2008 Annual Report

PROBLEM. SOLVED.

Georgia Tech Research Institute

The GTRI Mission:

- **EXECUTE** a synergistic model of research, innovation and education, and
- **APPLY** this to solve the significant problems of a complex world.

www.gtri.gatech.edu

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Why GTRI

Genuine Innovation

Genuine innovation takes place when unique ideas and inventions are put into action. From developing new systems to keeping older systems state-of-the-art, our researchers drive innovation beyond the basics to prototyping, field testing and real-time, real-scenario performance.

Trusted Partnerships

We never stop asking "what's next?" and strive for excellence in everything we do. Government and industry rely on us to provide quality solutions with the objectivity that comes from being a nonprofit research organization. We are trusted partners who seamlessly integrate with our customers, anticipate their needs and solve their problems quickly and creatively.

Real Value

For nearly 75 years, GTRI has served the research needs of our customers by combining interdisciplinary expertise, creative thinking and real-world practicality. From ideas to impact, the complex becomes simple and tough problems are solved – the right way and the first time.

Institutional Leverage

Working with GTRI means having the collective research might of a world-class research institute and one of the nation's top research universities at your fingertips. By working with GTRI, government and industry customers gain access to the vast intellectual resources of the Georgia Institute of Technology. Working together, experts from many disciplines solve the toughest problems for our clients.

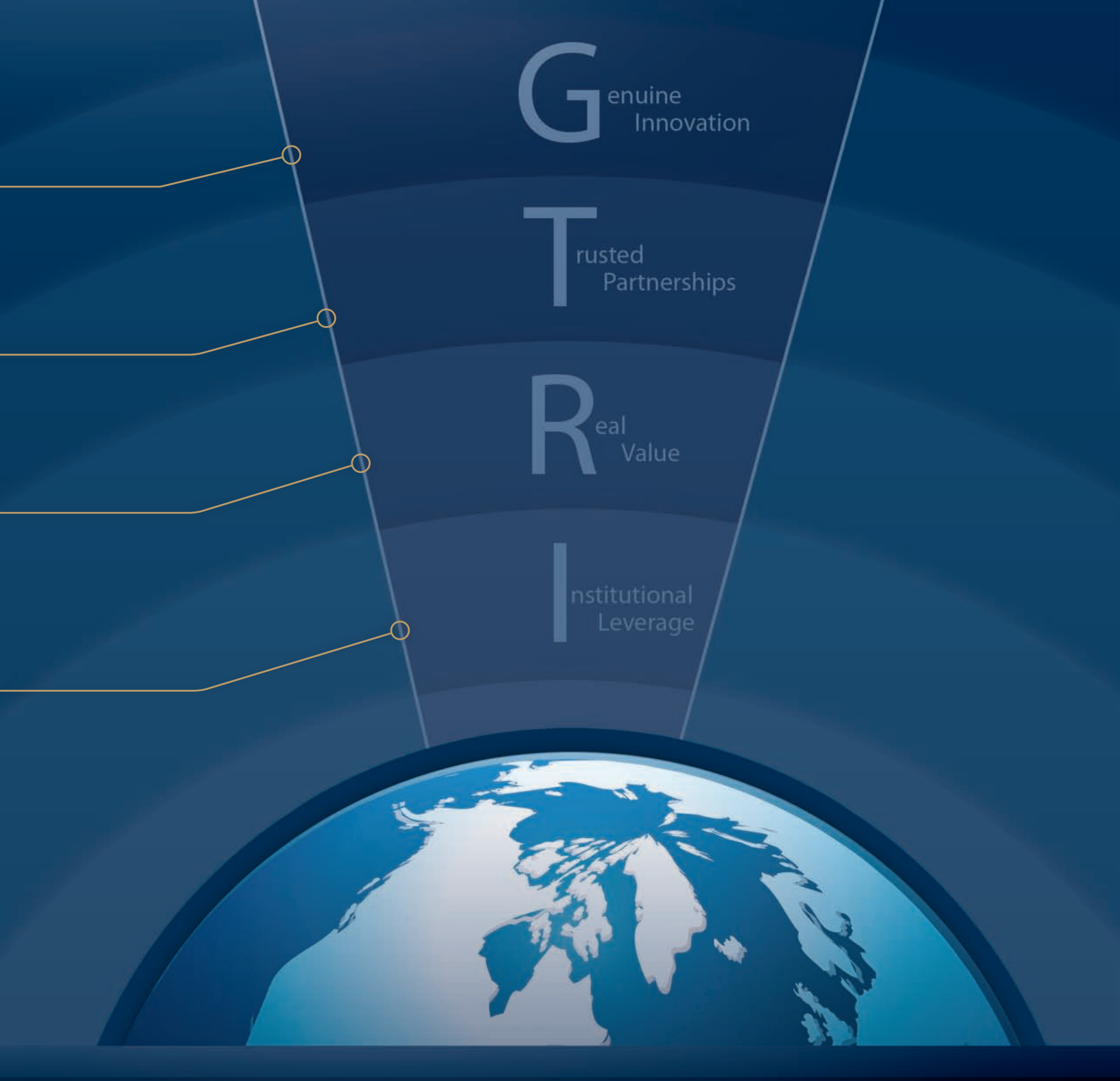
Problem Solving.

That's GTRI – the Georgia Tech Research Institute – one of the world's leading university-affiliated applied research organizations.

GTRI's world-class scientists and engineers have a long track record of turning complex challenges into real-world solutions and new opportunities for government and industry – solving tomorrow's problems today.

Developing unique and creative ideas is only the beginning at GTRI. Bringing those ideas to life and putting them into action are what set GTRI apart from the competition.

Since 1934, GTRI has established itself as an objective and trusted partner to government and industry, tackling some of the world's toughest technical problems and serving as a source of true innovation.



Welcome to GTRI.
Problem. Solved.

From the Director

The Georgia Tech Research Institute – GTRI – is *Georgia Tech's research institute*. Actually, we are also Georgia Tech's largest research unit, its only applied research institute and widely regarded as an organization of great impact. Conceived by the Georgia General Assembly in 1919 and first funded in 1934, we proudly entered our 75th year of operation in 2009.

Our motto – *Problem. Solved.* – underscores everything that is great about Georgia Tech and GTRI. We pursue a strategically focused and synergistic model of research, innovation and education that is continually enhanced and applied to solve problems of a complex world. Our strengths are based on:

- World-class subject matter experts in systems engineering, sensors, and information and telecommunications technology;
- A unique laboratory infrastructure including classified facilities; and
- Collaboration with Georgia Tech's academic colleges and access to the vast intellectual resources of one of America's premier research universities.

The year 2008 was a time of significant progress and growth, which was enabled by our innovative problem solving in partnership with our valued government and industry sponsors. While many organizations and corporations have struggled to deal with a weakened American economy, GTRI has pushed forward with a carefully crafted strategy for sustained growth. In the past year, more than 100 new scientists and engineers have joined the ranks of our world-class research faculty. Research awards also increased to $184 million, a 43 percent increase over fiscal year 2007.

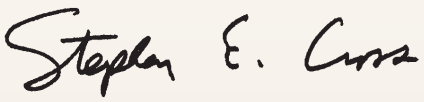
In hearings held at GTRI by the Georgia General Assembly, it was noted that GTRI is clearly achieving the vision originally specified in its state charter – to support economic advancement through innovation. Our return on investment of $18 for every state dollar invested in our organization this past year is a remarkable and commendable accomplishment given the ongoing global financial crisis. This success is predicated on our reputation as innovative problem solvers – a reputation that has been sustained throughout our history.

Our success, however, is not measured solely by new hires, new contracts or increased revenues. We measure our success by the impact our work is having on our state, our nation and the world – as an integral part of a leading global research university. This work is crucial to the overall strategy and mission of Georgia Tech. Our research, the basis for our problem solving, both supports and benefits from collaborative efforts with Georgia Tech's colleges and interdisciplinary research initiatives.

This past year, GTRI research awards accounted for 45 percent of the total dollar volume of research awards for all of Georgia Tech. We are also the largest employer of Georgia Tech cooperative education students, and many GTRI personnel serve in important faculty and staff leadership positions within the university. These facts contribute directly to Georgia Tech's reputation and impact. One measure of that impact is a recent *Times of London* survey that ranked Georgia Tech eighth among the world's technological universities.

We are pleased to present this annual report to you. It contains a sampling of the problems we partnered with our customers to solve and the core competencies upon which the solutions were based. You will also get some sense of the amazingly talented and dedicated staff that every day live our motto – *Problem. Solved.*

Please feel free to contact me at any time if you desire more information about our work.



Stephen E. Cross, Ph.D.
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GTRI is systems engineering.

At GTRI, systems engineering is not just an area of expertise – it's how we approach every research project no matter how large or how small, balancing customer needs with technical requirements and human interaction.

In a time when economic uncertainty is forcing government and industry to modernize older systems rather than purchase new ones, our experts are uniquely qualified and highly experienced at revitalizing legacy systems – keeping them state-of-the-art.

Systems engineering excellence requires the ability to apply interdisciplinary know-how, technical expertise and leading-edge resources to assess, develop and optimize improvements needed to modernize full systems – and all of their unique parts.

GTRI has a broad set of subject matter expertise and a wide array of potential technologies available to solve system-level problems. Without a profit or product line motive to drive us toward a particular solution, it is part of our culture to take a broad and interdisciplinary approach to problems.

We combine systems expertise with a long history of real-world development, integration and evaluation – "roll-up-your-sleeves" execution on large systems-level projects, first-of-a-kind systems demonstrations, and full life-cycle support.

It is our culture. It is our practice. It is our research.

GTRI Research Areas

SYSTEMS ENGINEERING
TEST AND EVALUATION
AUTONOMOUS SYSTEMS
ROBOTICS
MISSI
TECHNOLOGY INSERTION
COMMUNICATIONS AND NETW
RADAR SYSTEMS
WORKPLACE SAFETY
COMMAND AND CONTROL
INFORMATION SHARING
INTELLIGENCE TECHNOLOGIES
MACHINE VISION
ACCESSIBILITY AND ASSISTIVE TECHNOLOGIES
DIGITAL M
SOFTWARE ENGINEERING
INFORMATION SECUR
INTEGRATED AIR AND MISSILE DEFENSE

GTRI is sensor technology.

GTRI is a pre-eminent innovator in sensors, contributing to many radar, electronic warfare, optical and intelligence-gathering systems over the last 75 years. We are proud of our unique ability to work with a broad range of sensor technologies. From basic research and fundamental studies, to exploratory development, through prototyping of one-of-a-kind sensor systems – GTRI is uniquely positioned to take integrated sensing to the next level.

As a part of one of the nation's top research universities, we leverage the broader Georgia Tech community to devise innovative technology solutions that balance performance, cost and operational utility.

We are internationally recognized for our work in antenna technologies, signal processing algorithm development, and radar cross-section measurements and modeling. Our expertise in electronic warfare, electronic protection, signature control and threat systems assessment addresses national security needs.

Our staff of experienced scientists and engineers embraces an innovative and entrepreneurial spirit.

The breadth of our research staff helps GTRI set new directions in sensor technologies.

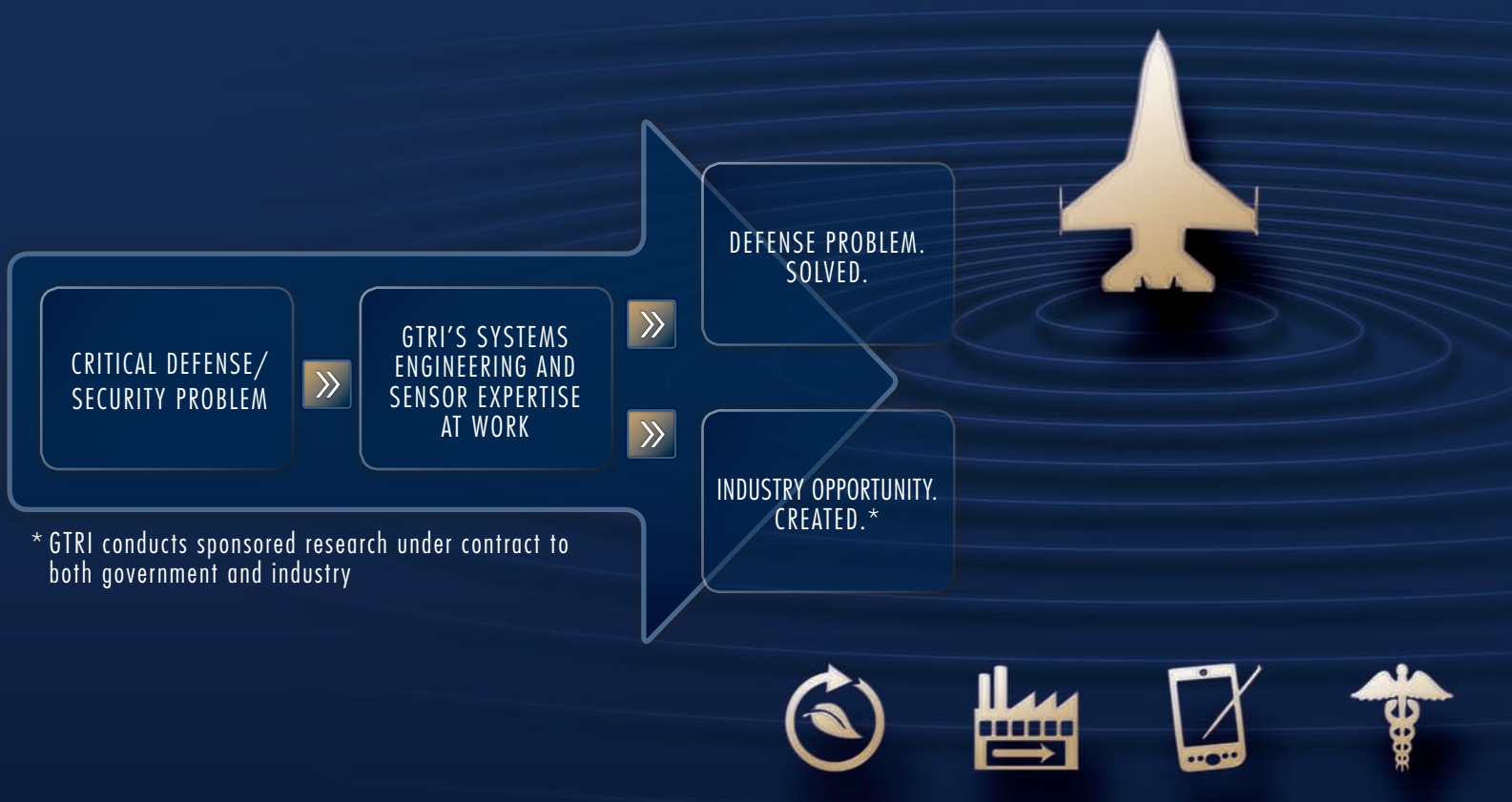
Multi-spectral sensor fusion, enormous bandwidth antennas, exploitation of meta-materials, lightweight and high-performance sensors, next-generation weapons location radar, and sensor forensics are a few areas in which GTRI continues to make vital contributions.

Integrated sensor solutions for the real world

OPPORTUNITY. CREATED.

Leveraging GTRI defense research

GTRI has a strong reputation for meeting the mission-critical needs of the U.S. military and other federal agencies supporting national defense and homeland security. With unmatched expertise in systems engineering and sensor technology, GTRI often develops breakthrough innovations that make the world a safer place. GTRI also has a long history of turning "game-changing" military solutions into new opportunities for industry.



Georgia Tech Research Institute

RESEARCH AT GTRI

From electronic warfare automation, new materials for thermal control and controlling UAV noise to remote detection of aviation hazards, disaster monitoring and new radiation detection technologies, GTRI applies systems engineering and sensor technology to solve challenging problems for both government and industry.

Tackling an Urgent Aircraft Defense Upgrade

Many GTRI researchers collaborated on a priority program to upgrade missile protection on the A-10, a key combat aircraft.

When the Air Force found that one of its top combat aircraft needed more protection from an enemy missile threat, a multidisciplinary GTRI team went into action. The A-10 attack aircraft needed important additions to its electronic warfare (EW) countermeasures systems.

"We made it a priority across many different GTRI labs because of the broad requirements," said research engineer Melanie Hill, who was GTRI's lead engineer on the program. "That included electrical engineering, software development, systems engineering and mechanical engineering."

At issue was the ability of the A-10 to detect infrared signals from certain classes of enemy weapons. The A-10 already carried extensive electronic warfare equipment, including the ALQ-213, a central controller that is the core of the airplane's electronic warfare systems.

The GTRI team's first task was to take an existing infrared-detection tool, the AAR-47 missile warning system, and determine whether it could do the job on the A-10. Then the team had to decide exactly how to add the AAR-47 to the A-10, and how to integrate the new missile-warning functions into the ALQ-213 controller.

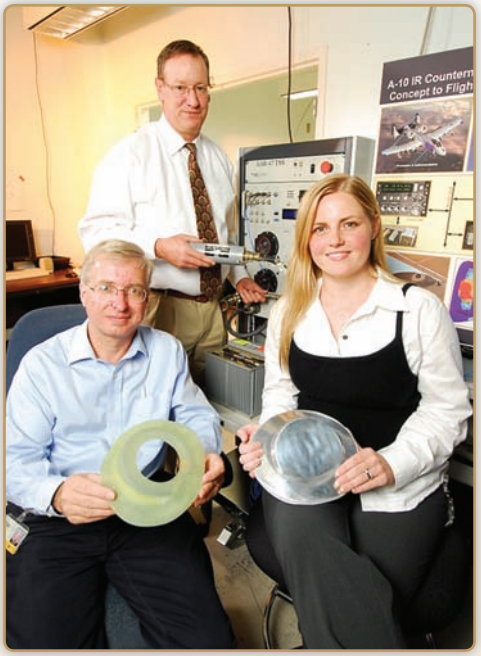
The effort, called the A-10 Infrared Countermeasures (IRCM) Program, was on a tight schedule from the start, with 200 days to move from concept to flight test.

Researchers from across GTRI pulled together to meet the deadline. GTRI principal research scientist Charlie Carstensen used a pedestal-mounted A-10 located at an Air Force facility in Rome, N.Y., to establish that the AAR-47 was a viable option for the A-10. With principal research engineer Mike Willis as program manager, principal research engineer Jeff Hallman led the AAR-47 research effort, and principal research engineer Byron Coker led the team developing the software that allowed the AAR-47 to communicate with the ALQ-213.

A successful flight test kept the program on schedule. GTRI's next task was to take the prototype and use it to develop a standardized installation kit that included a complete package of technical drawings.

