GT Georgia Tech.
Research Institute

GTRI
90TH
ANNIVERSARY
1934 | 2024

2024
ANNUAL
REPORT

CELEBRATING 90 YEARS OF
INNOVATION AND IMPACT

GTRI.gatech.edu

Message From the Director

Welcome to the Georgia Tech Research Institute's (GTRI) 2024 Annual Report. This year, GTRI celebrated 90 years of advancing research and innovation. From our humble beginnings as the Engineering Experiment Station (EES) during the Great Depression to becoming a nearly $1 billion entity, we continue to pursue our vision: Our people are the foremost innovators creating a secure nation, a prosperous Georgia, and a flourishing world. For nine decades, GTRI has led the way in fielding innovations ranging from our earliest days researching the aerodynamics of rotary wing aircraft to the present day researching DNA for low power, high-capacity memory. As we look forward to the next 90 years, we are excited to leverage the unprecedented combined innovative power of GTRI and the Georgia Institute of Technology (Georgia Tech) to impact the state of Georgia, the nation and the world. Thank you for your continued support!

FY24 was a year of strong growth and continued progress. GTRI's dedicated workforce of more than 3,000 staff, research faculty and students completed $919 million of impactful research and development fulfilling GTRI's mission to enhance Georgia's economic development, secure our nation, improve the human condition, and educate future technology leaders. In this Annual Report you will find a small sample of our impact across these mission areas.

As the applied research unit of Georgia Tech and a Department of Defense University Affiliated Research Center (UARC), GTRI remains uniquely positioned to leverage the creativity of the whole of Georgia Tech as we adapt to the future challenges our sponsors and the world need us to solve. Thank you for joining us on this journey. We look forward to working with you to solve even greater challenges in FY25 and beyond.

James J. Hudgens
Director, Georgia Tech Research Institute
Senior Vice President, Georgia Institute of Technology

James J. Hudgens
Director, GTRI
Senior Vice President, Georgia Institute of Technology

Keith McBride
Chief of Staff

William Robinson
Deputy Director, Chief Technology Officer (Interim)

Troy Littles
Deputy Director, GTRI Operations Officer

Raj Vuchatu
Deputy Director, GTRI Information Officer

GTRI LEADERS

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Deputy Director, GTRI Finance Officer (Interim)

Tommer Ender
Deputy Director, Electronics, Optics, & Systems

Stephen Welby
Deputy Director, Sensors & Intelligent Systems

William Robinson
Deputy Director, Information & Cyber Sciences

Michelle Belton
Deputy Director, Strategic HR Partners
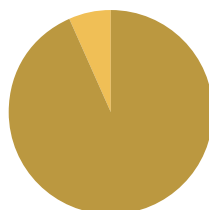
## GTRI Financial Statement

GTRI BY THE NUMBERS

GTRI FY24

Sponsored Research Awards: **$ 869.4M**
Revenue Earned: **$ 918.8M**
Economic Impact to State: **$ 1.45B**
Total Employees: **3,099**

* Visit report.research.gatech.edu/2024 to see the 2024 Georgia Institute of Technology financial numbers.

SPONSOR PERCENTAGES FOR FY24

93.43% Federal

6.57% Non-federal

RESEARCH BREAKDOWN BY CUSTOMER FOR FY24
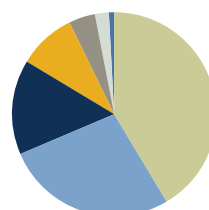
Air Force **41.42%**
Army **27.40%**
Other DoD **14.97%**
Navy **9.01%**
Private **4.37%**
State, Local Gov't **2.20%**
Other Non-DoD **0.64%**
Federal Agencies

· Generating high-paying jobs
· Keeping University System of Georgia graduates in Georgia
· Driving economic growth in Georgia

The digital train inspection portal uses AI and machine vision to identify mechanical defects in moving trains.

