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[www.gtri.gatech.edu](http://www.gtri.gatech.edu)
The Georgia Tech Research Institute (GTRI) is a nonprofit applied research organization that operates as part of the Georgia Institute of Technology, a top-ranked academic and research institution located in Atlanta, Ga. For more than 72 years, GTRI has transformed innovative basic research into leading-edge real-world solutions, prototype systems and training for a broad range of customers – including industry and government organizations in Georgia, across the nation and throughout the world.

GTRI traces its roots to 1919, when the State Engineering Experiment Station (EES) was formed by the Georgia Legislature. The Station, which began operation in 1934, was given the mission of helping develop the resources, industries and commerce of Georgia, while assisting with national programs of science, technology and preparedness. Seventy-two years later, the organization – which became the Georgia Tech Research Institute in 1984 – continues to meet all of those needs and many more.

Today, GTRI research involves a broad spectrum of activities combining engineering, science, economics, policy and technical exploration. Like its Georgia Tech parent organization, GTRI research is interdisciplinary, bringing together key elements of multiple disciplines to address today’s most challenging issues. Core research areas include full-spectrum sensing, information technology and exploration. Like its Georgia Tech parent organization, GTRI research is interdisciplinary, bringing together key elements of multiple disciplines to address today’s most challenging issues. Core research areas include full-spectrum sensing, information technology and exploration.

At GTRI, nearly 600 of the nation’s best and brightest scientists and engineers work on solutions to today’s real-world problems – while anticipating the challenges of tomorrow. They apply the results of innovative basic research to provide solutions to challenging technical issues while maintaining a worldwide reputation for unsurpassed creativity and technical excellence.

GTRI research takes place within seven laboratories and a dozen field locations that have focused technical missions linked to one another by coordinated program thrusts. The interdisciplinary nature of GTRI research facilitates the formation of teams that bring together expertise to provide clients with the right mix of talent and experience to meet their needs – and consistently exceed their expectations.

Today, GTRI research involves a broad spectrum of activities combining engineering, science, economics, policy and technical exploration. Like its Georgia Tech parent organization, GTRI research is interdisciplinary, bringing together key elements of multiple disciplines to address today’s most challenging issues.

THE GTRI MISSION:
To serve the university, the state, the nation and the world by maturing selected technologies and developing innovative engineering solutions to important and challenging problems of society.

THE THEME FOR THIS 2006 GTRI ANNUAL REPORT IS “RESEARCH FOR THE REAL WORLD.”
The stories that follow illustrate the impact GTRI has by delivering innovative solutions to our diverse stakeholders. There are three key attributes that allow GTRI to consistently develop and deliver high-payoff solutions to our customers:

**EXPERIENCED AND HIGHLY CAPABLE SUBJECT MATTER EXPERTS:** Throughout our seven laboratories, a dozen national field locations – and now our first international location in Ireland – GTRI’s research staff of skilled and experienced engineers and scientists is recognized for technical expertise and commitment to doing what it takes to solve the most difficult problems of our stakeholders.

**TRUSTED PARTNERSHIPS:** The research results we deliver to our stakeholders depend in large part on trusted relationships developed through all levels of the government and industry organizations with which we work. The relationships can be developed and maintained because we are committed to being an independent, “honest broker” choosing the best solutions regardless of where they originate. The unique partnerships that result allow GTRI to develop a deep understanding of the challenges facing our stakeholders. Because of the trust they place in us, we are able to anticipate future needs and recommend innovative solutions.

**UNIQUE POSITIONING:** Through our connections to Georgia Tech, and with a national network of field locations, we are able to quickly bring the necessary expense to bear on our stakeholders’ most difficult problems. Because we are an integral part of Georgia Tech, we can contribute to and benefit from the advances made by this leading research university, which operates a $400 million-per-year research program with top-ranked activities in most major areas of science and technology.