Research associate Kim Wood was a leader in electrical/mechanical design and aircraft installation, and principal research engineer Rod Beard and electrical engineer Wallace Gustad were among the GTRI personnel who worked on the original prototype used for flight testing as well as on development of the upgrade installation kits. Numerous other engineers, technologists and scientists worked on the program's mechanical engineering and drafting needs.

To help get the actual A-10 upgrade process under way, GTRI supported the manufacture of the low-rate initial production kits and then turned the engineering over to the Air Force for continued production.



The upgrade is now active on the U.S. A-10 fleet worldwide. The project was sponsored by the Warner Robins Air Logistics Center at Robins Air Force Base.

Developing a Technology Road Map for Test and Evaluation of UAV Systems

GTRI is supporting development of a road map designed to improve the testing and evaluation of unmanned and autonomous systems for the U.S. Office of the Secretary of Defense (OSD).

"The field of unmanned and autonomous systems is evolving rapidly, and new techniques are needed to effectively test and evaluate the capabilities that are being inserted into these systems. This is especially challenging for systems that are increasing in levels of autonomy," said Lora Weiss, a GTRI principal research engineer. "Our task is to develop a road map that identifies new approaches to testing autonomous systems and details what needs to be tested, how the autonomous technologies can be tested and when the testing needs to occur."

The unmanned systems test and evaluation project is a new area within the Test and Evaluation Science and Technology Program, which is sponsored by the Test Resource Management Center (TRMC) within the Office of the Secretary of Defense. Known as the Roadmap Development and Technology Insertion Plan (RD-TIP), the award was funded through the U.S. Army at White Sands Missile Range.

"Many new technologies are being developed for unmanned and autonomous systems that must be tested and evaluated before they can be deployed. New approaches are needed for testing and measuring the robustness of these systems, especially in non-deterministic and evolving environments, " Weiss noted. "The only way to know how to test them is to understand both the details of the technology and the system that it is going into. GTRI has extensive experience in both areas and can uniquely couple fundamental research with warfighter systems."

The effort will address all five major unmanned and autonomous systems domains, including systems that operate in the air, on the ground, underwater, on the sea surface and in space. The roadmap will address both vehicles and the socio-technical environments in which they operate.

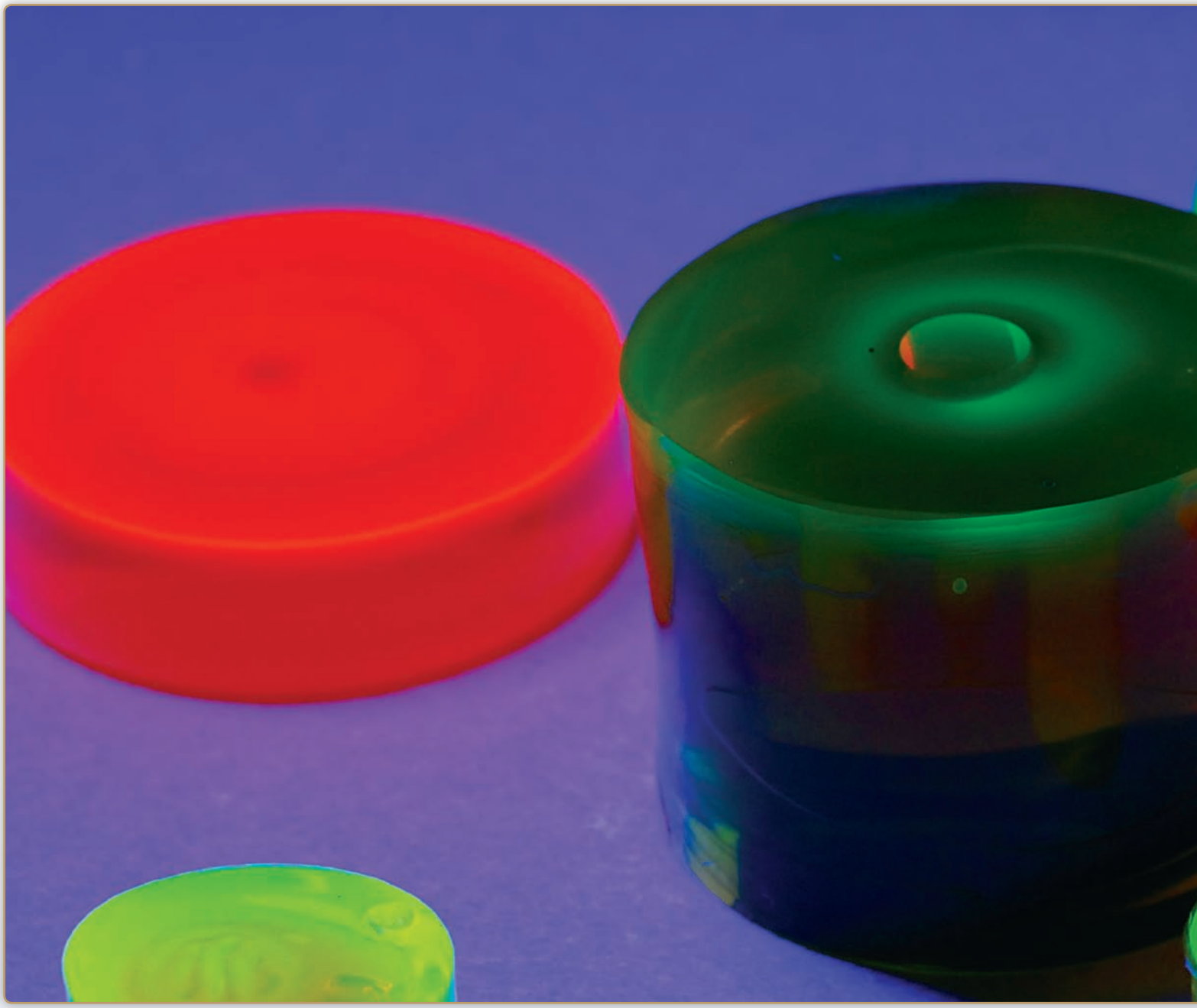
Test and evaluation has traditionally been a focus area for GTRI, noted Rusty Roberts, director of GTRI's Aerospace, Transportation and Advanced Systems Laboratory. "The current road map award builds on GTRI's long-term experience with test and evaluation for government customers and couples it with GTRI's strong knowledge of unmanned systems," he said.

GTRI has ongoing projects in four areas of the T&E Science and Technology Program: unmanned and autonomous systems, directed energy, net-centric systems and non-intrusive instrumentation.

Unmanned and autonomous systems are recognized as critical components of all aspects of modern warfare across the joint forces, and they are growing in mission effectiveness. They have proved effective in Afghanistan and Iraq by providing commanders at both the operational and tactical levels with improved intelligence, surveillance, reconnaissance and precision strike capabilities.

GTRI researchers are developing methods to improve testing and evaluation of unmanned and autonomous systems.

Using Nanotechnology to Detect Gamma Radiation



One of the many challenges in homeland security is detecting materials associated with potential nuclear threats while effectively filtering out the many legitimate radioactive objects commonly found in commerce and the environment.

One type of gamma radiation detector contains an inorganic single-crystal scintillator, such as sodium iodide, which absorbs the high energy radiation and coverts it to light pulses. The light-pulse intensities are then measured and compared to the energies of known nuclides. While crystals typically have a high stopping power, meaning not much radioactive energy is lost during interaction with the crystal, they are plagued by low energy resolution and long decay times, and typically need to be protected from the environment.

GTRI researchers are investigating replacing the crystals with composite materials made of nanoparticles or quantum dots embedded in a polymer matrix.

"Scintillators made of quantum dots or nanoparticles may have many advantages over a single crystal, including better resolution, meaning they can better distinguish differences in energy intensity, and better stopping power," said Bernd Kahn, director of GTRI's Environmental Radiation Center.

Fabricating the composites is also less expensive than growing a single crystal, and the size and shape of the fluorescent material is not constrained by crystal growth. Also, the particles are automatically sealed off from the environment because they are suspended in plastic.

GTRI researchers are developing new radiation detector materials that contain different types of quantum dots or nanoparticles.

Because nanoparticles and quantum dots are so small, the properties they exhibit differ substantially from the properties of the same material in bulk. Quantum dots become more efficient as they become smaller and their decay times become faster, meaning more gamma rays can be detected in a given amount of time.

"Quantum dots are promising because they can be tuned to certain wavelengths by making them a specific size, and suspending several different types of quantum dots in the plastic allows for a broader wavelength range to be utilized," explained principal research scientist Brent Wagner. "But to get the best performance and higher stopping power, we need to use quantum dots made of heavier elements."

In the proper format, nanoparticles of standard scintillator materials, like sodium iodide, could also have a major advantage over the crystalline form – a reduction in light scattering.

The researchers are currently developing and testing polymer composites containing several different types of quantum dots or nanoparticles, including barium and lanthanum halides, lead sulfide, and cerium-doped yttrium aluminum garnet (YAG).

Research engineer Jason Nadler, research scientist Zhitao Kang, and senior research scientists Robert Rosson, David Roberts and Hisham Menkara are also working on this project, which is supported by the U.S. Department of Homeland Security.

Developing Miniature Robots for Future Missions

GTRI teams are participating in a multi-university program to develop tiny intelligent mobile robots.

GTRI and other Georgia Tech units – including the College of Computing, School of Aerospace Engineering and School of Physics – are assisting in the development of tiny intelligent mobile robots that could someday support U.S. combat missions.

Called the Micro Autonomous Systems and Technology (MAST) Collaborative Technology Alliance Program, the new initiative is led by BAE Systems and includes 10 principal and general members, including other universities. Georgia Tech researchers are contributing to three of four primary MAST research teams.

"By bringing together world-class expertise from several different fields, it's hoped that within five years real-world applications can be developed," said Mike Heiges, a GTRI senior research engineer involved in the program.

The program, sponsored by the Army Research Laboratory, includes four principal research teams:

» Integration, led by BAE Systems Inc., oversees all research efforts and addresses the application of results to practical systems. The team includes the California Institute of Technology/Jet Propulsion Laboratory, Georgia Tech and the University of California at Berkeley.

» Microelectronics, led by the University of Michigan, addresses the hardware aspects of control, communications and sensing for autonomous robot operations. The team includes the University of California at Berkeley and the University of New Mexico.

» Microsystems Mechanics, led by the University of Maryland, addresses locomotion technology for tiny mobile robots. The team includes the California Institute of Technology/Jet Propulsion Laboratory, Georgia Tech, North Carolina A&T State University and the University of California at Berkeley.

» Processing for Autonomous Operation, led by the University of Pennsylvania, addresses autonomous navigation, distributed perception and group behaviors for an ensemble of intelligent and mobile micro autonomous systems. The team includes Georgia Tech, the University of California at Berkeley and the University of New Mexico.

Other institutions participating as sub-awardees include Boston University, Harvard University, the Massachusetts Institute of Technology, Vanderbilt University, the University of Milan in Italy, the University of Sydney in Australia – and two companies: Centeye and Daedalus.

Heiges, working with GTRI principal research engineers Jim McMichael and Lora Weiss, is supporting the integration effort. The GTRI integration team is also collaborating with Dimitri Mavris of Georgia Tech's Aerospace Systems Design Laboratory.

The team's immediate focus involves determining the most desirable capabilities for the palm-sized robots. Among the traits likely to be at the top of the list are intelligence and independence.

GTRI principal research engineer Tom Collins is leading a team focused on the processing for autonomous operations. Collins is collaborating with several investigators from the Georgia Tech College of Computing, including Regents' professor Ronald Arkin; Henrik Christensen, director of the Robotics and Intelligent Machines Center; and associate professor Frank Dellaert. Working with the University of Pennsylvania and others, these researchers are contributing to intelligence technology for the small autonomous systems.

Currently, Collins said, research favors a decentralized approach in which individual robots would gather information and then share it among their companions to form a more complete picture.

Using Video Game Graphics Processors for Defense Applications

Researchers are helping the defense industry utilize the speed and efficiency of graphics processing units.

Video gaming computers and video game consoles available today typically contain a graphics processing unit (GPU), which is very efficient at manipulating and displaying computer graphics. However, its highly parallel structure also makes it more efficient than a general-purpose central processing unit for a range of complex calculations important to defense applications.

Researchers from GTRI and the Georgia Tech School of Electrical and Computer Engineering are developing programming tools to enable engineers in the defense industry to utilize the processing power of GPUs without having to learn the complicated programming language required to run a program on a GPU.

"As radar systems and other sensor systems get more complicated, the computational requirements are becoming a bottleneck," said GTRI senior research engineer Dan Campbell. "We are capitalizing on the ability of GPUs to process radar, infrared sensor and video data faster than a typical computer, and at a much lower cost and power than a computing cluster."

Mark Richards, a principal research engineer and adjunct professor in Georgia Tech's School of Electrical and Computer Engineering, is collaborating with Campbell and graduate student Andrew Kerr to rewrite common signal processing commands to run on a GPU. This work is supported by the U.S. Defense Advanced Research Projects Agency and the U.S. Air Force Research Laboratory.

The researchers are writing functions defined in the Vector, Signal and Image Processing Library (VSIPL) to run on GPUs. VSIPL is an open standard developed by embedded signal and image processing hardware and software vendors, academia, application developers and government labs. GPU VSIPL is available for download at (http://gpu-vsipl.gtri.gatech.edu/).

Studies have shown that VSIPL functions operate between 20 and 350 times faster on a GPU than a central processing unit, depending on the function and size of the data set.

"The results are not surprising because GPUs excel at performing repetitive arithmetic tasks like those in VSIPL, such as signal processing functions like Fourier transforms, spectral analysis, image formation and noise filtering," noted Richards. "We've just alleviated the need for engineers to understand the entire GPU architecture by simply providing them with a library of routines they frequently use."

For the future, the researchers plan to continue expanding GPU VSIPL, developing additional defense-related GPU function libraries and designing programming tools to utilize other efficient processors, such as the one in the PlayStation 3 video game console.

Helping to Deliver on the Promise of IPTV

GTRI is developing new applications for Internet protocol television (IPTV).

GTRI researchers are developing new applications for Internet protocol television (IPTV), a broadband technology that delivers digital television services to subscribers in a closed network. IPTV offers highly interactive, advanced video services – including video-on-demand, Web browsing, advanced e-mail and messaging services.

GTRI research engineers Shane Owens and Jeff Smart are collaborating with several academic institutions and industry partners to focus on three areas of IPTV development:

- Interactive application development, e-commerce and e-learning;
- Network management and monitoring, and network delivery methods;
- Test bed development.

IPTV research has been supported through equipment donations and private gifts.

"IPTV is in an early phase now, but it's poised for some big steps forward," Smart said. "It shows promise for delivering content that people today only dream about, such as real-time traffic news and rerouting information that's available anywhere."

Development of IPTV test beds at Georgia Tech in Atlanta and at Georgia Tech Ireland has created an international interactive-television environment aimed at product research. A central control facility is now located in Athlone, Ireland, with clients based at Irish universities.

GTRI's IPTV investigators are working with Intellione Technologies Corp., an Atlanta-based traffic-information company that provides real-time traffic data to hand-held devices. Intellione's software monitors cell phones in moving vehicles, measuring the phones' movement to map traffic conditions.

GTRI is helping Intellione create an IPTV interface for the Intellione io-vector personal traffic-guidance system. Intellione recently announced it has raised $14.5 million to accelerate its growth, and that it expects to offer location-based services to cell phones by early 2009 – including driving directions, real-time rerouting and gasoline price information.

IPTV interests telephone companies and broadband Internet service providers because it allows them to offer interactive video services – thereby letting them compete more effectively with cable companies. IPTV also has potential applications in entertainment, content and distance learning, as well as telemedicine.

Researchers still face a number of technical challenges, such as the need for uniform industry standards in an IPTV marketplace that is currently heavily proprietary. However, GTRI is a leader in this emerging technology and will actively seek additional partners interested in exploring frontiers and defining the IPTV future.

Using Military Antenna Technology to Relay Ocean Data

Antenna technology developed by GTRI will enable this Wave Glider to communicate information to its operator via satellite.

California-based Liquid Robotics Inc. developed a wave-powered autonomous surface vehicle called Wave Glider. The vehicle provides a persistent presence on the ocean surface and has the ability to perform a wide variety of sensor functions and communicate the collected information back to the operator via satellite.

However, the amount of information that could be communicated by the unique Wave Glider platform was constrained by the limits of traditional antenna solutions, including available data bandwidth and/or high power consumption. In need of a more reliable and faster way to receive high-bandwidth information such as streaming audio and video from the Wave Glider, the company has turned to GTRI.

GTRI researchers had developed a reconfigurable aperture antenna technology several years earlier for a military software-defined radio that could be repurposed to quickly send and receive the required information. For Liquid Robotics, this included environmental and global positioning data, video, audio from a hydrophone, and instructions telling the vehicle where to go.

"We're very pleased with the results of the Wave Glider platform to date and we're excited about the additional capabilities that GTRI's technologies will bring to the platform," said Tim Richardson, chief operating officer at Liquid Robotics.

The original antenna technology was developed by GTRI Signature Technology Laboratory director Lon Pringle, principal research engineer Paul Friederich and principal research engineer Jim Maloney.

"The antenna technology developed at GTRI allows for fast data transfer because it can be steered electronically with very low power so that it stays pointed toward the satellite as the boat is moving around and bobbing back and forth on the waves," said GTRI principal research engineer Don Davis.

The antenna's performance can be optimized because it is reconfigurable, which means the electrical structure of the antenna can be easily changed. The antenna consists of a thin dielectric substrate that supports an array of square, metallic patches that can be switched on or off as needed to provide the proper configuration. The researchers simulated the antenna patterns to determine which switches should be open and which should be closed to maximize the antenna performance.

"This antenna technology allows limited space on a ship or vessel to be used most effectively because it can conform to the surface of an object. Additionally, it gives the user the ability to repurpose an antenna for other frequencies, bandwidths or directivity requirements," added Davis.

Turning Poultry Waste into Fuel

Researchers are investigating methods for separating and converting poultry processing residuals into higher value products such as high-grade fuels.

GTRI researchers are developing cost-effective techniques for separating and converting poultry processing residuals into higher value products such as high-grade fuels. The techniques would provide a beneficial use for these by-products, which are typically blended back into lower value products.

"Our ultimate goal is to extract usable, quality feedstocks from poultry processing by-products such as brown grease extracted from wastewater pre-treatment processes. If successful, we will help reduce costs by providing a cheap and simple way for the industry to better utilize their low-quality waste oil and grease by-products," said John Pierson, a GTRI principal research engineer.