## GTRI, Norfolk Southern Use Machine Vision to Improve Railway Safety

GTRI and Norfolk Southern Corporation have launched Georgia's first digital train inspection portal that uses advanced machine vision and artificial intelligence to enhance railway safety and efficiency. Unveiled in 2024 near Jackson, Georgia, the portal is equipped with 38 high-resolution cameras and stadium-grade lighting to capture thousands of images of key components on passing trains. Norfolk Southern's AI algorithms analyze these images within minutes to detect mechanical issues, allowing for immediate reporting.

Norfolk Southern first deployed this technology in Leetonia, Ohio, in 2023, with plans to expand to six additional sites by the end of 2024 and 11 more by 2026. The project began in 2021 and involved about a dozen researchers across four GTRI laboratories. GTRI's machine vision expertise spans various sectors, from food processing to transportation and military applications.

Weather Radar Enhancing Research, Education, Coverage

Collaboration among three Georgia institutions of higher education - Georgia Gwinnett College (GGC), the Georgia Institute of Technology (Georgia Tech) and the University of Georgia (UGA) - on the operation of a new weather radar system will enhance student learning, provide new opportunities for research, and help improve severe weather coverage in north Georgia.

Installed recently at GGC, an X-band weather radar purchased two years ago by Georgia Tech and UGA is now providing data for a section of North Georgia where information
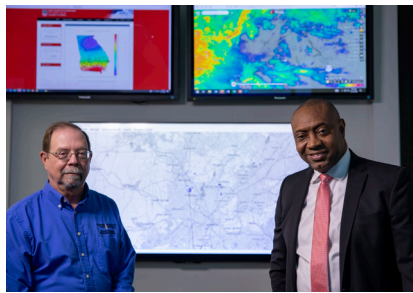
Georgia Tech and University of Georgia researchers are operating a new weather radar.

on severe storms such as tornados can be limited by terrain. The radar will also be used for research into weather and severe storms, and by students at the three institutions for learning about everything from physics and engineering to weather, rainfall, and the effects of changing climate on the migration patterns of birds and insects. The instrument will be one of just a handful of weather radars operated by universities in the United States.

The X-band weather radar operates atop a GGC building.
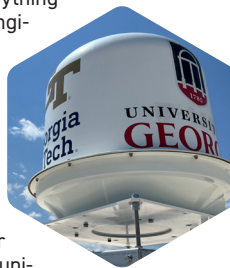
GTRI is collaborating in this effort with the Southwest Georgia Regional Commission.

AI Hub to Streamline Disaster Management in Southwest Georgia

GTRI is developing an artificial intelligence response hub for Southwest Georgia to improve disaster management and logistics, enhancing community resilience and response efficiency to save lives and reduce economic losses. GTRI is collaborating in this effort with the Southwest Georgia Regional Commission (SWGRC), a regional planning agency that serves 14 counties and 44 cities in the region.

This project is part of the Georgia Artificial Intelligence in Manufacturing (Georgia AIM), a $65 million federal grant awarded to Georgia Tech and a coalition of state partners, including the SWGRC. Funded through the

U.S. Economic Development Administration's Build Back Better Regional Challenge grants, Georgia AIM promotes equitable AI adoption in Georgia's manufacturing sectors. GTRI is also working with emergency management agencies, non-governmental organizations, federal entities, utility companies and corporations, with plans for broader statewide and national implementation.


GTRI researchers test prototype MCAT circuit boards.

## Mold Conditions Awareness Tool (MCAT) Could Protect Soldier Barracks

Ingenuity from a group of soldiers stationed at Fort Stewart – and help from GTRI – has produced a possible solution for an issue that affects personnel at multiple U.S. Army facilities located in areas with high humidity and temperatures.

Those conditions can lead to the growth of dangerous mold, which in facilities that may be unoccupied due to deployments can damage both soldiers' personal belongings and Army equipment. Through the 3rd Infantry Division's (3ID) Marne Innovation and Technology Center, the soldiers and GTRI collaborated to develop a Mold Conditions Awareness Tool (MCAT), a device now being evaluated in large-scale tests at the Army base.

