

Dr. Robert Miskewitz

An Associate Research Professor in the Rutgers Department of Environmental Sciences, Dr. Miskewitz's research focuses, in part, on measurement and analysis of various aspects of the water cycle. His work with CAIT relates to new methods of processing dredge material for beneficial reuse.

Dr. Roger Wang



An Assistant Professor of Civil and Environmental Engineering at Rutgers, Dr. Wang's research is aimed at developing numerical models to connect big data and decision-making in civil and environmental engineering systems.

Past Projects and Accomplishments

- **Marine and Coastal Infrastructure Asset Monitoring Program**

  Marine and Coastal Infrastructure Assets are infrastructure components of the natural and built environment within the coastal system, and are analogous to transportation assets such as pavement, for example. A goal of MCIAMP is to identify existing MCIA monitoring efforts that MCIAMP can support, but also identify data gaps where a continuous monitoring effort is needed.

- **Augmented Reality in Life-cycle Management of Transportation Infrastructure Projects**

  VR and AR as an immersive computing and visualization technology has seen explosive development, but there is a lack of understanding of how these technologies mesh with the needs of infrastructure management. With that in mind, a Rutgers team developed two fully-interactive virtual environments that can train workers on everything from roadside set ups to bridge inspections.

- **Updated Manual on the Beneficial Use of Dredged Materials**

  A critical component for incorporating natural and non-structural features into resilience projects is identifying appropriate sediment sources for construction. One solution in the state has been the beneficial use of dredged material for coastal resilience. Dredging for safe navigation at the federal and state-level in NJ is a continual process that produces significant sediment that can potentially be used as a resource instead of being treated as waste. Many channels within NJ's state and federal navigation system have been identified as containing sediment suitable for various uses.

- **Hyper-resolution monitoring of urban flooding with social media and crowd-sourcing data**

  Hyper-resolution datasets for urban flooding are rare. This problem prevents detailed flooding risk analysis, urban flooding control, and the validation of hyper-resolution numerical models. We employed social media and crowdsourcing data to address this issue and found that these big data based flood monitoring approaches can complement the existing means of flood data collection.

- **Prioritizing Infrastructure Resilience throughout the Capital Planning Process**

  The Port Authority of NY & NJ is a leader nationally in incorporating climate resilience into major capital projects at the design phase. This project mapped current processes used in the region to make capital planning and project selection/prioritization decisions, documented leading practice case examples from transportation agencies nationally and recommended ways to better align decisions to support improved resilience to extreme weather events and changing climate conditions.

- **Assessing and Mitigating Transportation Infrastructure Vulnerability to Coastal Storm Events with the Convergence of Advanced Spatial Analysis, Infrastructure Modeling, and Storm Surge Simulations**

  To protect the security of the public transportation infrastructure and the enormous amount of public assets, this study will develop a decision support tool that can assist infrastructure stakeholders in making decisions at the day-to-day operation level to protect communities from impeding flooding events as well as in making long-term decisions in mitigating future flood risks facing their current infrastructure assets and their future projects.

- **Terrestrial LiDAR Mapping and Analysis of Buildings and Infrastructures within the New Jersey 500-Year Flood Plain**

  As part of this FEMA-funded project, CAIT researchers are collecting mobile terrestrial LiDAR data and street-level digital images along all roadways in the NJ 500-year flood plain. Based on the data, the team is developing digital elevation models to determine how well infrastructure in the area is following FEMA's Preliminary Flood Insurance Rate Maps. This information can be used by decision makers to improve infrastructure preparedness in the region, better understand what assets might be vulnerable to storms, and support future initiatives in flood risk mitigation.

Capabilities

Leveraging our resources to research new solutions and promote resilience.

Data Collection	The WAVE VR Lab allows researchers to model and visualize resilience data collected after disasters or other large-scale coastal events.
Severe Weather and Natural Disasters	UTC Partners are investigating damage done to pedestrian and transportation signs during Hurricane Maria to find out what caused the failures, and to help the island rebuild stronger.
Condition Assessment	The RABIT, THMPR, and BEAST provide comprehensive visualization of an asset's condition faster than ever before.
Construction and Design	A Rutgers Drone team mapped a gas pipeline replacement project to capture geo-locations and develop enhanced As-Built models.
Roads and Bridges	The BEAST speeds up deterioration as much as 30 times, making it possible to simulate 15 to 20 years of wear-and-tear in just months.
Coastal Communities	Post-disaster missions during recent hurricanes have advanced damage assessment methods and to help resilient rebuilding.
Sea Level Rise and the Environment	After Hurricane Sandy, researchers began implementing green storm-water infrastructure in NJ to combat future flooding
Materials Testing	Rutgers Asphalt and Pavement Lab is among the largest pavement labs in the country, and helps maintain 4-million-plus road miles.
Policy and Planning	Researchers are mapping ways to better align capital planning decisions to improve resilience to extreme weather events.
Technology and Tools	UTC partners developed a software tool that assists local agencies with designing their low-volume roads for various traffic needs, helping them build better roads that last longer.

Our Stakeholders

- New Jersey Department of Transportation
- Federal Highway Administration
- New Jersey Transit
- New Jersey Turnpike Authority
- Port Authority of New York and New Jersey
- Federal Emergency Management Agency

For more information about CAIT and opportunities to collaborate, contact:

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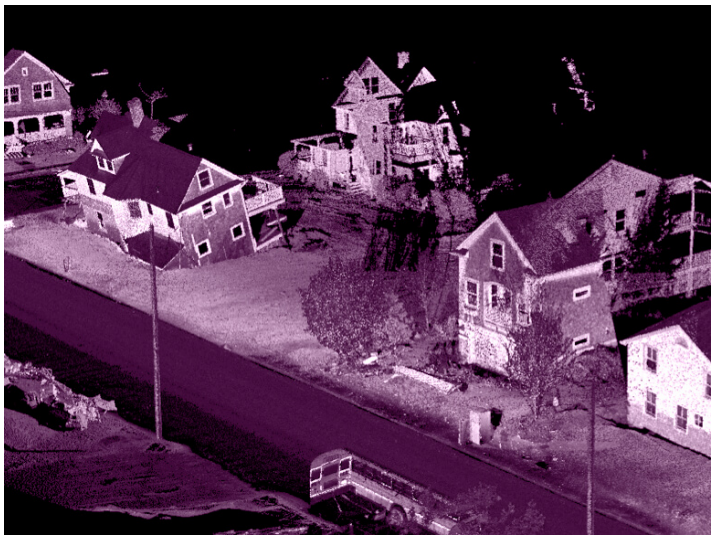

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