To achieve this goal, Pierson and GTRI research coordinator Robert Wallace teamed with the Cumming, Ga.-based company American Proteins to obtain samples of poultry processing waste materials. They first focused their efforts on developing better ways to separate usable portions of the waste – such as free fatty acids, neutral oil and waxes – from unusable portions, such as solids and other insoluble materials.

Using improved refining and degumming techniques, the researchers were able to effectively reduce the volume of waste material by 75 percent.

"We are currently working on increasing the efficiency of these separation techniques, and on scaling up our separation techniques for use in a plant rather than the laboratory," noted Wallace.

In addition to developing improved separation processes, the researchers are working to convert the various fractions into biofuels at a higher yield than currently possible with typical processes. For this project, Pierson and Wallace teamed with Christopher Jones, a professor in Georgia Tech's School of Chemical & Biomolecular Engineering; Tom Fuller, a GTRI principal research engineer and a professor in the School of Chemical & Biomolecular Engineering, and graduate student Eric Ping.

The team is currently conducting solid-catalyst research to convert recovered usable fractions into alkane hydrocarbons or kerosene fuel, a primary ingredient for jet fuel. Initial efforts have identified promising solid-catalyst materials capable of converting selected fractions of polished brown grease more efficiently than traditional processes.

"Recovering these value-added products from waste oils is very important because it gives the industry greater flexibility in revenue generation as the recovered, value-added products can be used for traditional products or biofuels, whatever the market will bear," added Pierson.

This project is supported by GTRI's Agricultural Technology Research Program, GTRI's independent research and development program, and Georgia's Traditional Industries Program for Food Processing.

Testing Product Usability for Arthritis Australia

Researchers are testing products to assess how well they can be used by persons who have disabilities.

Many people dread buying products wrapped in hard plastic clamshell containers with fused seams. While the heat-sealed edges keep shoppers from opening the packages in stores, they also keep many purchasers from opening the packages at home – especially the millions of people who live with arthritis.

Many individuals with arthritis have upper- and lower-body mobility issues, including difficulty grasping and lifting, as well as reduced sensation, which can make opening products and packaging very difficult.

To encourage manufacturers to design arthritis-friendly products and packaging, and to provide individuals with a way to distinguish products that are comfortable, effective and easy to use, Arthritis Australia recently began an "Ease of Use" program that will involve testing by GTRI.

"Almost 4 million Australians are living with arthritis and it can really limit their lifestyles," said Fergal Barry, strategic partnerships manager at Arthritis Australia. "This new program will allow these people to choose user-friendly products over the competition."

Similar to programs developed by the U.S. Arthritis Foundation and the Arthritis Society of Canada, products are tested for their ease of use by GTRI. If a product passes rigorous testing, the company can use the arthritis organization's logo in its advertisements and on its packaging.

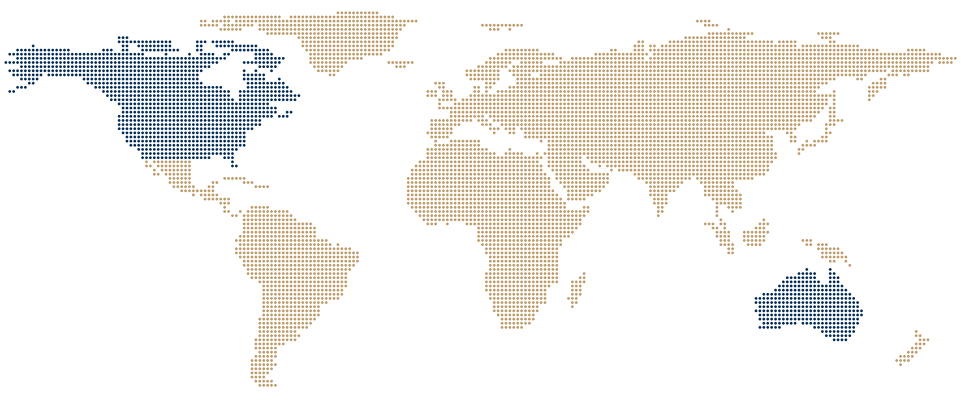
"We are excited for Australians to be able to feel confident that when they choose a product that has this logo on it that the product has been rigorously tested by a world-class testing center under strict scientific methods," added Barry.

As the sole independent laboratory authorized to test products for all three organizations, GTRI researchers evaluate products based on an arthritis-specific set of accessibility guidelines, as well as user testing by people with arthritis. Research participants, recruited from the local community, perform a series of tasks with the products being tested while researchers monitor their performance on these tasks.

"The results of this user testing and the checklist evaluation provide us with objective data about product accessibility, which we provide to the product manufacturer so that changes can be made in the design if necessary," said GTRI senior research scientist Brad Fain, who leads this research.

Products evaluated for ease of use commendation from the U.S. and Canadian organizations include appliances, exercise equipment, grooming tools, health aids, home and garden equipment, home furnishings, kitchen products, mobility aids, office products, orthopedic devices and sporting goods.

"We hope to test our first products in the next few months," noted Barry. "This new program will greatly benefit those people with arthritis in Australia, as well as every person who has ever been frustrated opening a package or using a product."



GTRI is assisting arthritis organizations in Australia, Canada and the United States.

Testing a Nuclear Plant's Warning System to Ensure Compliance

GTRI researchers completed an accelerated program to test a siren warning system used by a nuclear power plant in New York.

Demonstrating full regulatory compliance can be a challenge for managers of U.S. nuclear power plants. A GTRI team is working with the owner-operators of a major New York state nuclear facility to ensure that a critical safety measure will work correctly if a problem occurs.

At issue is a siren warning system surrounding the Indian Point Energy Center, a nuclear plant owned by Entergy Corp. about 35 miles north of mid-Manhattan. The Federal Emergency Management Agency (FEMA) recently ordered Entergy to show that its system of 172 pole-mounted warning sirens, which covers a 10-mile radius around the plant, complies fully with regulations.

"FEMA wanted proof that these horns produce sound at a given frequency that is repeatable and steady," said Rick Gaeta, a GTRI senior research engineer who led the project.

Federal regulations require a loudness of at least 70 decibels just outside every building in the warning zone. But real-world testing can jangle area residents' nerves, so it can't be done frequently. To help show regulatory compliance, Entergy turned to laboratory testing and evaluation.

A GTRI acoustics team supported Entergy's testing and evaluation effort with two crucial tasks:

- Testing to demonstrate that the sirens' warning tone had the requisite volume, reliability and steadiness in the quiescent environment of an anechoic chamber;
- Field testing to demonstrate siren performance in realistic atmospheric and meteorological conditions.

Moreover, there was an important time element to the project. Failure to comply with regulations could result in the big power plant being fined by regulators.

To demonstrate that the sirens installed around the plant were functioning properly, Gaeta and his team first evaluated a number of units in an anechoic chamber. They devised a rotating stand they called a "siren spit" so they could easily turn the devices in different directions.

To reproduce the sirens' real-world environment, the team placed multi-siren units on utility poles at GTRI's Cobb County Research Facility. Using several man-lift machines, the investigators tested both old and new sirens at 18, 100, 200 and 400 feet, moving each microphone in a four-foot circle and taking the average decibel level as the final result.

"Just as at the power plant, we encountered a great deal of variability due to meteorological conditions such as wind and temperature gradients, as well as terrain effects," Gaeta said. "We tested in clear weather and in overcast weather, which produced different effects at long distances from the source – namely, we received some community complaints during tests with overcast weather."

The bottom line: The GTRI team found that the sirens functioned as expected and that the outdoor measurements showed remarkable consistency with the anechoic chamber measurements.

GTRI is working toward a new program with Entergy that will validate computer models that predict siren coverage around the Indian Point facility. Investigators are using computer models rather than live testing so residents don't have to endure the many hours of blaring sirens that would be required to test sound levels.

Cooling Higher-Power Radars with a Novel Material

A novel material being developed by GTRI could benefit defense electronics by improving heat dissipation.

GTRI engineers are developing a novel material for removing heat from high-power defense electronics. The exotic material, a composite of diamond and copper, is one of those under development as part of a "Thermal Ground Plane" concept that aims to remove heat almost 100 times more effectively than present thermal-conducting schemes.

That performance leap could be vital to cooling next-generation radars, said GTRI research engineer Jason Nadler.

"As we rely increasingly on very high-power devices," Nadler said, "the methods of getting heat away from them have to become more efficient."

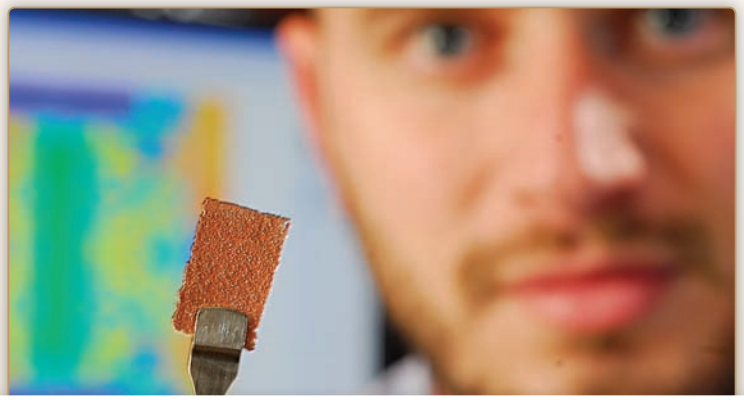
Georgia Tech is working with the Raytheon Co. on a project that seeks to raise thermal conductivity capabilities to 20,000 watts per meter Kelvin. The current thermal-conductivity champion in this application is a copper material with performance of approximately 200 to 300 watts per meter Kelvin. The three-phase, four-year project is sponsored by the Microsystems Technology Office of the Defense Advanced Research Projects Agency (DARPA).

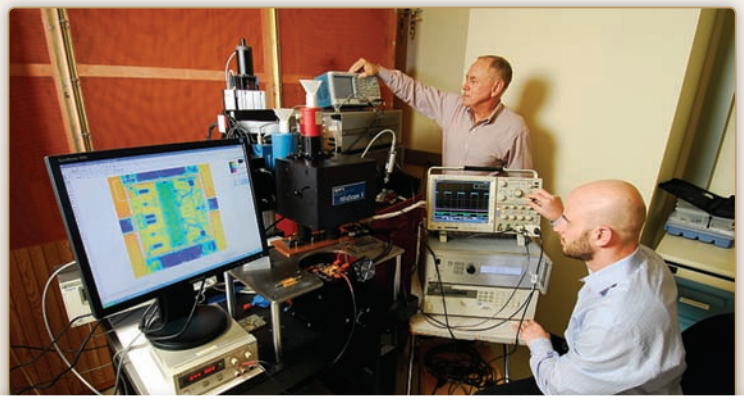
This improved cooling capability could benefit future high-power transmit-receive (T/R) module packages. Because of their higher power, those transmit-receive modules will also have higher cooling needs that may require a Thermal Ground Plane – a sort of heat-dissipating sandwich about one millimeter thick that would be part of the T/R module's packaging.

In this concept, a thin layer of Nadler's porous diamond-copper material, already highly conductive, would be improved with a kind of moving part – a liquid coolant able to carry heat away from the T/R module devices the same way sweat cools a body. A metal heat sink would help the liquid coolant dissipate the heat by condensing the vapor back to a fluid.

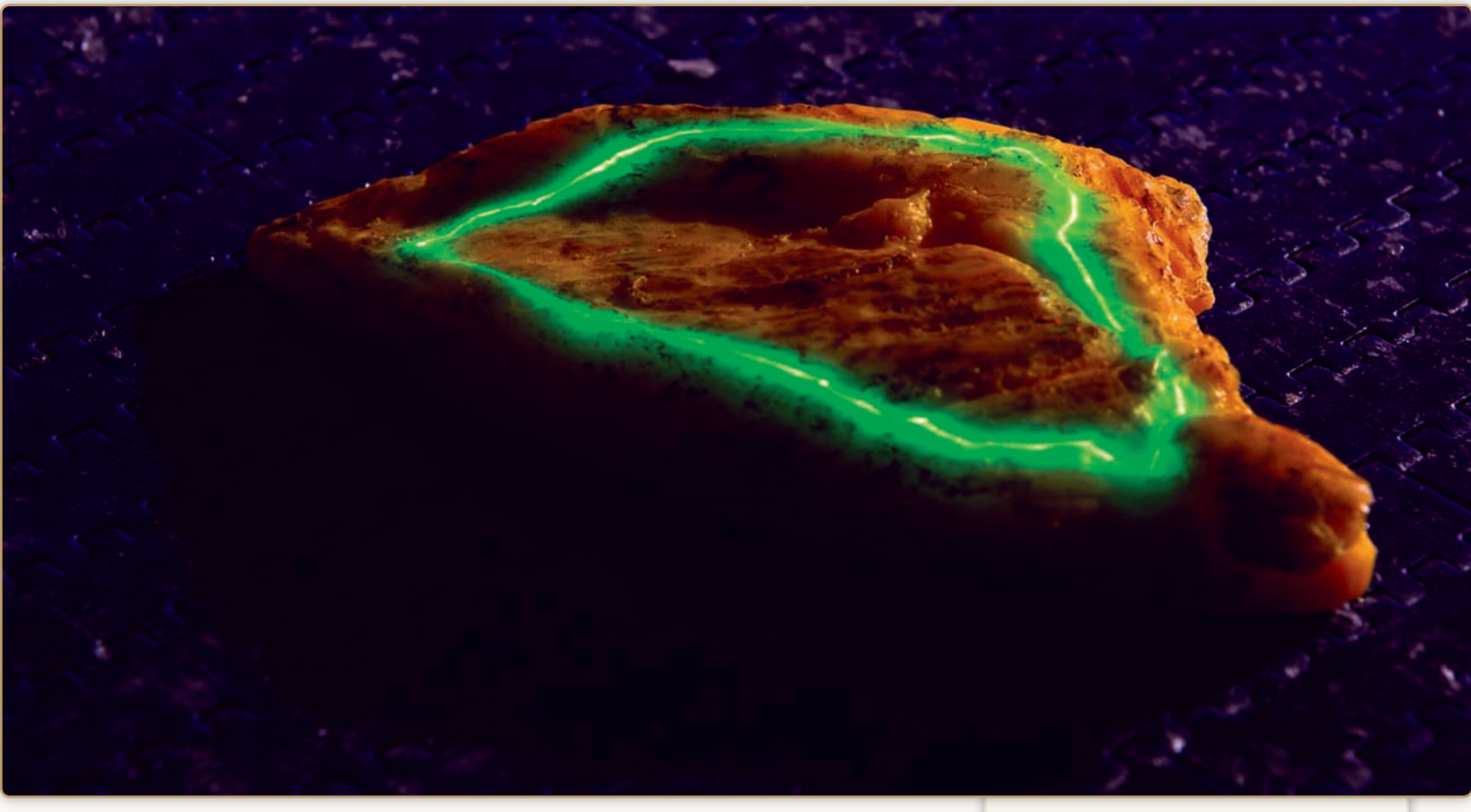
This systems approach takes advantage of both intrinsic conductivity and phase changes – the conversion of matter between liquid and vapor states. The diamond-copper material conducts heat to the liquid coolant and optimizes wicking and evaporation. Then the heat is rejected as the vapor is re-condensed to liquid on the side attached to the metal heat sink.

"The trick is to use evaporation, condensation and intrinsic thermal conductivity together, in series, in a continuous system." Nadler said. "The whole device is a closed loop."





Relaying Information to Food Processing Technicians



A laser projection system designed by GTRI shines a laser light symbol to alert technicians of a substandard chicken breast.

Alerting technicians in a food processing plant about a substandard item on the processing line could be much easier in the future with a laser projection system developed by GTRI researchers.

"We've developed a system that shines a laser light symbol onto the imperfect food product so that it can be removed from the conveyor belt, allowing the technicians to maintain their focus on the product stream without the need to look up at a monitor," said GTRI research scientist Simeon Harbert.

With funding from GTRI's Agricultural Technology Research Program, Harbert designed and fabricated the system, which consists of equipment installed in two plant-ready waterproof enclosures. One contains a laser, high-speed laser-pointing mirrors and a small camera, while the other houses the controller and power systems, and software to control the system.

The camera is used to track the substandard product while galvanometers move the mirrors that reflect the laser beam and essentially create line drawings of geometric shapes – such as circles, squares, triangles and stars – on top of the food product. Different symbols are used for the various types of defects.

"The inspectors will know immediately what's wrong with the food item based on the symbol and they can make adjustments to the forming, cooking or conveyor equipment as needed," explained Harbert.

The laser projection hardware is driven by software with several modules:

- A product list module that keeps information about multiple product items in the laser projection area,
- A tracking module that uses the built-in camera to track locations of product in the viewing area,
- A laser projection control module that translates the product list information into laser projection symbols on the product, and
- A computer server that receives product defect information relayed by an inspection system.

Harbert recently integrated the laser projection system with an inspection system designed by GTRI research scientist Colin Usher. The researchers are currently inspecting sausage patties for defects and relaying that information to the laser projection system. They plan to test the combined system in a food processing plant soon and envision that the laser projection system could be used for other applications.

"Because the system is modular and self-contained, it can be used whenever information that is not readily apparent to a worker viewing the product needs to be relayed," said Harbert.

Supporting Pilots with Electronic Warfare Automation

GTRI researchers are helping pilots of many U.S. combat jets fly with greater security and reduced in-flight workload. A recent upgrade now allows an entire suite of electronic warfare (EW) systems to work together automatically on the F-16 and the A-10, protecting the aircraft from enemy threats without requiring pilot involvement.

"The pilot's real job is to fly the plane and to accomplish his mission," said Mike Willis, a GTRI principal research engineer who participated in the project. "If he has to also monitor and manually control the state of all of the electronic warfare equipment, he's really got a lot to do."

Formerly, combat aircraft typically carried multiple EW systems that were separately monitored and operated by the pilot. The AN/ALQ-213(V), a central controller introduced in the 1990s, took information from the individual EW systems and processed it in a coordinated manner, but the systems still required manual operation.

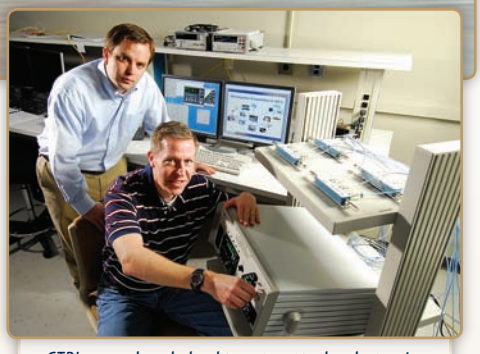
Today, a pilot can turn a dial on the ALQ-213 and the controller will automatically monitor and operate the aircraft's entire EW suite, including the ALR-69 radar warning receiver, the ALQ-131 or ALQ-184 active jamming pods and the AAR-47 missile warning system, which protects against shoulder-launched weapons.