Similar in size to a plug-in air freshener, MCAT includes humidity and temperature sensors integrated with a Wi-Fi transmitter in a small device that can be plugged into existing room power outlets. The device provides data to a central maintenance office that can respond if heat or humidity exceed levels that can lead to mold growth.
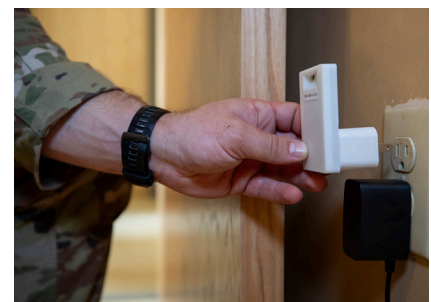
*The MCAT device plugs into existing room power outlets.*
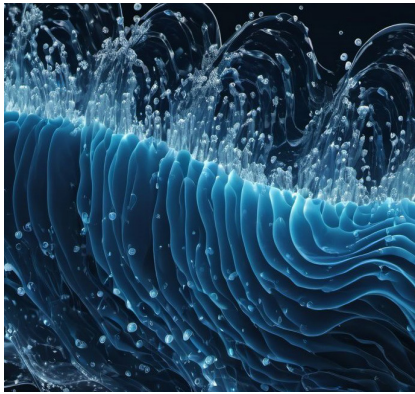
Quantum computing could speed up CFD simulations with greater accuracy.

Quantum Computing to Optimize CFD Applications

GTRI and the Georgia Institute of Technology (Georgia Tech) are developing an application of quantum computing to solve proof-of-principle problems in computational fluid dynamics (CFD) that could streamline efficiencies and reduce costs in aircraft design, weather prediction, nuclear weapons testing, and more.

Because CFD involves complex simulations of how fluids, such as air or water, move and interact with different surfaces, classical computers often struggle with the immense number of calculations needed for such detailed simulations. The ability for quantum computers to process multiple pieces of information simultaneously could significantly speed up these simulations and produce more accurate results.

GTRI and Georgia Tech's research could help organizations strategically allocate resources and avoid costs associated with manufacturing and testing potentially flawed designs. In the defense realm, an example of this can be seen with designing aircraft. Quantum-enhanced CFD could replace traditional wind tunnel testing, enabling engineers to efficiently and cost-effectively analyze stresses, assess designs and predict performance, especially at high speeds, where airflow and turbulence complicate simulations.
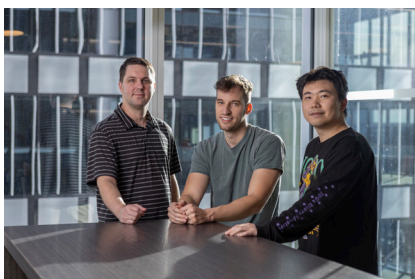
GTRI is collaborating in this effort with Georgia Tech academic faculty.

The study aims to help Georgia healthcare systems cut turnover costs by addressing burnout triggers.

GTRI, Children's, Emory Combat Burnout with Wearable Sensors

Health care worker burnout, exacerbated by the Covid-19 pandemic, continues to pose risks for the nation's health and economic wellbeing. To address this challenge, GTRI, Children's Healthcare of Atlanta and Emory University's Nell Hodgson Woodruff School of Nursing have conducted a study using wearable sensors to better understand how the interplay of workload, stress and sleep contribute to an elevated risk of burnout among healthcare workers and how to mitigate those risks going forward.

The group recently measured real-time movement patterns of 40 combined physicians and nurses in the cardiac intensive care unit (CICU) at Children's and collected data on their stress levels, work and sleep cycles, health care delivery and perceived workloads over a four-week time period. With the data collected, it will be analyzed and interpreted to evaluate potential solutions. The study aims to create a methodology for health care systems statewide to reduce turnover costs by predicting and addressing burnout triggers.