And when the upgraded ALQ-213 detects an immediate threat, it can activate the ALE-47 chaff and flare dispenser without pilot involvement.

"The new automation is the result of algorithms developed over the past decade that we call the threat response processor, or TRP," Willis said. "This software runs in the ALQ-213 and fully automates the EW decisions that a pilot used to have to make on top of everything else that he had to do."

In an effort led by GTRI principal research engineer Bob Beasley, Willis worked with GTRI engineers Byron Coker, Lee Montaña and Luke Starnes on the TRP automation project. Coker, Montaña and Starnes have also been extensively involved in research aspects of the deployment of the automated ALQ-213 in U.S. aircraft. The project was sponsored by the Warner Robins Air Logistics Center at Robins Air Force Base.

Air Force testing indicates that the automated ALQ-213 is effectively protecting F-16 and A-10 pilots, Willis said. However, when conditions require it, a pilot can still operate the ALQ-213 manually.



GTRI researchers helped to automate the electronic warfare suite of U.S. combat aircraft.

Testing of ALQ-213 units running TRP has been enhanced by the addition of the Virtual Electronic Combat Training System (VECTS) into the ALQ-213. VECTS, developed by a GTRI team led by principal research scientist Linda Viney, can simulate realistic enemy threats on an aircraft's actual cockpit displays.

GTRI continues to develop further improvements for the ALQ-213. A project now under way under Montaña's direction seeks to upgrade the unit's processing capability by updating the hardware with a faster processor and more memory to allow for improved software functionality.

Maximizing Response to Natural Disasters with a Portable Imaging System

The white box attached to this helicopter contains a high-resolution imaging system developed by GTRI and known as the Mini ModPOD.

GTRI researchers have developed a low-cost, high-resolution imaging system that can be attached to a helicopter to create a complete and detailed picture of an area devastated by a hurricane or other natural disaster. The resulting visual information can be used to estimate the number of storm refugees and assess the need for health and humanitarian services.

"Without a real-time map, it's very hard to do population estimates and demographic estimates to figure out where people are, how they're moving, how they're spaced out and even how many people you have on the ground," said Benjamin Sklaver, a project officer from the Centers for Disease Control and Prevention (CDC) International Emergency and Refugee Health Branch. "This technology does not exist currently, so GTRI's imaging system is really an innovative project."

The imaging system – designed by senior research technologist David Price and senior research engineer Gary Gray – is called the "Mini ModPOD," which stands for "Miniature Modular Photographic Observation Device." It consists of an off-the-shelf Canon Digital Rebel XTi digital camera, a global positioning system receiver, a small circuit board that uploads mission parameters, and an inertial measurement unit that measures the aircraft's rate of acceleration and changes in rotational attributes.

The camera can be activated within a specified zone of interest, and the images collected from the system can be stitched together to create a complete picture of the affected area and the physical location of the scenes shown in each photograph can be determined with precision. The research team has tested the device on several flights, selecting areas with large populations of people likely to be outdoors.

"We could see tennis balls on the ground and people reading books at outdoor tables. This was sufficient detail to allow accurate counting of the number of people in an area," Price said in describing one of the test flights. "Individuals on the ground were easily distinguishable as people separate from other objects."

The imaging system was developed with funding from the CDC, and agency officials would like to begin using this device as soon as possible. It will also be available to other agencies, such as the American Red Cross, to count people in refugee camps to plan for health and humanitarian services.

The research described in this article was supported by cooperative agreement #U38 EH000363 from the CDC. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC.

Image, left, was collected by the Mini ModPOD system. The red outline shows the area enlarged in the middle image. Researchers, right, set up the device.

Developing Better Methods for Detecting Land Mines and Minefields

Land mines pose a threat in 68 countries around the world. Researchers are developing new techniques to detect minefields from the air, which could facilitate cleaning up the problem.

According to the United Nations, more than 100 million land mines are buried in 68 countries around the world. The task of finding these land mines is not easy – the deadly devices are small, varied in shape and material, and commonly found with harmless objects that can confuse current detection techniques.

GTRI is leading a team of researchers from the University of Hawaii, University of Florida, University of Maryland, Rochester Institute of Technology and Clark Atlanta University to develop better methods for detecting land mines from the air. This research is supported by the U.S. Army Research Office under a Multidisciplinary University Research Initiative (MURI) grant.

"Land mine detection is never 100 percent, but if the military has an indication of where land mines are, they can direct their troops around them and send explosive ordinance disposal experts to that area," explained J. Michael Cathcart, project director and GTRI principal research scientist.

Cathcart and GTRI research scientist Alan Thomas are developing computer algorithms to detect minefields from aerial hyperspectral long-wave infrared images.

"The key we're looking for in these images is disturbed ground," said Cathcart. "Once someone digs up the ground and puts something into it, the character of the soil below is changed and this disturbance shows up in thermal images."

To test their algorithms, images at 70 different wavelengths between eight and 12 micrometers were collected using an airborne hyperspectral imager developed by the University of Hawaii. Mines were buried at a depth of four inches, inserted flush with the surface or laid on the surface of the ground.

Once the researchers removed all vegetation anomalies from the images and found a signal they believed to be a land mine, their computer program searched in specific patterns to locate other land mines nearby. Since land mines are typically laid out in geometric patterns, the researchers developed methods for determining the orientation and size of the land mine pattern within the image.

"Our program has been successful in locating buried minefields in the images," noted Cathcart. "We are still examining which spectral signatures show land mine signals best because they vary based on moisture content and the size of the particles on the surface of the ground."

In the future, the research team plans to examine ways to identify nonlinear minefield patterns – such as skewed grids, radially symmetric patterns and mines laid in relation to naturally occurring contours like roads – using physics-based detection algorithms.

This research was sponsored by the U.S. Army Research Office and U.S. Army Research Laboratory and was accomplished under Cooperative Agreement Number DAAD19-02-2-0012. The views and conclusions contained in this document are those of the researchers and should not be interpreted as representing the official policies, either expressed or implied, of the Army Research Office, Army Research Laboratory or the U.S. Government.

Evaluating Instruments for Detecting Invisible Aviation Hazards

While radar and other existing systems typically warn aircraft pilots of potential weather hazards during flight, they do not detect all possible atmospheric dangers.

"Some hazards can be the most dangerous because pilots' eyes and radar cannot see them," said Gary Gimmestad, a GTRI principal research scientist.

GTRI is leading a team of researchers from five universities and research organizations to investigate the feasibility of using an instrument called a forward-looking interferometer to detect several of these invisible hazards during takeoff, cruise and landing. Forward-looking interferometers can detect the presence of the environmental hazards by identifying each hazard's distinct infrared spectral signature.

With funding from NASA, the researchers are conducting studies to determine the sensitivity of the system for detecting clear-air turbulence, wake vortices, volcanic ash, dry wind shear and ice on runways, and improving sight in low visibility situations. A major concern for air navigation is clear-air turbulence because it cannot be seen and is therefore difficult for pilots to avoid.

During a ground test in Boulder, Colo., the research team evaluated the feasibility of the infrared interferometer to detect clear-air turbulence at a useful distance from the sensor by measuring temperature fluctuations. They also evaluated the turbulence detection and hazard prediction algorithms they developed.

"The measured results corresponded well to the model predictions, and this result was interpreted as a successful detection of mountain waves with interferometric radiometry, which has never before been accomplished," added Leanne West, project director and GTRI senior research scientist.

A second field test was conducted in Madison, Wis., to investigate the ability of the instrument to detect wake vortices. This tornado-like turbulence forms behind an aircraft as it passes through the air and can cause problems for any subsequent aircraft following the same flight path.

The preliminary results from the field tests show that the imaging system is a promising technology to detect many, if not all, of the external hazards. Further research will be completed to determine if the hazards can be detected in-flight with sufficient time-to-alarm for safe maneuvering to avoid the hazards.

The material in this article is based upon work supported by NASA under award number NNX07AN17A. Any opinions, findings, conclusions or recommendations expressed in this article are those of the researchers and do not necessarily reflect the views of NASA.

Researchers are studying the ability of instruments like these to detect invisible aviation hazards.

Providing Information to People with Disabilities

GTRI researchers are making it easier for people with disabilities to receive important information at public venues such as hospitals, museums, airports and sports stadiums.

They are building on the wearable captioning system they developed previously, which sent the same information to all recipients. Now the researchers, led by GTRI senior research scientist Leanne West, are sending personalized information to individual recipients based on who they are or where they are located.

At the Shepherd Center, an Atlanta-based catastrophic care hospital, the technology is helping automate check-in for patients. The research team is designing a system that detects when a patient enters the facility, queries the hospital patient database and sends a text message to the patient directing the individual to the correct waiting room.

To ensure that the technology does not interfere with medical devices, the researchers are working with Ralph Herkert, director of GTRI's Medical Device Test Center. They plan to install a test system at the Shepherd Center in early 2009.

GTRI researchers are also installing technology at the Mystic Aquarium in Connecticut that will provide location-specific video captions to the deaf and hard of hearing. Wireless tracking will determine where the visitor is located so that the system can send the appropriate video caption to a visitor's iPod or cell phone.

"If you walk through an exhibit with videos and just see the video but can't hear what the people in the video or the narrator are saying, you aren't getting the whole experience," said West.

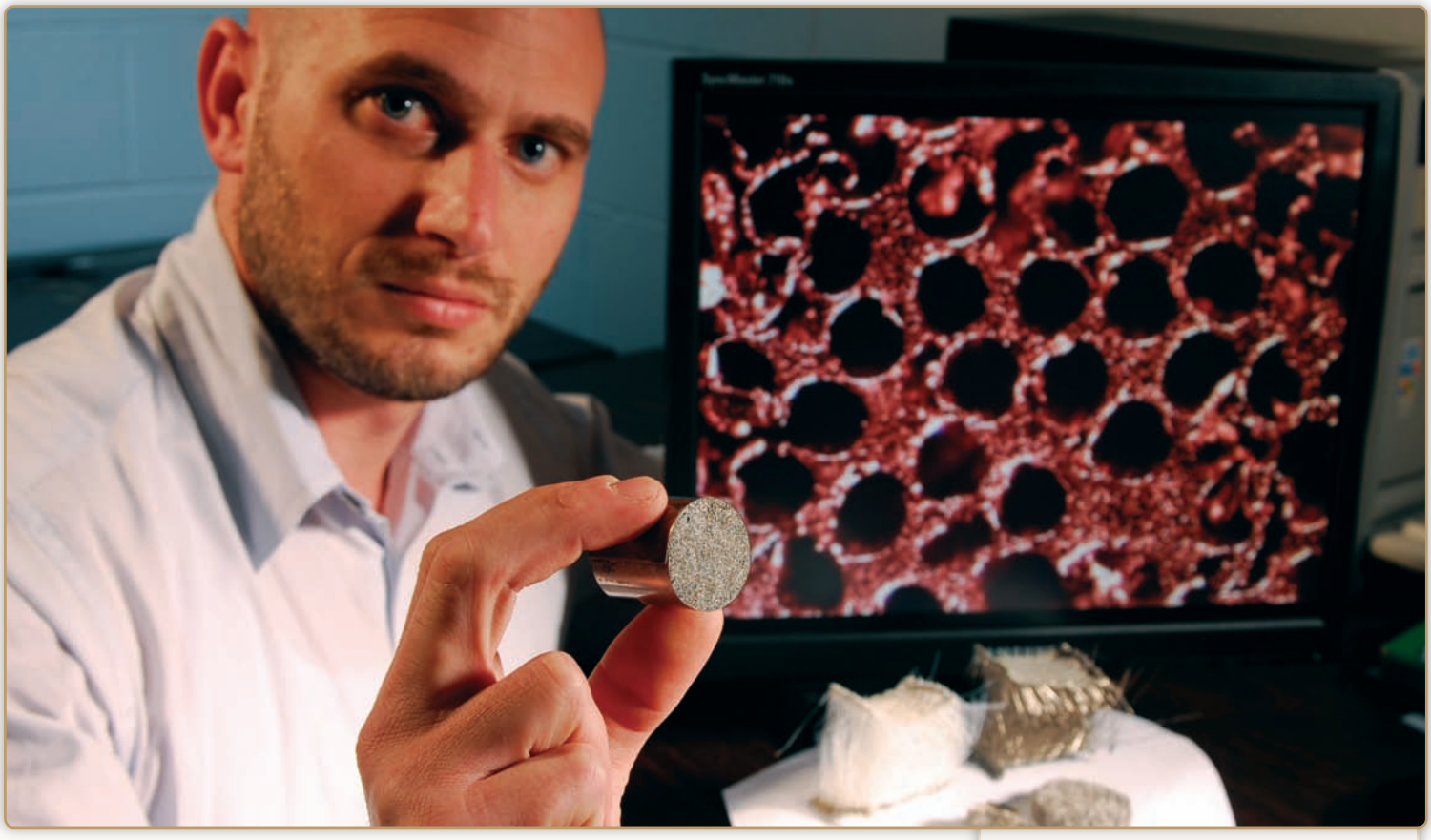
GTRI researchers are also working with Delta Air Lines' Disability Working Group, and the National Center for Accessible Transportation, to develop a system that will send airport announcements, both general and flight-specific, as cell phone text messages to passengers who are deaf and hard of hearing.

In sports stadiums, the captioning system can provide the deaf and hard of hearing with stadium and play-by-play announcements and even song lyrics in real-time through their iPods or cell phones. The system can also provide captioning on ribbon boards located at the 50-yard lines on both sides of the stadium.

Research scientists Ethan Adler, Jeffrey Jo, Brian Parise and Jeffrey Wilson are also working on these projects. This research is supported by the Wireless Rehabilitation Engineering Research Center, which is funded by the National Institute on Disability and Rehabilitation Research, a unit of the U.S. Department of Education.

Researchers are developing a system that will send information such as airport announcements and sports scores to the cellular phones of persons who are deaf and hard of hearing.

Reducing Aircraft Noise with Micro Honeycomb Materials



Unique honeycomb materials being developed by GTRI can decrease noise using acoustic-wave dissipation.

Noise from commercial and military jet aircraft causes environmental problems for communities near airports, obliging airplanes to follow often complex noise-abatement procedures on takeoff and landing.

To address this situation, GTRI engineers are turning to innovative materials that make possible a new approach to the physics of noise reduction. They have found that honeycomb-like structures composed of many tiny tubes or channels can reduce sound more effectively than conventional methods.

"This approach dissipates acoustic waves by essentially wearing them out," said Jason Nadler, a GTRI research engineer. "It's a phenomenological shift, fundamentally different from traditional techniques that absorb sound using a more frequency-dependent resonance."

The two-year project is sponsored by EADS North America, the U.S. operating entity of EADS.

Most sound-deadening materials – such as foams or other cellular materials comprising many small cavities – exploit the fact that acoustic waves resonate through the air on various frequencies, Nadler explained. Just as air blowing into a bottle produces resonance at a particular tone, an acoustic wave hitting a cellular surface will resonate in certain-size cavities, thereby dissipating its energy. An automobile muffler, for example, uses a resonance-dependent technique to reduce exhaust noise.

The drawback with these traditional noise-reduction approaches is that they only work with some frequencies – those that can find cavities or other structures in which to resonate.

Nadler's research involves broadband acoustic absorption, a method of reducing sound that doesn't depend on frequencies or resonance. In this approach, tiny parallel tubes in porous media such as metal or ceramics create a honeycomb-like structure that traps sound regardless of frequency. Instead of resonating, sound waves plunge into the channels and dissipate through a process called viscous shear.

"It's the equivalent of propelling a little metal sphere down a rubber hose when the sphere is just a hair bigger than the rubber hose," Nadler explained. "Eventually the friction and the compressive stresses of contact with the tube would stop the sphere."

This technique, Nadler adds, is derived from classical mechanical principles governing how porous media interact with gases – such as the air through which sound waves move. Noise abatement using micro-scale honeycomb structures represents a new application of these principles.

In researching this approach, Nadler constructed an early prototype from off-the-shelf capillary tubes, which readily formed a low-density, honeycomb-like structure. Further research showed that the ideal material for broadband acoustic absorption would require micron-scale-diameter tubes and a much lower structural density.

Creating such low-density structures presents an interesting challenge, Nadler said. It requires a material that is light, strong enough to enable the walls between the tubes to be very thin, and yet robust enough to function reliably amid the high-temperature, aggressive environments inside aircraft engines.

Nadler has developed what could be the world's first superalloy micro honeycomb using a nickel-based superalloy. At around 30 percent density, the material is very light – a clear advantage for airborne applications – and also very strong and heat resistant.

Making UAVs Stealthier through Aeroacoustics Research

New research into aeroacoustics could make it easier for UAVS to gather reconnaissance data.

Ranging in size from the huge Global Hawk aircraft to hand-held machines, unmanned aerial vehicles (UAVs) are growing ever more vital to the U.S. armed forces in roles that include surveillance and reconnaissance.

In some instances, UAVs must fly close to their targets to gather data effectively and may evade enemy detection with sophisticated techniques like radar stealth, infrared stealth and special camouflage. GTRI aeroacoustics researchers are investigating an additional kind of stealth that could also be vital to these UAVs – technology that can evade enemy ears.

"With missions changing, and many vehicles flying at lower altitudes, the acoustic signature of a tactical UAV has become more and more critical," said senior research engineer Rick Gaeta.

Gaeta, an aeroacoustics specialist, is working with a GTRI research team to find ways to reduce a UAV's sound footprint. In research sponsored by GTRI's independent research program and the Department of Defense, the researchers have characterized UAV noise using both ground-based methods and vehicle flight tests.

The GTRI investigators' central task has involved characterizing the acoustic signature of a UAV's propulsion system, which typically consists of a piston engine and a propeller, but could also be electrically or fuel-cell powered. The researchers needed to know how much noise comes from the engine's exhaust as opposed to the spinning propeller.

One complex testing issue involved measuring acoustic performance and engine performance simultaneously – a key to making the right design tradeoffs. Researchers utilized two special acoustic chambers at GTRI's Cobb County Research Facility: the Anechoic Flight Simulation Facility and the Static Jet Anechoic Facility.

The flight simulation facility is a unique chamber with a 29-inch air duct that can simulate forward-flight velocities while also allowing precise acoustic measurements. To take full advantage of the flight-simulation chamber, Gaeta's team built a special dynamometer capable of driving a small UAV engine and a propeller. By placing the engine-dynamometer unit in the simulation chamber, the researchers could test both engine and acoustic performance, thereby providing data for UAV design tradeoffs.

"We have been able to develop a unique testing capability as a result of this project," Gaeta explained. "It allows us to separate acoustics issues into their component parts, and that in turn helps us to attack those problems."

The researchers must find a systems solution because UAVs are highly integrated. For example, a concept that rendered a UAV acoustically undetectable might also affect the UAV's infrared and radar signatures. And changes in those signatures could interfere with the aircraft's ability to evade hostile infrared detection equipment. Working from its findings, the research team has identified specific acoustic measures that could lead to truly covert, low-altitude UAVs.

"Our next step is to put our findings into a prototype for testing," Gaeta said. "We believe that we have the means to make tactical UAVs much quieter."

Helping Astronomers Collect More Accurate Images of the Sky

The brightness of stars and galaxies seen through a telescope can vary from day to day because of atmospheric variability. The sky's inconsistency is due to the presence of atmospheric aerosols – seen as haze – that scatter and absorb some of the light from the stars and distort what is seen through the telescope.

To address this problem, GTRI researchers developed a device to accurately assess the impact of this variability on light traveling through the Earth's atmosphere. The tool was developed in collaboration with the University of New Mexico and supported by the National Science Foundation.

"Until now, astronomers never had an independent way to measure the transparency of the atmosphere," said Gary Gimmestad, a GTRI principal research scientist. "They always had to compare their measurements to the standard star catalog, which was itself created without having this atmospheric information."

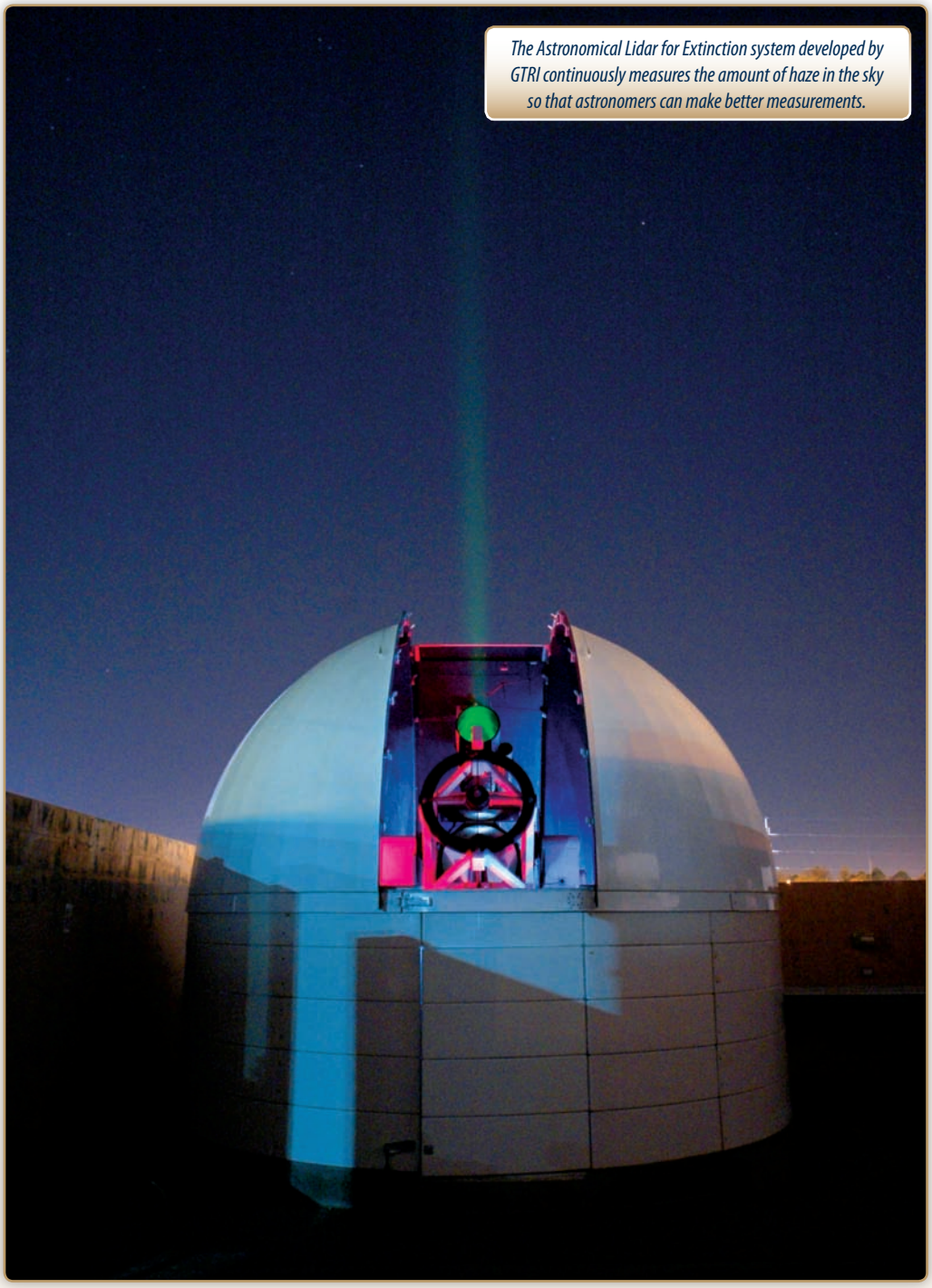
The device developed by Gimmestad, senior research scientist David Roberts and senior research engineer John Stewart is called the Astronomical Lidar for Extinction (ALE). It scans the entire sky to probe for cirrus clouds and accurately measures the transmission of the atmosphere by taking measurements at multiple angles above the horizon.

"ALE provides real-time continuous and unattended monitoring, and measurements of the amount of atmospheric extinction – the absorption or scattering of light – as well as its cause, whether low-lying aerosols, dust or smoke," said Roberts.

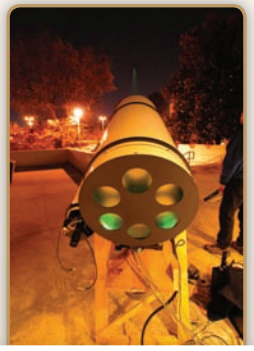
When activated, the device transmits rapid pulses of eye-safe green laser light into the atmosphere, which are scattered back to two detectors. Measuring the scatter provides a distance-resolved profile of gas, particles and clouds that allows astronomers to calculate precisely the amount of light lost in traversing the atmosphere at a specific moment.

Using that information, the researchers calculate extinction coefficients, which are applied to the telescope's photometric data to correct the photometric images for the light loss in the atmosphere. The result is more accurate stellar photometry along with a precision profile of the structure of Earth's atmosphere.

The Astronomical Lidar for Extinction system is currently in use at the University of New Mexico campus observatory.



The Astronomical Lidar for Extinction system developed by GTRI continuously measures the amount of haze in the sky so that astronomers can make better measurements.



Modeling Transportation Infrastructure for the Port of Savannah

The Port of Savannah has experienced dramatic growth – 15 percent per year on average since 2002. This trend could necessitate expanding the roads and railroads leading to and from the seaport on Georgia's coast. To help guide these infrastructure decisions, GTRI researchers have developed models that show how freight moves on roads and railroads from the Port of Savannah to the rest of the nation.

"We are developing models that can answer questions about the local and downstream impacts of growth in port operations, port infrastructure or local infrastructure on the larger system," said Michael Rodgers, a GTRI principal research scientist.

Rodgers is working on this project with GTRI principal research engineer James McMichael, civil and environmental engineering assistant professor Michael Hunter, and graduate students Christopher Puglisi, Thomas Wall, Franklin Gbologah and Lakshmi Peesapati.

With data from the Logistics Innovation Center and funding from GTRI's independent research and development program, the models aim to help transportation organizations plan for corresponding growth in rail and highway systems. The models can reveal bottlenecks in the transportation network and determine where money would best be spent to improve the transportation infrastructure.

"Transportation organizations and governments have very limited resources, so our models will tell them what types of improvements give the most bang for the buck," added Rodgers. "It is so much quicker, easier and less expensive to change the infrastructure in a computer than it is to change the infrastructure on the ground."

With the models, the researchers can examine many "what-if" scenarios – such as the impact of new technologies, a high-speed rail line, truck-only lanes or the development of a regional freight corridor. In addition to studying proposals from a technical perspective, the researchers are also investigating the environmental impact of the scenarios based on energy consumption and vehicle emissions.

Currently, the model includes the Port of Savannah, railways from Miami to Washington, D.C., and west to Chicago, and highways from Savannah west to Atlanta. The researchers plan to expand the model to include ports in Charleston, S.C.; Norfolk, Va., and Jacksonville, Fla., and highways throughout the southeastern United States.

"Our models may help determine improvements that will allow freight moving through the Port of Savannah to reach its final destination faster, which could make the port even more attractive to shippers and improve the economy in Georgia," explained McMichael.

Researchers have developed models to show how freight moves on roads and railroads from the Port of Savannah.

The Carbon Motors E7 will be the first vehicle designed and built specifically for law enforcement patrol use.

Designing the World's First "Purpose-Built" Law Enforcement Vehicle

GTRI's expertise in human-factors issues helped an Atlanta-based startup company create the world's first vehicle designed specifically to meet the patrol needs of law enforcement agencies.

The Carbon Motors E7, slated for production in 2012, features an ergonomic "cockpit" designed to help drivers safely and efficiently interact with the vehicle under high-stress conditions. It features a large touch screen with voice-activated controls and a backup manual system.

"Like the pilots of jet fighters, law enforcement officers must interact extensively with their vehicles, receive and evaluate large amounts of information and make split-second decisions in high-pressure environments," noted Dennis Folds, GTRI's chief scientist and head of its Human Systems Integration Division. "The assistance we provided Carbon Motors helped the company develop a new-generation vehicle cockpit designed to help these officers do their jobs safely and efficiently."

The human-machine interface was one of the most critical aspects of the new vehicle, which was designed to meet more than 100 requirements recommended by law enforcement agencies across the nation, said William Santana Li, chairman and CEO of Carbon Motors Corp.

"We wanted to reach out beyond the usual automotive design groups," he said. "Getting insight from GTRI's military and aerospace background was helpful. There are a lot of similarities between what a fighter pilot has to do and what a police officer has to do while chasing a suspect at 100 miles per hour at 3 a.m."

Powered by a 300-horsepower clean-diesel engine that can accelerate it to 60 miles per hour in 6.5 seconds, the E7 will be offered with more than 70 options – including an automatic license plate reader, radiation detector and night-vision capabilities. The vehicle is designed to meet a 250,000-mile durability specification, and it will use up to 40 percent less fuel than current law enforcement vehicles – which are modified passenger cars.

"Today, the 425,000 law enforcement vehicles that patrol our country in most cases do not meet federal safety standards because they have been modified in a haphazard way for police work," Li added. "We will give these agencies a safer product with world-class performance and a reduction in total lifecycle cost."

The company recently showed a running prototype vehicle to law enforcement agencies around the country. According to Li, the response has been "overwhelming," and he expects the company's first year of production to be sold out before manufacturing begins.

GTRI assisted Carbon Motors with human-factors issues in the design of the company's new vehicle.

Milestones of Service

One measure of the success of GTRI's service to its customers is the longevity of relationships. GTRI recently celebrated key anniversaries of its research presence at Redstone Arsenal in Huntsville, Ala., its assistance to Georgia industry with occupational health and safety consulting, and its service to the food processing industry through the Agricultural Technology Research Program (ATRP).

Georgia Tech Research Institute

Problem. Solved.

Huntsville Research Laboratory Celebrates 30 Years of Service

GTRI's Huntsville Research Laboratory (HRL) recently celebrated a major anniversary. HRL became official 30 years ago – in February 1978 – when Georgia Tech research faculty began establishing an on-site presence at Redstone Arsenal in Huntsville, Ala., to support U.S. Army missile technology.

Since its modest beginning as "Huntsville Operations," the laboratory's impact has grown, branching out into a variety of defense fields. Moreover, its location on a key Army installation has helped enhance communication between GTRI and its military stakeholders.

"Our Huntsville Research Laboratory is an extremely important part of our overall strategy," said Stephen E. Cross, GTRI's director and a Georgia Institute of Technology vice president. "It has delivered outstanding technical assistance and real innovation on a consistent basis, which is reflected in the positive feedback we get from our stakeholders."

HRL's milestone was celebrated at a Feb. 26, 2008, Huntsville event that drew some 200 attendees, including Georgia Tech officials, researchers and alumni, and representatives from the Army and other U.S. military branches.

At the event, former Georgia Tech President Wayne Clough presented a GTRI award to William McCorkle, executive director of the Army Aviation and Missile Research, Development, and Engineering Center (AMRDEC) and an early proponent of a permanent GTRI presence in Huntsville. McCorkle is the first recipient of the GTRI Award for Exceptional Innovation and Leadership.

Today, HRL focuses on software engineering and systems engineering for a variety of U.S. Department of Defense programs, said Barry Bullard, the lab's director. HRL's biggest customers include the Army Aviation and Missile Research, Development, and Engineering Center (AMRDEC); the Army Aviation and Missile Command (AMCOM); the Security Assistance Management Directorate (SAMD); the Army Space and Missile Defense Command (SMDC); the Army Program Executive Office Missile and Space; the Army Program Executive Office Aviation; and the Department of Defense Missile Defense Agency.

These agencies keep HRL busy with research that covers air defense systems modeling, software testing and evaluation, war-game simulations and analysis, and weapons system modernization. The lab's current work includes hardware/software-in-the-loop (H/SWIL) systems engineering and analysis of the Patriot air and missile defense system, as well as ongoing modernization of the Hawk air defense system, a legacy system still used by numerous U.S. allies.

"Our expansion into the aviation mission area and several forms of systems engineering is keeping our staff of 33 very busy," said Bullard, HRL director since 1998.

AMRDEC Executive Director McCorkle has been at Redstone Arsenal for nearly 50 years. He recently expressed his long-term satisfaction with the Huntsville lab's work.

"It's certainly true that we're happy with GTRI's work," McCorkle said. "Over the years, it's been a very good thing for both us and for Georgia Tech. You have done important technical work on the Hawk system and assisted us in the air-defense arena, and that's been a good arrangement."

AMRDEC Executive Director William McCorkle, center, receives recognition from former Georgia Tech President Wayne Clough, left, and GTRI Director Stephen Cross.

GTRI's presence in Huntsville helps support key systems such as the AH-64 Apache helicopter and the Patriot Air and Missile Defense System.

Health and Safety Program Celebrates Three Decades of Assistance

GTRI's Occupational Health and Safety Program, which helps businesses comply with requirements of the federal Occupational Safety and Health Administration (OSHA), marked its 30th year of service recently.

"Reaching our 30th year of OSHA-related activity is a significant milestone," said Dennis Folds, GTRI's chief scientist and head of its Human Systems Integration Division, which incorporates the health and safety program. "It underscores both the state of Georgia's need for OSHA programs and GTRI's success in handling those programs."

Science and engineering consultants from GTRI currently provide two separate services to Georgia business and industry:

- The OSHA 21D Consultation Program provides free, on-site safety and health consulting to smaller Georgia companies – those with fewer than 500 employees.
- The OSHA Training Institute Education Center offers safety and health courses in more than 20 topics, principally through Georgia Tech Distance Learning and Professional Education.

"It can be challenging for smaller businesses to deal with OSHA and state requirements, and we're here to help them comply fully and stay safe," said Daniel Ortiz, a GTRI principal research scientist who directs the OSHA programs at Georgia Tech.

The 30-year history of the GTRI health and safety effort reaches back to the days of the Engineering Experiment Station, the original name for the organization that became GTRI. The health and safety group was initially managed by the late Bill Howard; Ortiz has been director since 2000.

The health and safety program has a staff of 17, composed mainly of research scientists and engineers. This team performs fact-finding and idea development in Georgia and other states to help businesses improve the workplace.

Students can take courses that cover a wide variety of subjects and industries, from hazardous materials and machine safety to the prevention of falls and respiratory problems. By taking multiple courses, participants can earn OSHA certificates.

The consultation program is funded mainly by OSHA, which provides 90 percent of the program's $1.38 million annual budget; the state of Georgia provides the balance. GTRI consultants provide on-site services to more than 200 Georgia manufacturing companies and other businesses each year and make some 450 visits to job sites.

The education program, under which Georgia Tech teaches OSHA courses to the private sector, is paid for by the students themselves or by their employers. Occupational Health and Safety Program instructors – typically the same GTRI consultants who work with industry -- train about 2,500 people yearly in these courses.

In addition, the program provides training interventions for companies around the state. Nearly 100 such interventions were done last year, and those efforts reached more than 14,000 persons. The program saved Georgia companies almost $2.5 million in OSHA penalties, the cost of injuries and lost work days prevented through GTRI assistance.

One important new strategic area for the health and safety program involves teaching courses to high school students who are preparing for the workplace by taking vocational courses. Those graduating from the course receive the OSHA 10-hour card, a qualification that can give them an advantage with employers.

Working with OSHA, GTRI has helped Georgia companies maintain a safe workplace for 30 years.

Agricultural Technology Research Program Celebrates 35 Years

Thirty-five years ago, through the efforts of the Georgia Poultry Federation, what would become the Agricultural Technology Research Program (ATRP) was started at Georgia Tech.

Its beginnings came when the Federation sought to reduce the noise in poultry processing plants. To get advice about possible solutions, the Federation utilized an assistance service implemented by the University System of Georgia and the request was referred to Georgia Tech. That call led to what has become a long and productive partnership.

"From the program's inception, ATRP scientists have been committed to the challenge of developing the technological tools and resources the poultry industry needs now and into the future," said ATRP director Craig Wyvill.

In the early days, much of ATRP's research focused on energy efficiency and alternative fuel resources, including wood, solar energy and methane. In the 1980s, the work shifted to systems development projects dealing primarily with environmental compliance and information capture. In the 1990s, the research transitioned to strategic technology systems development in areas such as machine vision, robotics, advanced sensors, food safety, worker safety, waste treatment and minimization, and intelligent systems.