*The study tracked real-time movement of 40 combined physicians and nurses at Children's.*

Identifying What's 'Normal' to Protect Electric Power Systems

By developing a deep and comprehensive understanding of what constitutes "normal" operations inside electric power systems, cybersecurity researchers at GTRI and the Georgia Tech School of Electrical and Computer Engineering hope to identify "abnormal" and "illogical" control system commands that may indicate the presence of insider threats – or malicious attackers.

Both the understanding of normal operations and detection of suspicious activities will rely on the application of artificial intelligence (AI) to understand what the complicated grid systems normally do – and to identify actions that logically shouldn't be taking place.

With funding from the U.S. Department of Energy, the researchers have begun work on the development of GridLogic, which builds on earlier work – a project known as GridTrust – aimed at keeping both outsiders and insiders from attacking the power grid. GridLogic will include collaborators from the National Renewable Energy Laboratory (NREL), Marietta Power, the city of Marietta, the Southern Company, Georgia Power, and AVEVA, an industrial software provider.
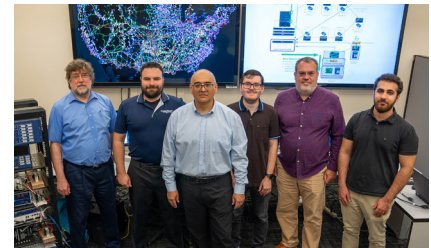

Researchers are developing a new approach for protecting the power grid.

Physics, Machine Learning Team Up to Enhance Satellite Operations

Machine learning (ML) has strong potential for predicting how satellites spin, which could ultimately prevent collisions in space. However, the complexity and variety of data inputs in these algorithms can make their predictions unreliable and difficult to interpret, potentially eroding trust among operators who rely on them for critical tasks like collision avoidance. To address this challenge, GTRI is developing a physics-informed ML approach that combines the theoretical foundations of traditional physics models with the advanced capabilities of modern ML techniques to improve the accuracy of satellite spin predictions and strengthen operator trust.

Many existing ML models rely on simplified or partial equations to predict satellite behavior rather than precise and comprehensive mathematical solutions, limiting their effectiveness and accuracy. Physics could be a promising solution for the black-box concerns of current ML models. By integrating physics into these models, they could leverage established principles of the natural world that govern satellite motion to make more accurate and transparent predictions.
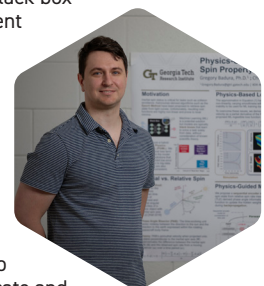
Physics could help explain the "black-box" nature of machine learning models.

The NSA and GTRI are collaborating to address AI challenges in national security.

NSA and GTRI Collaborate on AI for National Security

Artificial intelligence, particularly applications in machine learning, is attracting attention for uses in a broad range of areas – including national security – where the ability to understand complex patterns could be extremely helpful. In the civilian world, Generative AI based on large language models is helping produce written documents, while testing is already underway on self-driving vehicles facilitated by AI.

But "hallucination" errors in AI-produced documents and well-publicized accidents in autonomous vehicles raise doubts about using this type of AI in national security and other applications where a single error could have catastrophic results. Producing AI systems useful to national security requires development and training approaches that differ from those used in the commercial and academic communities – and leverage trust-based considerations throughout the development process to build in risk reduction prior to deployment.

To address these concerns, GTRI researchers, in collaboration with the National Security Agency's (NSA's) Laboratory for Advanced Cybersecurity Research (LACR), are developing metrics, tools, and techniques to improve the robustness and trustworthiness of AI for such high-stakes applications.

Researchers are developing tools and techniques to improve AI use.

Ranges of the Future Will Enhance Warfighter Training and Readiness

The LMOC Platform helps pilots and aircrew members stay at the top of their game.

Training ranges across the United States and around the world help pilots and aircrew members stay at the top of their game, all while adopting the new tactics and equipment necessary to address the changing threat environment. A training solution known as LMOC Platform is helping fulfill the program's tagline, "Better Training. Faster." by integrating disparate training applications and systems at the ranges.

Part of the U.S. Air Force's Live Mission Operations Capability (LMOC) program, this platform has been installed at training ranges around the world. It brings together as many as a dozen programs that provide information on potential threats, handle radio communications, analyze aircraft engagements, support mission planning, and display a fused combat operating picture. LMOC Platform operates on non-proprietary commercial-off-the-shelf (COTS) computer systems.

Developed by GTRI, what LMOC does is comparable to how modern smartphones brought together separate pagers, cameras, mobile phones, electronic calendars, and other devices.

Machine Learning Platform to Streamline DoD Data Management

GTRI is developing a machine learning operations (MLOps) platform for the U.S. Department of Defense (DoD) to standardize the development and testing of artificial intelligence (AI) and ML models, boosting their speed and efficiency in real-time decision-making.

Rather than treating ML development in isolation, GTRI's MLOps platform would bridge the gap between data scientists and field operations so that organizations can oversee the entire lifecycle of ML projects from development to deployment at the tactical edge. The tactical edge refers to the immediate operational space where decisions are made


The platform enables management of machine learning projects across their entire life cycle.

and actions take place. Bringing AI and ML capabilities closer to the point of action would enhance the speed, efficiency and effectiveness of decision-making processes and contribute to more agile and adaptive responses to threats. For example, in an electronic warfare scenario, the models could rapidly analyze data to identify threats and recommend real-time countermeasures against enemy aircraft or missiles.

Sensor Modernization for MQ-9 Adopts Open Systems Technology

Modernization efforts utilizing the Modular Open Systems Approach (MOSA) and the Sensor Open Systems Architecture (SOSA™) standard have enabled the rapid development and prototyping of upgrades for critical sensor systems on the MQ-9 Reaper, a remotely-piloted aircraft designed for long-endurance surveillance. The enhancements, implemented in five prototype systems delivered by GTRI to the U.S. Air Force, could help operators more rapidly scan video for threats and allow more frequent hardware and software updates.
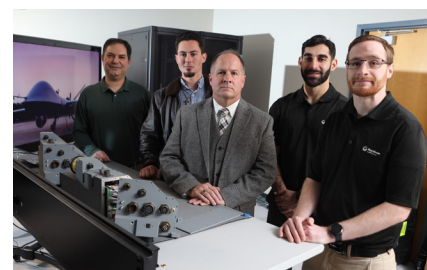
Open systems technology helped modernize the MQ-9 Reaper.

Enhanced computing capabilities demonstrated in the MQ-9's prototype Multi-Spectral Targeting System – Intelligent Electronics Unit (MTS-iEU) system improve the ability of operators to identify items of interest in video generated by the aircraft's sensor systems. The use of MOSA and SOSA-aligned components accelerated the development of the modernized MTS-iEU, which is designed to be easily upgraded with commercial off-the-shelf (COTS) components as future needs develop.

TAP is available to full-time USG employees with at least six months of service complete.

TAP Supports Debt-Free Education

GTRI offers a Tuition Assistance Program (TAP) that enables employes to pursue debt-free degrees by covering tuition and fees for eligible staff enrolled at University System of Georgia (USG) institutions. In 2023, there were 155 GTRI employees who participated in TAP. TAP is available to full-time, benefits-eligible USG employees who have successfully completed six months of employment. Through TAP, GTRI employees can enroll in up to nine academic credit hours per semester.