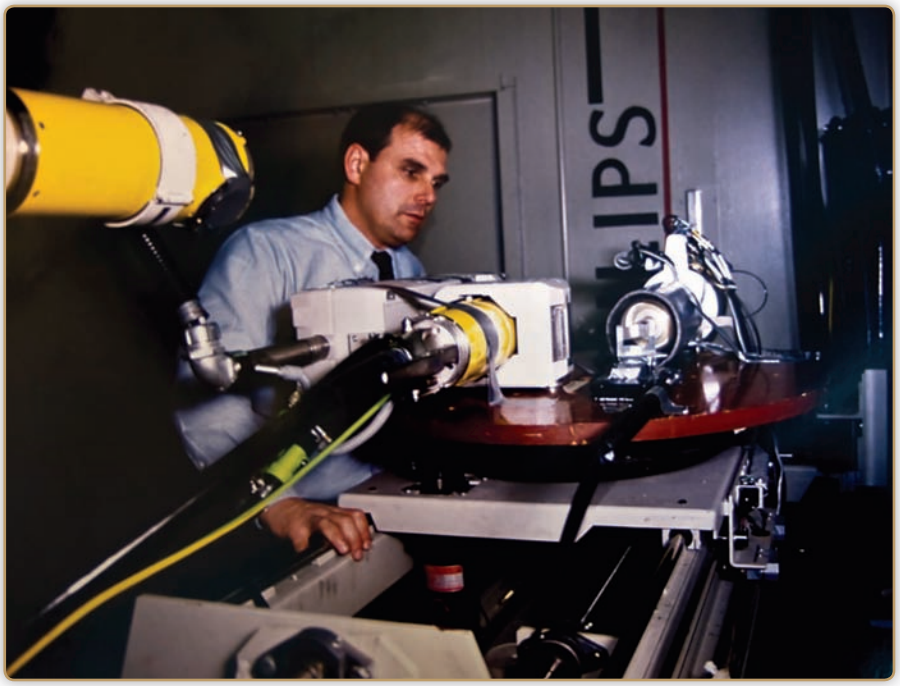
As the program grew, so did its parent organization, GTRI's Food Processing Technology Division. The division's success led the state of Georgia and numerous corporate donors, many in the poultry industry, to financially support construction of a $7.3 million, 36,000-square-foot Food Processing Technology Building that was dedicated on May 19, 2005.

Over the years, ATRP researchers have developed numerous innovations that have improved processing operations. Their pioneering high-speed, natural-product imaging techniques led to the development of several high-speed imaging systems and influenced many commercial products.

A new generation of robot systems was purpose-built by ATRP to meet the industry's special needs, including one that is among the first to withstand the rigors of a high-pressure, caustic wash-down without special protective covers and seals.

In the information technology area, researchers designed innovative wearable computers and augmented reality systems, and introduced a first-of-its-kind computer-based motion and exertion tracking system for ergonomically analyzing cutting tasks as they are being performed on a production line. The ATRP environmental and food safety researchers designed a novel ultraviolet disinfection system and a unique chemical biosensor, and made numerous advances in waste separation, water recycling and biofuel production.

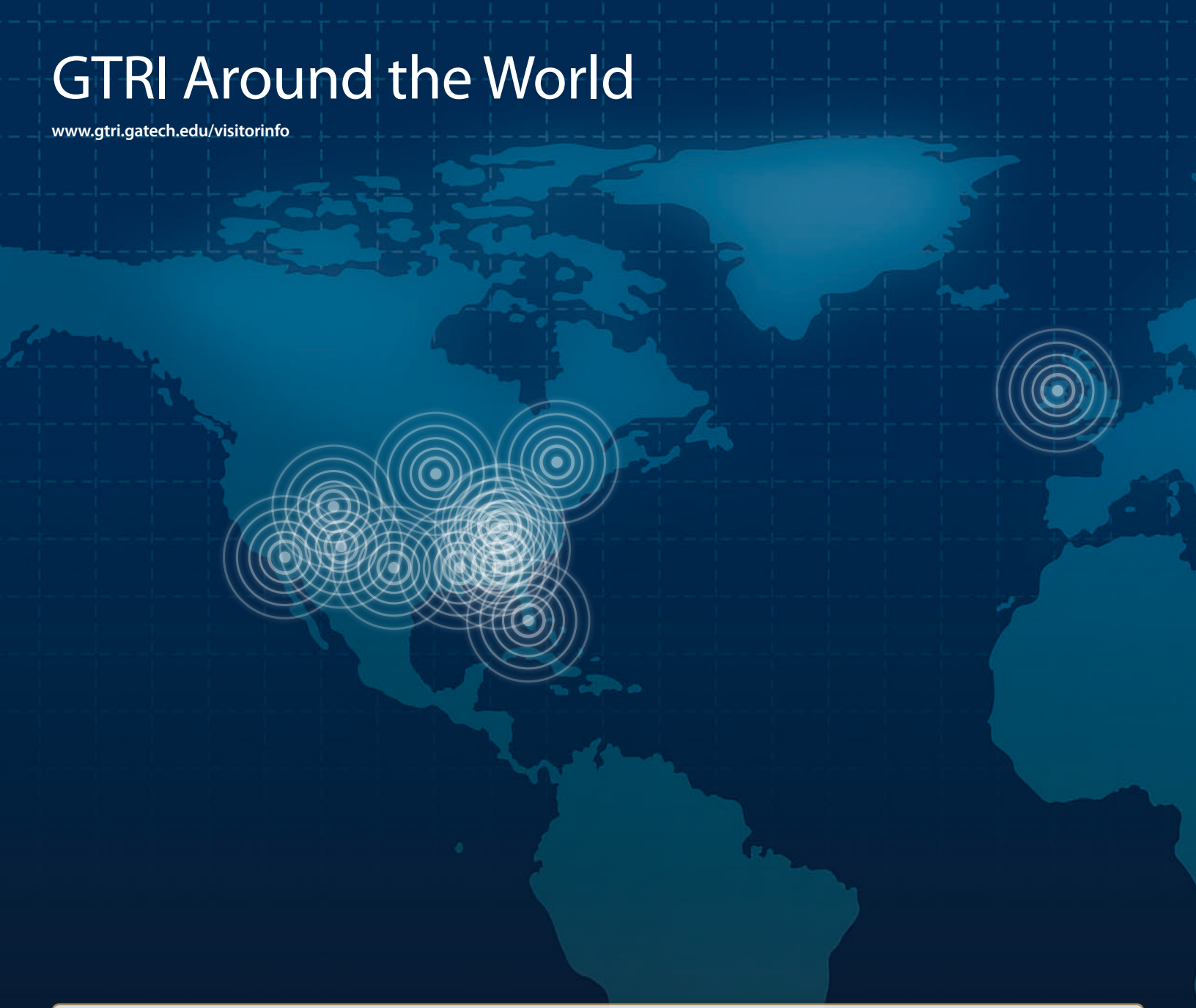
As ATRP celebrates its first 35 years, one thing is clear – the program has and will continue to be a leader in technological innovation.



For more than 35 years, the Agricultural Technology Research Program has developed new technological tools and resources for the poultry industry.

GTRI Around the World

www.gtri.gatech.edu/visitorinfo



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The Georgia Tech Research Institute (GTRI) is headquartered on the Georgia Tech campus in midtown Atlanta. The toughest engineering problems of our customers are solved in seven dynamic research laboratories found on and off the main campus (details on page 42), in 12 field offices located around the nation and in our international location in Athlone, Ireland.

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Research Laboratories of GTRI

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Aerospace, Transportation and Advanced Systems Laboratory (ATAS)

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*James M. McMichael III, Ph.D., served as ATAS Director until January 5, 2009.

The Aerospace, Transportation and Advanced Systems Laboratory (ATAS) develops advanced systems concepts and performs research on technologies related to aerospace, transportation, power and energy, threat systems, unmanned systems, food processing, energy and system sustainability. Research areas include aerodynamics, flow control, aeroacoustics, aeroelasticity, flight dynamics, smart projectiles, autonomous systems, unmanned aerial and ground vehicles, structural analysis, rotorcraft, fuel cell and battery technologies, biofuels, and complex energy and power system modeling. To enhance the productivity of Georgia's agribusiness and the competitiveness of Georgia's food processing industry, ATAS conducts significant research on food quality and safety, along with research aimed at minimizing environmental impacts by applying computer vision, robotics, plant ergonomics, advanced sensors, augmented reality and advanced mixing and separation technologies. The lab conducts air quality and transportation research related to monitoring and reducing the environmental impact of vehicular emissions and the development of intelligent highway maintenance systems. It also conducts modeling and simulation of complex dynamic systems. ATAS researchers conduct applied research and development of radar-related technologies in support of national defense preparedness that spans the spectrum from mechanical and electronic system design and fabrication to full-scale system integration, including embedded computing and control. ATAS has a national reputation for its expertise in threat systems, advanced transmitter technology and weapon systems interpretation.

Russell (Rusty) Roberts

Electronic Systems Laboratory (ELSYS)

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The Electronic Systems Laboratory (ELSYS) focuses on systems engineering solutions in the areas of electronic defense and human-systems integration. Current projects include research in modeling, simulation and analysis, countermeasures technique development, sensors performance analysis, systems integration, flight test support, missile warning, tactics development and evaluation, mission data development, technology insertion, command and control, network-centric warfare, data links and C4ISR. ELSYS researchers are nationally recognized for their contributions to national defense in countermeasures technique development, employing an end-to-end approach to countermeasures development. ELSYS also provides operational embedded software and has designed hardware modifications for several production systems that are fielded on military aircraft worldwide. ELSYS human-systems research includes support to key U.S. government agencies in the areas of aircraft and ship crew station design, traffic management and first-responder actions. These researchers also run the Georgia OSHA consultation program and provide training as an OSHA Training Institute Education Center for the U.S. Department of Labor. ELSYS performs commercial product evaluations to determine their accessibility to the widest user community. ELSYS sensor performance analysis includes intercept receiver analysis, advanced radar concepts analysis, electronic countermeasures analysis, specialized instrumentation and real-time simulation. Over the past decade, ELSYS has supported flight tests covering all aspects of airborne testing.

Terry Tibbitts

Electro-Optical Systems Laboratory (EOSL)

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The Electro-Optical Systems Laboratory (EOSL) conducts research in remote sensing, modeling and analysis, integrated sensing systems, optical device technology, LIDAR, electro-optical (EO) system characterization, microelectronics, nanotechnology, solid state lighting, performance support systems, and sensor data collection and analysis. Technology areas of pre-eminence include LIDAR systems for atmospheric characterization, multispectral imaging, EO countermeasures technology and analysis, wide band-gap semiconductors, and advanced packaging for transmit/receive modules used in active phased-array radars. The lab performs applied research in the growth and application of carbon nanotubes, multifunctional materials, radio frequency identification (RFID) and optical tagging, and chem-bio sensors. EOSL has specially configured research centers: Sensors and Sensing Systems Information and Analysis Center (SENSIAC), serving the military sensor community as a repository of information; Landmarc Research Center, formed to provide solutions for mobile, wireless and performance-based tasks; Environmental Radiation Center, performing radiation monitoring; Environmental Safety and Occupational Health Center (ESOH), providing compliance oversight for environmental emergency response, and occupational safety and health issues; the Medical Device Testing Laboratory; Phosphor Technology Center of Excellence; and the Center for Optimization of Simulated Multiple Objective Systems (COSMOS).

Gisele Bennett

Huntsville Research Laboratory (HRL)

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Located in Huntsville, Ala., the Huntsville Research Laboratory (HRL) conducts world-class applied research for several government agencies located at the U.S. Army Redstone Arsenal and the local Huntsville area, including the U.S. Army Aviation and Missile Research Development and Engineering Center, U.S. Army Program Executive Office Missile and Space, U.S. Army Program Executive Office Aviation, U.S. Army Aviation and Missile Command, and the Department of Defense Missile Defense Agency. The laboratory's multidisciplinary systems and software research skills include battlefield command and control modeling, simulation and analysis, analysis and modeling of complete air and missile defense systems, and software development and engineering of rotary-wing aviation mission planning systems. The lab also conducts applied research in testing and evaluation of air and missile defense and aviation systems including hardware-in-the-loop, live field testing and system-of-systems interoperability. Other significant research areas include war gaming and large-scale force-on-force simulations, missile guidance and control, and safety-critical tactical software development.

Barry Bullard

Research Laboratories of GTRI

www.gtri.gatech.edu/labs

Information Technology and Telecommunications Laboratory (ITTL)

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*Randolph Case served as ITTL Director until December 31, 2008.

The Information Technology and Telecommunications Laboratory (ITTL) conducts a broad range of research in areas of computer science and information technology and communications and networking, and develops commercial products from university research. ITTL conducts research that solves complex problems involving information processing, storage, representation and exchange, Internet and database technologies and applications, information security and assurance, and privacy, knowledge management, data visualization, mapping/geographical information, distributed simulation and enterprise information systems. Researchers work in broadband telecommunications, wireless access systems, network security, multimedia information systems, tactical communications, communications surveillance and disruption, information warfare and assurance, communications networks and network management, technology assessment, application integration and software radio systems. In commercial product realization, multidisciplinary research teams drawn from across GTRI and Georgia Tech apply product research and development toward product commercialization. Other researchers provide policy monitoring and assessment to facilitate responsiveness to changes in the technological research environment. ITTL also provides C4I capabilities and functional requirements analysis to various service components across the Department of Defense in northern and eastern Virginia.

James (Jim) McGarrah

Sensors and Electromagnetic Applications Laboratory (SEAL)

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Sensors and Electromagnetic Applications Laboratory (SEAL) researchers primarily investigate and develop radio frequency (RF) sensor systems, with particular emphasis on radar systems, MASINT, ELINT, COMINT, electromagnetic environmental effects, radar system performance modeling and simulations, signal and array processing, and antenna technology. SEAL also supports the development of acoustic sensor systems and multispectral fusion methodologies. Radar programs focus on the development, analysis and performance evaluation of radar systems, reflectivity and propagation measurement characterization, electronic attack and protection techniques, avionics integration, target identification, tracking and sensor fusion, vulnerability analysis, signal processing techniques, space-time adaptive processing, ground and airborne moving target indication, synthetic aperture radar, and system sustainment tool development. Antenna-related research programs characterize antenna properties, develop phased-array antenna concepts and develop various kinds of reflector-type and lens antennas. In the field of electromagnetic environmental effects, SEAL researchers analyze, measure and control the electromagnetic interactions among elements of an electronic system and between the system and its environment. Additional research areas include sensor development for ballistic missile defense, physical security, meteorology, space-based surveillance and detection, transportation applications, and engineering data analysis and modeling for sustainment of complex electronic systems. SEAL also provides customer-tailored short courses in electronic defense.

William Melvin

Signature Technology Laboratory (STL)

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The Signature Technology Laboratory's (STL) main focus is the development of technologies for the management and control of multispectral signatures of objects under observation by sophisticated sensor systems. STL conducts research and development over a broad range of topics, including electromagnetic materials and structures, electromagnetic apertures and scattering, optical and infrared physics and phenomenology, secure information systems, signal processing and geo-location of emitters, passive ranging, advanced waveforms for electronic attack and protection, terahertz sources, magnetic erasure of high-density data storage media and the integration of quantum information systems. The laboratory maintains world-class numerical modeling and measurement capabilities to cover electromagnetic phenomena from quasi-static to ultraviolet wavelengths. Extensive facilities are devoted to optical measurements specializing in laser and white-light scatterometry, electromagnetic materials characterization, radar cross-section measurements, antenna characterization and computational electromagnetics. These are applied to the design, fabrication and testing of thin, broadband antennas with tailored performance and controlled impedance surfaces for management and control of signature characteristics from the systems level to components. Numerical modeling has recently been extended to nano- and micro-magnetics phenomena. The lab's secure information systems work is nationally recognized for the design, development and deployment of enterprise information systems requiring state-of-the-art database, platform and Internet security.

Lon Pringle

Georgia Tech Ireland

www.georgiatech.ie

Georgia Tech Ireland location.

While working at Georgia Tech Ireland, students Brian Srikanchana and Jonathan Murphy meet Brian Cowan, prime minister of Ireland.

GTRI Director Stephen Cross (left) and Prof. Ciarán Ó Catháin, president of Athlone Institute of Technology, sign the agreement.

In 2008, its second year of operation, Georgia Tech Ireland (GTI) moved from a limited space on the lower floor of an office building to a dedicated 13,000-square-foot structure with two functioning test beds, conference rooms and an area dedicated to advanced collaboration technology.

The move significantly improved GTI's capabilities and demonstrated its commitment to its mission as a center of excellence in translational research.

In January 2009, GTI and Athlone Institute of Technology (AIT) signed an agreement to explore collaborative research and educational opportunities. The memorandum of understanding (MOU) creates the possibility of joint research programs, joint/dual undergraduate and postgraduate programs, as well as collaboration on the ongoing development of a Midlands Gateway Research and Innovation Centre.

Over the course of the past year, AIT and GTI have collaborated on various initiatives in nanomedicine, biomedicine/biosciences and food processing technologies. The MOU looks to the continuation of this development.

Irish government support for GTI remained strong, as Prime Minister Brian Cowen personally assured GTRI director Steve Cross in an hour-long meeting. IDA, Ireland's development agency, renewed its financial support after GTI passed a first-year review with flying colors.

Academic links also deepened. Trinity University, Dublin, appointed GTI Director Krishan Ahuja a visiting professor, while MOUs with other institutions were signed.

GTI's unique test beds – one for Internet Protocol Television (IPTV) and one for Radio Frequency Identification (RFID) – set up experimental conditions that allow GTI's partners in academic and corporate research to test new technologies, models and computational tools under rigorous conditions before they are implemented on a broad scale.

RFID refers to any system in which an electronic device known as a "tag" is attached to an item. The tag uses radio frequency or magnetic field variations to enable the item to be tracked by another device, called a reader.

One of the many demonstrations developed as part of GTI's RFID test bed simulates an airport baggage carousel. It has successfully proved that it can track baggage, identify items removed from the carousel and show on a monitor where a parcel is located in a defined space.

GTI has already won a contract from a company in Northern Ireland to study the use of RFID tags to manage energy usage in buildings. GTI also intends to focus on RFID uses in manufacturing and health care.

GTI's second operating test bed is for IPTV (see page 18), a technology that enables the delivery of interactive digital television services by broadband to registered subscribers in a closed network.

Uses of IPTV in e-learning are being evaluated in conjunction with a major publishing company as a potential partner. In addition, GTI received a feasibility grant to design IPTV systems for university use from Enterprise Ireland, an organization that promotes the growth of small- and medium-sized Irish companies.

GTI's new building in Athlone also includes ample space to host workshops. The first, attended by major multinational companies with operations in Ireland, was held in October 2008. A collaborative visualization environment (CoVE) with sophisticated technology to facilitate discussions and presentations on complex issues is under development. Space has been set aside for use by exchange students and visiting faculty from the U.S. campus of Georgia Tech.

GTRI Interdisciplinary Research Centers

www.gtri.gatech.edu/centers

GTRI's scientists and engineers team with one another, as well as with other Georgia Tech researchers and clients. This interdisciplinary approach allows GTRI to apply and transfer knowledge from multiple disciplines to deliver the best possible solution for each problem.

Military Sensing Information Analysis Center (SENSIAC)

SENSIAC is an information analysis center that serves the U.S. Department of Defense. It provides information on all sensing-based technologies related to defense activities, including infrared, laser, radar, acoustic, electro-optical, aroma, chemical and many other sensors. In addition to being a clearinghouse for information, SENSIAC conducts research projects and educational programs. The center draws upon experts across Georgia Tech, as well as seven other universities that serve as SENSIAC team members.

Center for Innovative Fuel Cell and Battery Technologies (FC/BT)

The Center for Innovative Fuel Cell and Battery Technologies takes a multidisciplinary approach to fuel cell and battery research. It serves as a catalyst for development of revolutionary advances through world-class research integrated across disciplines and spanning from fundamental discovery to application-specific prototypes.

Center for International Development and Cooperation (CIDC)

CIDC develops low-cost radar and phased-array concepts through joint international research activities. It also provides an international forum for technical interchange and seeks dual-use applications for foreign radar technologies.

Commercial Product Realization Office (CPRO)

CPRO helps companies from across technical and business domains get new technology products to market. The office provides customers with a broad range of services, including advice on technology selection, product design, prototyping, production preparation, product data documentation and testing assistance.

Environmental Safety and Occupational Health Center (ESOH)

ESOH oversees programs in compliance, sustainability, environmental emergency response, and occupational safety and health issues, and conducts research related to the environmental concerns in the state of Georgia. It bridges the communications gap between constantly updated government regulations and Georgia business, industry, community organizations and individuals. It is also linked to GTRI's Occupational Safety and Health consultation and education program.

Foundations for the Future (F3)

Supporting technology-enabled learning in Georgia's K-12 schools since 1996, F3 provides vendor-neutral technology advice, customized professional development experiences for educators and other services that directly affect learning in the classroom. Current efforts focus on the Georgia Cybersafety Initiative, using virtual worlds for interactive education and learning beyond the bandwidth barrier.

Georgia Tech Quantum Institute (GTQI)

The GTQI is a multidisciplinary effort to explore and develop quantum information science and technology. Its mission is to combine the strengths in engineering and technology at Georgia Tech with the emerging field of quantum information science to advance both fundamental science and emerging quantum information technologies.

Landmarc Research Center (Landmarc)

Landmarc is a multidisciplinary research and development center focused on mobile and wireless solutions. Landmarc has expanded from its original focus of logistics and maintenance to include broader technologies and capabilities such as mobile platform computing, wireless solutions, location-based services, software and hardware usability and universal design, Web site and database development and management, and information display technologies.

Office of Policy Analysis and Research (OPAR)

OPAR integrates public policy considerations into GTRI's technical research and facilitates GTRI's input into the science and technology policy debate. Specifically, OPAR supports the Georgia General Assembly with policy analysis and subject matter expertise in a wide range of science and technology issues.

Severe Storms Research Center (SSRC)

SSRC is a focal point for severe storm research in Georgia. It also provides Georgia with quick response information to weather and emergency agencies and helps educate Georgians about severe weather.

Test and Evaluation Research and Education Center (TEREC)

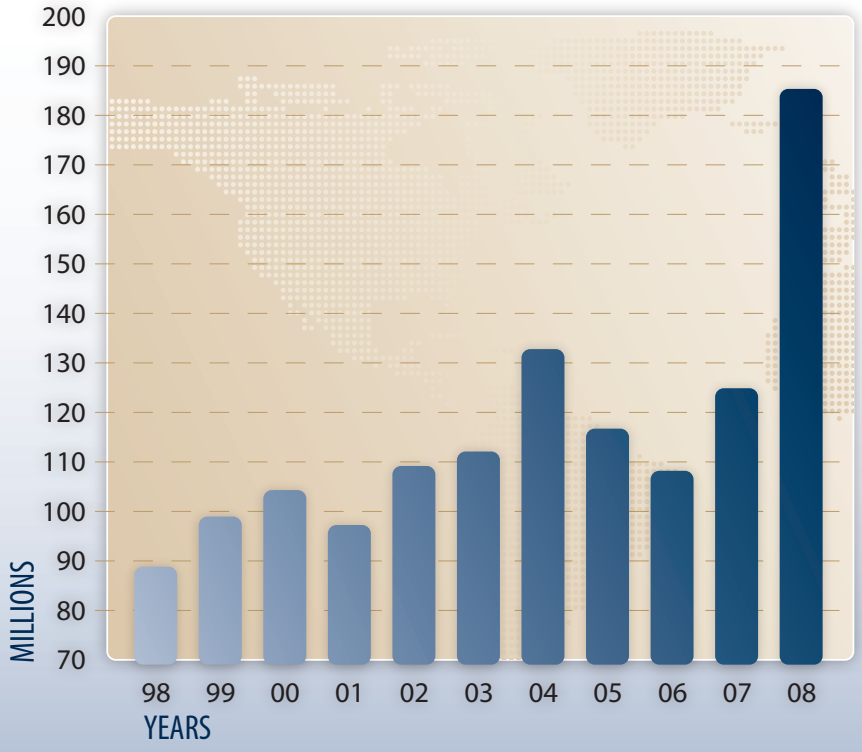
TEREC serves as a focal point for solving problems for the test and evaluation community. Leveraging the Georgia Tech academic environment and decades of test and evaluation experience, TEREC is defining the future of test and evaluation by advancing knowledge, education and training.

Georgia Tech Research Institute

Problem. Solved.

By the Numbers

GTRI Research Awards FY 1998 - 2008



Total Research Awards ..... $185.5 million

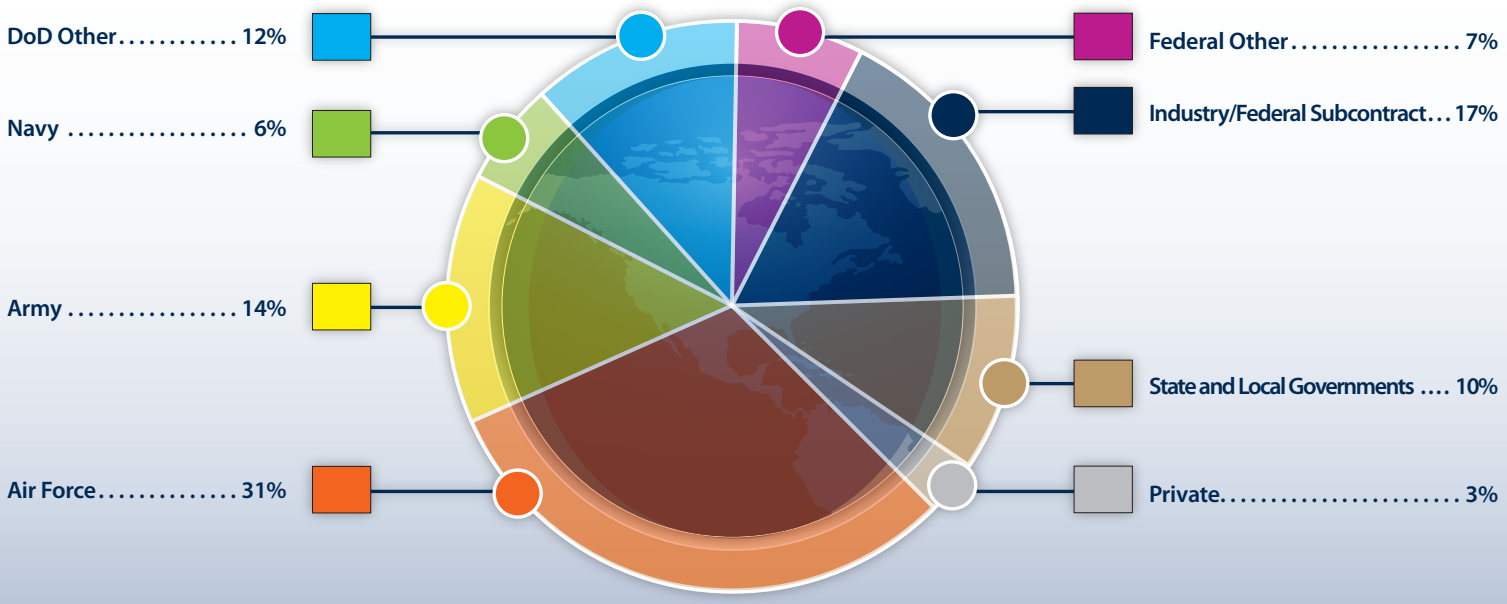
Total Research Volume ..... $147 million

Independent Research and Development Investment ..... $4.1 million

New Research Programs Awarded in FY08 367

Unique Research Sponsors as of June 2008 ..... More than 300

GTRI Customers – FY 08



GTRI and Georgia Tech: Real Support - Real Collaboration

GTRI is the largest research entity at the Georgia Institute of Technology (Georgia Tech) and has developed a reputation as one of the world's premier university-based applied research and development organizations. GTRI's existence is a necessary and enabling component of Georgia Tech's rise as a leading 21st century technological research university.

When customers work with GTRI, they get much more than the world-class expertise and experience of a leading research and development organization. They also open the door to the vast intellectual resources of one of America's leading research universities.

GTRI and Georgia Tech are world-class institutions that combine the best of both applied and basic research to solve the innovation equation on behalf of clients. This combination provides unsurpassed expertise, capabilities and know-how in solving some of the toughest problems facing government and industry.

SUPPORT:

GTRI is the largest employer of Georgia Tech students, hiring more than 200 each year. Georgia Tech has the largest voluntary cooperative education program of any university in the nation.

Forty-one GTRI researchers hold joint appointments with Georgia Tech's academic colleges.

GTRI scientists and engineers teach more than half of the courses offered by Georgia Tech's Distance Learning and Professional Education division (DLPE) including a new Professional Masters Degree in Applied Systems Engineering (see page 54) created in collaboration with the Georgia Tech College of Engineering.

GTRI researchers hold top-level university leadership positions as chairperson and secretary of the Georgia Tech Faculty Council.

GTRI has developed a new philanthropically funded applied studies program for undergraduate students.

COLLABORATION:

GTRI operates a number of multidisciplinary research centers (see page 47) that facilitate research collaboration with Georgia Tech's academic colleges. They include the new Georgia Tech Quantum Institute, as well as the Center for Collaborative Systems Engineering – which has attracted more than $4 million in new sponsored research programs for the College of Engineering and includes a new secure research facility funded by GTRI.

Advances in robotics, "serious gaming" and machine learning are being explored by GTRI in collaboration with the Georgia Tech College of Computing.

Georgia Tech's School of Applied Physiology is working with GTRI researchers to redesign and test a system for assessing injury risk due to motion and posture in food processing operations.

The Socially Intelligent Machines Lab in the Georgia Tech School of Interactive Computing has teamed with GTRI to develop a robot that uses facial expressions to enhance human-robot interaction.

Georgia Tech's School of Aerospace Engineering is working with GTRI on projects related to advanced wind turbine development.

Georgia Tech's Aerospace Systems Design Laboratory is working with GTRI to establish a collaborative visualization environment (CoVE) for the U.S. Army Aviation and Missile Research Development and Engineering Center in Huntsville, Ala.

Georgia Tech's Schools of Mechanical Engineering, Aerospace Engineering and Electrical and Computer Engineering are collaborating with GTRI – as well as three other universities – to research and develop adaptive flow control strategies for application to small unmanned aerial vehicles (UAVs).

Cutting-edge wireless captioning devices are being developed for the hearing impaired by GTRI researchers in collaboration with professors from Georgia Tech's Mobility Rehabilitation and Engineering Research Center.

Enhancing homeland security by designing high-tech shipping containers equipped with the latest sensors to identify security breaches is the focus of work being done through a collaboration of Georgia Tech's School of Electrical and Computer Engineering and GTRI.

The People of GTRI

At GTRI it's our people who make the difference. We work hard to hire the best and brightest researchers and administrators. We also provide unparalleled support to our current employees, helping develop their skills and advance their careers.

www.gtri.gatech.edu/people-and-culture

Hire the Best, Equip the Best, Retain the Best

GTRI's scientists and engineers are among the best problem-solvers in the business. Our team-based approach to supporting customers allows our more than 1,200 dedicated employees the flexibility to be creative and truly innovative.

We provide a challenging work environment, impressive benefits and great opportunities to build and advance careers.

It's no wonder GTRI has built a stellar team that pairs the vast technical experience of veteran researchers with the best and brightest young minds of today. All of them take pride in the fact that they are helping to make the world a better place.

Hire the Best

While many organizations are downsizing due to the struggling U.S. economy, GTRI is experiencing a period of rapid growth. We are adding highly-technical positions at a record pace.

Total number of employees..... 1,243
(as of 10/31/08)

New Hires..... 106
(11/1/07 – 10/31/08)

Equip the Best

Providing a supportive environment where employees can continue to learn and grow is part of what makes GTRI such a desirable place for world-class scientists and engineers to call home.

GTRI offers a comprehensive professional development program, which supports personal growth and professional learning. It offers free in-house courses and support for attending external training and professional conferences.

GTRI provides a tuition reimbursement program, available to eligible research and administrative employees. Unlike many programs in industry, GTRI waives all course fees rather than reimbursing the employee after a course is taken.

Retain the Best

At GTRI, it is not uncommon to see veteran scientists and engineers with 20 or more years of experience working alongside junior researchers.

Employee satisfaction surveys indicate a majority of our people truly like the work they are doing and they are very pleased to be working for GTRI.

This satisfaction is reflected in a five-year low in the turnover rate for research faculty and a four-year low in the turnover rate for administrative and classified staff.

Leanne West

Joined GTRI: As a student–1993

Full-Time–1997

Degrees: Completed a master's degree in applied physics in 1994 and a second master's degree in engineering science in 1997.

Current Role: Senior research scientist and director of the Landmarc Research Center. Her work focuses on remote sensing of the atmosphere and wireless technologies for people with disabilities.

"GTRI is very understanding about both taking and teaching classes. Flex time works well and many of the classes are on-site, which is an added convenience."

Terence Haran

Joined GTRI: As a student–1999

Full-Time–2002

Degree: Completed a master's degree in physics in 2008.

Current Role: Branch head in intelligent sensors and imaging sensors with a research focus on electro-optical and infrared sensor system design, test and analysis.

"If you pursue a Georgia Tech degree, our location on campus makes it much easier to do here. Our culture really values advanced degrees, and the organization is very supportive of you during the process."

Greg Rohling

Joined GTRI: As a student–1986

Full-Time–1989

Departed: Left for a job in industry in 1992, but returned to GTRI in 1995.

Current Role: Senior research engineer with a research focus in applying multiple objective evolutionary algorithms to the optimization of missile warning receiver algorithms.

"I decided the smartest people I had worked with were at GTRI, and I wanted to work on something that I felt would have a long lifetime and real impact. While I was away, I developed a lot of new skills and I believe I came back more valuable than when I left."

The People of GTRI

Warren Lee

Joined GTRI: As a student–1998

Full-Time–2002

Degree: Completed a master's degree in aerospace engineering in 2007.

Current Role: Studying advanced aerodynamics, which includes the design, fabrication, instrumentation, installation and evaluation of wind tunnel models, including unmanned aerial vehicles.

"GTRI's flex time was invaluable in finding enough time to meet the requirements of earning the degree. If I were working in industry with rigid working hours, it would have been impossible to attend the classes to earn my degree."

Bryan Smith

Joined GTRI: Full-Time– 2003

Degree: Completed a master's degree in software engineering in 2006, and expects to complete a doctorate in computer science in 2010.

Current Role: Software development for the Aviation Mission Planning System at Redstone Arsenal in Huntsville, Ala.

"The atmosphere of higher education is wonderful and the well-defined paths for promotions (based largely on higher education) make it clear what the risks and rewards are."

Catherine Herrington

Joined GTRI: As a student–1999

Full-Time–2002

Degree: Completed master's degree in computer science in 2008.

Current Role: Research engineer developing software for an application that decodes and displays messages generated by military aircraft missile warning receivers and countermeasures systems.

"Many people you work with are also pursuing advanced degrees so everyone understands if you need to have a flexible schedule and leave during the day to attend a class. For new employees, GTRI's generous vacation schedule is much better that what industry offers, which helps you meet both your work and class obligations."

John Stewart

Joined GTRI: As a student–1989

Full-Time–1992

Departed: Left for industry job in 1999, but returned to GTRI in 2001.

Current Role: Senior research engineer focusing in electro-optics, developing vision systems to monitor and control industrial-scale cooking processes, improving GTRI's simulation environment for testing imaging trackers, testing missile warning receiver hardware and developing software for a turbulence profiling LIDAR.

"I wanted to see what it was like working for a private company. I realized the diversity of tasks associated with marketing and research keeps the work at GTRI exciting and provides me with a sense of empowerment I did not get from the management hierarchy at the [company]."

Jenny Houlroyd

Joined GTRI: Full-Time–2005

Departed: Left to work as a private contractor for a federal agency in June 2007, returning to GTRI in December 2007.

Current Role: Research scientist with a research focus in industrial hygiene, occupational health and safety.

"Working for a small contractor helped me to realize how incredible my job at Georgia Tech is from a benefits perspective, a career development perspective and a networking perspective. In particular, I found that the benefits and the flexible work schedule really have allowed me to be a successful working mother. This job allows me to put my career and family first, without having to choose."

Robert Kearney

Joined GTRI: Full-Time–1984

Departed: Left in 1988 to develop software for a commercial product, returning to GTRI in 1997.

Current Role: Senior research scientist working on software development for the Army's Aviation Mission Planning System (AMPS).

"I came back after encountering salary limits on technical positions at the other company. GTRI has allowed me to stay in a technical position while still giving me the opportunity to earn merit raises. GTRI also has more flexibility in recognizing and rewarding technical accomplishments. An employee is not forced into a certain career path in order to continue to have career growth."

Luke Starnes

Joined GTRI: As a student–2000

Full-Time–2002

Degree: Completed a master's degree in international affairs in 2008.

Current Role: Lead system engineer for the ALQ-213 program. The ALQ-213 is the electronic warfare integrator on the F-16C and the A-10.

"GTRI is a very fulfilling place to work. We have amazing customers, and it is wonderful to have such a great relationship with the military. Also, the relationship between GTRI and Georgia Tech at large offers a great opportunity to combine work and education."

Ben Brackett

Joined GTRI: Full-Time–2005

Degree: Completed master's degree in electrical and computer engineering in 2008.