In addition to TAP, GTRI offers the Staff Tuition Reimbursement Assistance Program (STRAP) for partial tuition at accredited, private non-USG institutions. Full-time research staff can also access support through the Georgia Tech Applied Research Corps (GTARC) Education Assistance Program and the GTRI Supplemental Tuition Assistance Program, which covers remaining costs and supports exclusive advanced degree programs.

These programs support employees' professional development and enrich GTRI's workforce by fostering an environment of continuous learning and innovation.

In 2023, 155 GTRI employees participated in TAP.

New GTRI-PE Courses Equip Leaders for Emerging Challenges

GTRI's Professional Education Program (GTRI-PE), in partnership with Georgia Tech Professional Education (GTPE), has launched a new certificate in Autonomous Intelligent Systems (AIS). The introductory course offers a comprehensive overview of autonomous systems, including foundational topics in robotics and machine learning, preparing students to design, implement, and manage AIS.

GTRI-PE's new courses cover autonomous systems, AI, machine learning and data science.

A new course, set to launch in spring 2025, will expand the AIS certificate by focusing on the transformative impact of autonomous technologies on military strategies. This advanced course will feature real-world case studies from Ukraine and Israel, delve into the evolution of joint warfighting doctrine, and address critical ethical considerations surrounding autonomous tactics.

Also debuting in 2025 is the Artificial Intelligence, Machine Learning, and Data Science certificate. The inaugural course, "A Survey of AI," scheduled for spring, introduces students to the history and foundational concepts of AI. It explores its diverse applications while examining its significance in national security and society. Students will engage with widely used AI tools and gain insights into the technology's potential for future advancements.

In 2024, GTRI-PE delivered a total of 212 courses led by 214 instructors. These efforts continue to demonstrate GTRI-PE's commitment to providing high-quality, impactful professional education.

The 71 participants in 2024 were chosen from 1,145 applicants.

STEM Beyond the Classroom

GTRI's K-12 outreach program STEM@GTRI hosted 71 high school students from 12 Georgia school districts for its 2024 summer internship program. The students were selected from an application pool of 1,145. Students gained real-world STEM experience, working on projects ranging from developing AI solutions to enhance GTRI operations, applying robotics to poultry processing, collecting and analyzing data on Atlanta traffic patterns and exploring quantum communications.

The following school districts were represented: Atlanta Public Schools, Bibb, Cobb, DeKalb, Fayette, Forsyth, Fulton, Gwinnett, Houston, Marietta City Schools, Paulding, and Stephens County. Forty-three GTRI professionals representing seven labs and one support unit served as mentors to the interns. The ultimate goal of the program is to provide students with real-world experience in the fields of science, technology, engineering, and math (STEM) and to create awareness of future STEM career opportunities.


STEM@GTRI strives to inspire, engage, and impact Georgia's students and educators through hands-on experiences, outreach, and professional learning.

Forty-three GTRI professionals served as intern mentors.

Rural Computer Science Initiative Expands

The Rural Computer Science Initiative, designed by GTRI's K-12 outreach program STEM@GTRI and Georgia Tech's Center for Education Integrating Science, Mathematics and Computing (CEISMC), has expanded to 40 Georgia school districts and 4,400 student participants since its launch in 2022.

The program connects Georgia Tech faculty and students with rural schools to co-teach interactive modules on topics such as artificial intelligence, cybersecurity and robotics while helping local teachers develop the necessary skills to ultimately teach these subjects independently. Each module is two weeks in duration and is taught virtually by Georgia Tech in collaboration with the teacher in the classroom. At the end of the module, students complete a project aimed at using the technologies they learned about to address a real-life challenge facing their communities. Tech faculty and students then provide feedback on their projects.
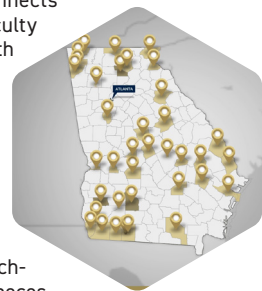
The program is helping shape Georgia's future workforce to meet the demands of a rapidly evolving technology landscape. The program is supported with funding from the State of Georgia.