Current Role: Research engineer and task lead working with electronic warfare embedded systems integration and container security embedded systems.

"The various tuition assistance plans that are available to Georgia Tech faculty take your mind off the financial aspect of attending graduate school by substantially decreasing or completely erasing the monetary burden. The encouragement and flexibility to pursue this degree while working full-time is unmatched at GTRI."

Sami Deen

Joined GTRI: Full-Time–2005

Degree: Completed master's degree in computer science in 2008.

Current Role: Research scientist for the Systems Integration Branch, which involves managing groups that develop Windows software for multiple programs.

"The important thing to remember is that the degree on its own is not enough to advance a career. It is essential that it is coupled with practical work experience. Having classes so close to the workplace gives you the opportunity to both work in your field of research and earn an advanced degree all in one convenient location."

Young and Fearless: The Next Generation of Scientists and Engineers

www.gtri.gatech.edu/careers/students

GTRI is the largest employer of bright Georgia Tech graduate and undergraduate students, who work alongside world-class researchers, making unique contributions to real projects for real clients.

In fact, many of our highly skilled researchers began their careers as student employees. Each year, as many as a quarter of GTRI's new full-time researchers emerge from the ranks of student researchers working throughout our organization. These are fearless young "go-getters" who see no limits, only possibilities.

Some of the technologies currently being worked on by GTRI students include photovoltaics, supercapacitors, piezoelectric fabrics, biological applications of carbon nanotubes, high-speed imaging, intelligent medical devices, circulation control and pneumatic powered-lift concepts, heavy vehicle aerodynamics, aeroacoustics, wind tunnel and flight test evaluation of unmanned aerial vehicles, and human target detection and identification using radar.

GTRI Student Employees – FY 2008:

Graduate Research Assistants and Graduate Students (in Georgia Tech's Cooperative Education program)	42
Undergraduate Cooperative Education Students	115
Student Assistants	79
Interns/Other	15
TOTAL	**251**

Providing better sanitation for developing countries.

Developing new techniques for rehabilitation.

Teaching students about workplace safety.

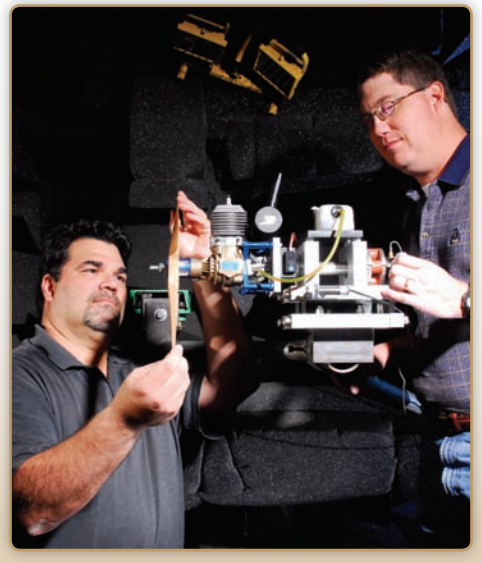
Making heavy trucks more fuel efficient.

Independent Research and Development at GTRI: New Frontiers, New Possibilities

GTRI's independent research and development program provides early-stage investments for researchers, encouraging them to explore new approaches to difficult challenges. Through this program, GTRI's best and brightest problem-solvers truly push the envelope and test new ideas, concepts and technologies. The results can be revolutionary and can accelerate entry into new research areas that may have high payoff for GTRI's current and future customers. During the 2008 fiscal year, GTRI invested more than $4.1 million in this program.

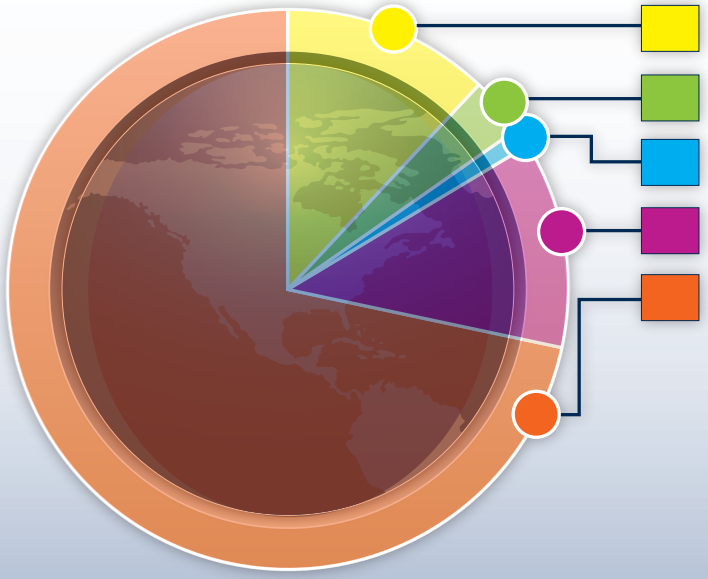
Among the projects supported by GTRI's independent research and development program are:

- Network-layer Convergence Issues for Applications Delivery over Wireless Broadband
- Acoustics of Unmanned Aerial Vehicles
- Logistics for the Port of Savannah
- Image-Based Control of Endoscope Tips
- Visualization and Scientific Analysis via Virtual Immersion (Visa VI)
- Quantum Dots
- Air Defense Componentized Fire Control
- Real-Time Work Zone Safety Warning for Public Safety Officials



Learn from the World's Best

Participants in GTRI-led Professional Education Courses in 2008



Defense Technology	2,360
Environmental Safety Training	670
Hazardous Materials (HAZWOPER)	208
OSHA Training & Safety Courses	2,328
OSHA Training Interventions	14,000
TOTAL Students	19,566

GTRI Professional Education

www.gtri.gatech.edu/prof-ed

GTRI scientists and engineers teach more than half of all professional education courses offered through Georgia Tech's Department of Distance Learning and Professional Education (DLPE). The courses, which include defense technology and occupational safety and health, can also be taught at customer locations and GTRI field offices nationwide.

GTRI's latest professional education offerings include a new interdisciplinary professional master's degree in applied systems engineering and a FalconView™ Defense Technology Certificate Program.

GTRI's modeling and simulation certificate, with courses taught by GTRI scientists and resident instructors, is geared toward engineers, scientists and technicians who have been out in the workforce for several years. The new certificate joins seven other defense technology-related certificates offered by GTRI and DLPE: systems engineering, test and evaluation, antenna engineering, electronic warfare technology, radar signal-processing and techniques, radar systems, and infrared and electro-optical technology.

Since 1995, GTRI's Test & Evaluation Research and Education Center (TEREC) has offered academic courses in test and evaluation, including courses in software testing, electronic warfare, directed infrared countermeasures and safety for explosives, among others.

Another area of defense technology professional education in which GTRI offers a certificate is systems engineering. The certificate program will soon be augmented by a graduate-level certificate and a professional master's degree program in applied systems engineering.

The remaining five GTRI defense technology certificates are sensor-related: antennas, electronic warfare, radar systems, and infrared and electro-optical technology. All are in high demand. In addition to course offerings in defense technology, GTRI offers continuing education courses in occupational safety and health standards. Such academic offerings are an outgrowth of the kind of research being done at GTRI.

Manufacturers in Georgia and the Southeast also can tap into GTRI's expertise via the Occupational Safety and Health Program. In addition to offering a certificate, GTRI offers a free, confidential, on-site consultation service for small companies in Georgia as well as safety and health courses in more than 20 topics throughout the Southeast. Additional resources such as Web-based training, slide presentations, Spanish language training materials and video guides are also available through the program.

New Professional Master's Degree in Applied Systems Engineering: Filling a Significant Educational Gap for Working Engineers

The Georgia Institute of Technology has received approval to launch a new professional master's degree program designed to help experienced, mid-career engineers expand their knowledge in the complex field of systems engineering. To be offered starting in Fall 2009, the new interdisciplinary degree is expected to be attractive to high-level engineers in corporations and government agencies that must design, develop and manage complex systems.

Based on a unique "blended learning" format that combines traditional teaching with group learning, distance education and face-to-face interactions, the new Professional Master's Degree in Applied Systems Engineering will fill a significant gap in the higher education offerings for working engineers.

"The new degree will meet the needs of experienced engineers already in the work force whose career plans include advancing to become systems engineers," explained Stephen Cross, director of GTRI, a Georgia Tech vice president and a professor in the School of Industrial and Systems Engineering. "Graduates will be proficient not only in the methods and practices of systems engineering, but they will also be aware of the upcoming research results that will shape the discipline in the future. This will make them both more capable engineers and more valuable to the agencies or companies where they work."

The unique format of the new program will appeal to practicing engineers because it fits how they work – and will build on the specific disciplines they have already mastered. It will include face-to-face instruction at work locations and substantial use of distance learning technologies to allow engineers to obtain the degree as part-time students. The program will include team-based projects on complex systems – and systems of systems – in which the students will apply what they learn.

To provide students an opportunity to apply modern systems engineering approaches, the program will utilize the Collaborative Visualization Environment (CoVE), a unique facility designed by researchers in the Aerospace Systems Design Lab (ASDL) in Georgia Tech's School of Aerospace Engineering.

Tom McDermott, GTRI deputy director for research, was instrumental in developing the new professional master's degree program and serves as a program instructor.

With an 18-by-10-foot multimedia wall, the CoVE allows users to simultaneously display and analyze more than 60 different variables that can be part of complex systems such as aircraft.

"Both the format and the professional master's degree program are new directions for Georgia Tech and part of a growing national trend toward meeting the needs of professional engineers in a broad range of disciplines," said Nelson Baker, vice provost in Georgia Tech's Office of Distance Learning and Professional Education. "This degree offers an opportunity for leading companies and other organizations to improve their competitiveness by enhancing the skills of their engineers in systems approaches."

The new degree will help engineers focus on the engineering of systems and development of a systems engineering mindset. The core information

includes the underlying principles of the systems engineering process, systems requirements engineering, analysis and design, integration, modeling and simulation, verification and validation, and systems engineering leadership and management.

As systems become more complex, engineers need a new set of skills to successfully design, develop and manage them, explained Don Giddens, dean of Georgia Tech's College of Engineering. Through the new degree program, Georgia Tech will help engineers with the skills they need to remain competitive.

"Engineering advances so rapidly that it is often difficult to remain on the cutting edge," said Giddens. "It is important for Georgia Tech to provide professional graduate engineering as part of our service to society. By partnering with the Georgia Tech Research Institute and Georgia Tech's Distance Learning and Professional Education, we are broadening our educational role for the state of Georgia and beyond."

An interdisciplinary field that focuses on the development and organization of complex systems, systems engineering is critical to large organizations, including corporations and government agencies – major customers of GTRI. The term was first used in the 1940s by researchers at Bell Laboratories to describe a new discipline that considers both the business and technical needs of customers.

"A systems engineer has to be able to apply proven methods and techniques to the design process and be able to bring in subject matter experts when necessary," explained Carlee Bishop, who helped develop the degree as a GTRI senior research engineer with a joint appointment in the School of Aerospace Engineering. "These systems engineers won't be experts on everything, but they will have a core understanding of all those different domains and will know how to apply the expertise in those disciplines to the design process."

The new degree program draws from Georgia Tech's academic programs campus-wide, and includes the Schools of Aerospace Engineering, Electrical and Computer Engineering, and Industrial and Systems Engineering. One of many specific elective tracks available through the new degree will be an aerospace systems design and engineering curriculum originally developed in Georgia Tech's School of Aerospace Engineering.

The Collaborative Visualization Environment will be used for portions of the new professional master's degree program.

"The aerospace systems design and engineering curriculum uses a project-driven, experimental applied approach, and is the largest program of its kind in the world, with approximately 300 graduate students," said Dan Schrage, a professor of aerospace engineering. "Inclusion of major parts of this curriculum in the new professional master's degree in systems engineering will make that program accessible to a much wider audience of professionals."

For more information, visit (www.pmse.gatech.edu).

GTRI Launches FalconView Certificate Program and User Courses

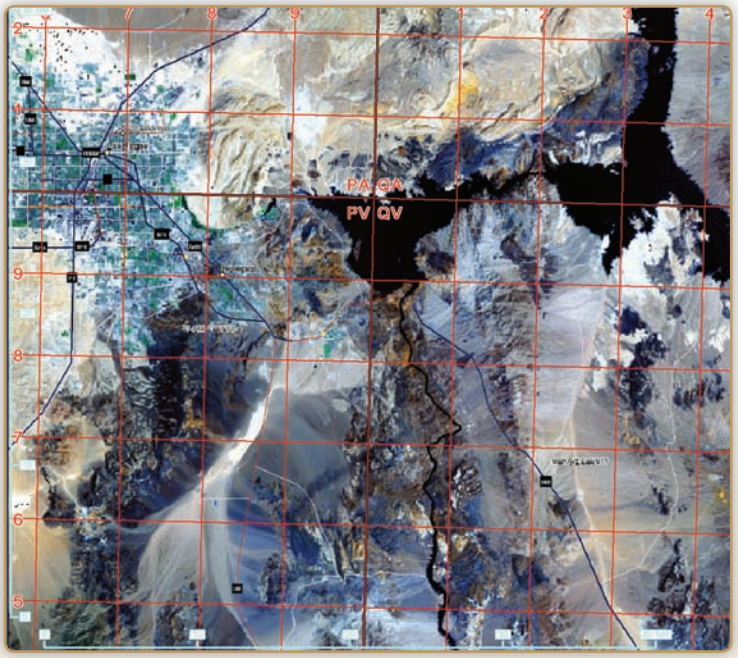
The Department of Defense has relied on the GTRI-developed FalconView™ software program since the 1990s to analyze and display geographical data crucial to mission planners. The program's ease of use, open architecture and interoperability all contribute to its popularity – there are more than 900 registered developers creating tools for use in FalconView and more than 45,000 users. These numbers will likely increase soon when portions of FalconView are released as open-source software.

To help developers master FalconView and improve the quality of new tools, GTRI created the FalconView Developer's Certificate Program in partnership with Georgia Tech's Distance Learning and Professional Education. The program includes six courses covering topics from developing basic overlays to tracking thousands of items in real-time to creating new background map types. Customized training is also available.

"Developers are shown the technical details of the FalconView programming interfaces and also the 'whys' and 'hows' of programming," said Daniel Longhurst, a GTRI senior research scientist and course instructor.

For users of the software, GTRI teaches three user courses: Introduction to FalconView-Basic Operations, FalconView Advanced Users, and FalconView Systems Administration. GTRI plans to make the user courses available online.

"It's definitely a benefit that the creators of the software are the ones helping developers and users learn how to better apply FalconView to their mission planning and situational analysis needs," said Chris Bailey, GTRI principal research engineer and FalconView project director.



For more information on upcoming developer and user courses, visit (www.defense.gatech.edu/falconview/).

Venture Philanthropy: Innovation and Nurturing the Next Generation of Problem-Solvers

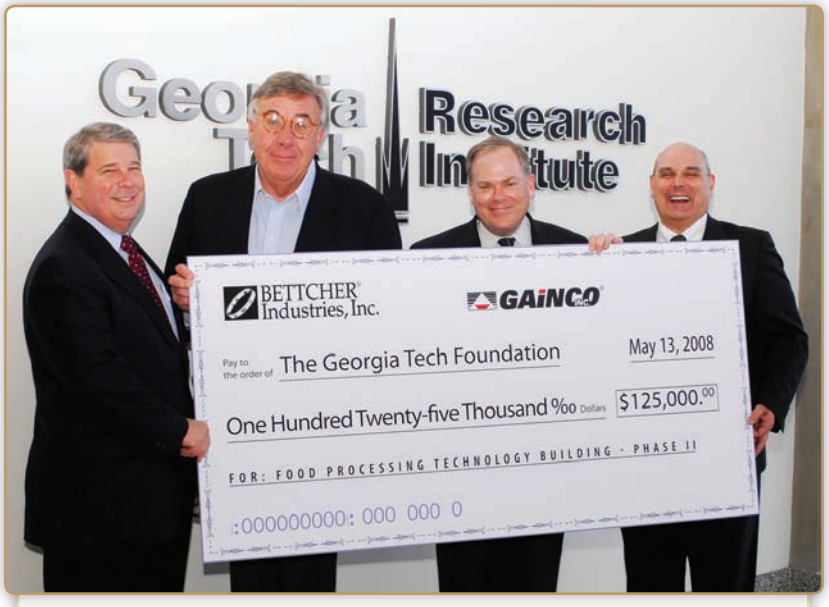
www.gtri.gatech.edu/venture-philanthropy

GTRI's primary focus is working for the government on defense technologies, using a systems engineering approach to tackle complex issues. While solving difficult problems for government sponsors, researchers often see alternative uses for technologies they are working on, and those alternatives provide opportunities to transfer knowledge into solutions for others.

Applying this systems engineering approach to complex community and societal issues is the focus of a new initiative that will bring GTRI's expertise to bear on a new set of problems. The goal will be to present researchers with complex social problems and ask them to look at the technologies they know well for solutions.

In 2008, GTRI established a Problem-Solver Fund to encourage social entrepreneurs, and others who want to invest in innovation, the opportunity to access dual-use technology that might otherwise never be directed to vulnerable populations. GTRI also created a New Frontier Fund to offer external parties the opportunity to fund creative and groundbreaking research ideas generated by scientists and engineers. As it celebrates 75 years of solving problems, GTRI wants to reconnect with its alumni, and to invite new and old friends to learn about ways to play a more active role in GTRI.

For corporations, foundations and individuals interested in investing in technologies and people – including students – GTRI has created a menu of options that is available online at (www.gtri.gatech.edu/venture-philanthropy). For more information, please contact Betsy Plattenburg at 404.407.7889 or (betsy.plattenburg@gtri.gatech.edu).



GTRI recently received a major donation to support phase II of the Food Processing Technology Building.

Martha Wallis Dawsey first learned about LIDAR as part of the GTRI outreach program at Agnes Scott College. The experience inspired her to pursue a Ph.D. in optical sciences.

GTRI Leadership

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Director, Georgia Tech Research Institute
Professor, School of Industrial and Systems Engineering

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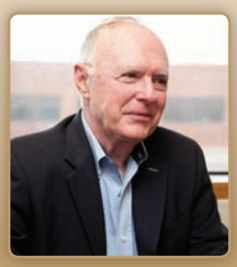


Dennis J. Folds, Ph.D.
Chief Scientist

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GTRI's seven laboratory directors are also key members of the leadership team. Their contact information, along with descriptions of the laboratories they lead, can be found on pages 42 to 45.

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Technology Consultant

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Linda Abercrombie
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