The program has expanded to 40 Georgia school districts and 4,400 student participants since its 2022 launch.

John Trostel of the GTRI Severe Storms Research Center (SSRC) chats with attendees.

From left to right: Georgia Tech President Ángel Cabrera, University System of Georgia Chancellor Sonny Perdue, and GTRI Director Jim Hudgens.

Celebrating 90 years, GTRI continues advancing research excellence to solve customers' toughest challenges

Ninety years since its founding, GTRI has stayed true to its core mission of combining science and engineering to create practical solutions for government and industry.

Established in 1934 as the Engineering Experiment Station (EES), GTRI has grown to over 3,000 employees supporting eight laboratories in multiple locations around the country. GTRI recently held an event at its Atlanta headquarters to commemorate this historic milestone, where over 300 attendees gathered, including University System of Georgia Chancellor Sonny Perdue, Georgia Tech President Ángel Cabrera, and former GTRI directors Edward Reedy and Stephen Cross.

Central to the event was a presentation on GTRI's top nine iconic technical achievements that were ordered by decade of GTRI's existence. Among those innovations were advancements in millimeter wave technology in the 1950s, where EES built the first military-designated millimeter wave radar that set the foundation for increasingly capable systems in subsequent decades. Millimeter waves utilize high-frequency radio waves for precise object detection, speed measurement, and distance determination.

In the late 1960s, EES researcher Richard C. Johnson developed the compact range, a technology using a parabolic reflector to simulate long-distance radar waves within limited spaces. This innovation enabled accurate indoor target measurements and became widely adopted. In 1989, GTRI advanced this technology by building the world's largest outdoor compact range at Fort Huachuca, Arizona, for the U.S. Army.

In the 1990s, GTRI developed the Falcon-View® mapping system for the U.S. Department of Defense. Now used by the military, various federal agencies, and allied countries, Falcon-View® serves as the mapping interface for mission planning software, helping warfighters navigate and avoid threats.

About a decade ago, GTRI developed the Angry Kitten® system, which utilizes advanced sensing techniques to counter rapidly evolving electronic warfare threats. Several versions of the Angry Kitten® technology are utilized across the Department of Defense. Most recently, GTRI has helped develop a technique for using synthetic DNA to provide high-density 3D archival data storage at ultra-low cost.

Today, GTRI remains committed to advancing technology across various fields, from defense and homeland security to public health, agricultural technology, and education. Its multidisciplinary approach and close partnership with Georgia Tech drive innovation, shaping the future of technology and preparing emerging leaders to tackle the nation's evolving needs.

EES researchers built the first millimeter wave direction finding system for the U.S. Department of Defense.

GTRI designed and built what was at the time the world's largest outdoor compact range at Fort Huachuca, AZ.
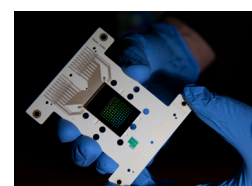

The Advanced Components Test Facility was a 325 kW solar thermal furnace operated by EES for the U.S. Department of Energy.

Operators demonstrate FalconView® aboard a C-130 aircraft parked at Dobbins Air Reserve Base near Atlanta, GA.

Angry Kitten Attack Pods have been flying on multiple aircraft, including F-16s.

Researchers developed a microchip for growing DNA strands that could provide high-density 3D archival data storage at ultra-low cost.

LOCATIONS

Atlanta (GA) Headquarters
Cobb County (GA) Research Facility
Colorado Springs (CO) Field Office
Dayton (OH) Field Office
Huntsville (AL) Field Office
Lincoln (MA) Field Office
Orlando (FL) Field Office
Panama City (FL) Field Office
Patuxent River (MD) Field Office
Phoenix (AZ) Field Office
Quantico (VA) Field Office
San Diego (CA) Field Office
Shalimar (FL) Field Office
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