These three attributes – world-class subject matter experts, trusted partnerships and our place within a major research university with worldwide operating locations – enable us to deliver solutions through innovation. We innovate, by helping to improve how things are done now. We also change the game – by providing a unique venue and capability that help our stakeholders envision new solutions and be the first to use disruptive innovations.

In the pages that follow, I invite you to read about some of our innovations from the past year. Please feel free to contact me about any of our “research for the real world.”

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Stephen E. Cross
Vice President, Georgia Institute of Technology
Director, Georgia Tech Research Institute

www.gtri.gatech.edu
GTRI has opened a new European facility, GT Ireland, to conduct applied research.

GT Ireland complements Georgia Tech's international strategy, observed Georgia Tech President Wayne Clough. "Georgia Tech is building its global presence by choosing strategic partners who share our values and our entrepreneurial spirit," he explained. "GT Ireland is a great fit for us given Ireland's innovative approach to developing its economy, the engagement of the research universities of Ireland and the plans to involve industry."

Georgia Tech already has operations in Europe and Asia:

• In 1990, Georgia Tech Lorraine was opened in Metz, France, offering graduate and undergraduate classes and conducting sponsored research.
• In late 1999, Georgia Tech partnered with the National University of Singapore to form The Logistics Institute-Asia Pacific in Singapore, which conducts research and offers educational programs in supply-chain management, optimization and technology.

In contrast to these operations, GT Ireland focuses on applied research in partnership with an entire country, noted David Parekh, GTRI's deputy director and GT Ireland's executive director. "Ireland is especially compelling because it has the complexity and resources of a nation but, because it's a small country, it has the agility of a startup. It's an ideal testbed for developing new technologies on a national scale," he added.

GT Ireland will begin with a core group of six researchers and grow to a staff of 50 in the next five years. Parekh expects the new initiative to build a research portfolio exceeding $24 million with work focused on four key areas: Internet protocol television (IPTV), radio frequency identification (RFID), biotechnology and sustainable energy. "This is market-driven research rather than R&D for its own sake," Parekh stressed.

When it comes to sustainable energy, GT Ireland provides a way to tap into the European perspective, said Tom Fuller, a GTRI Fellow and director of Georgia Tech's Center for Innovative Fuel Cell and Battery Technologies. That's important, because sustainable-energy technologies will be implemented on a larger scale abroad, Fuller said, noting that Europe and the United Kingdom have fewer energy resources and a greater environmental awareness compared to the United States.

"As we move to renewable energy, we have to think about how we manage, distribute, legislate and regulate it," Fuller added. "Ireland is going to have to deal with these challenges much sooner than we are, so we're really interested in how that plays out."

GTRI EXPANDS GEORGIA TECH'S INTERNATIONAL PRESENCE

GT Ireland

GTRI Opens Facility in Athlone, Ireland

"Successful economies of the future will be those that embrace knowledge and learn to leverage knowledge to its fullest potential. The Irish government has therefore placed the encouragement of research, development and innovation at the heart of Ireland's economic development strategy. The government's recently announced allocation of $4.7 billion to the ongoing development of Ireland's knowledge economy is evidence of this commitment to innovation and creativity. Further evidence can be seen in IDA's partnership with the Georgia Tech Research Institute, an acknowledged international leader in applied research with a sterling reputation for working alongside industry to solve difficult problems. I am delighted that in 2006, GTRI selected Athlone as the location for its first applied research institute outside the United States. Georgia Tech Ireland is a unique and innovative research institute which I am confident will become a critical component of Ireland's innovation infrastructure. I am proud of our partnership with GTRI and look forward to its continuing success in the future."

Sean Dorgan, CEO
IDA Ireland
www.idaireland.com

The Georgia Tech Research Institute (GTRI) keeps an eye on innovation to help meet the needs of its customers. GTRI conducts research in full-spectrum sensing, information technology and integrated systems development, serving society with research for the real world.
Breath analysis has tremendous potential as a non-invasive method for detecting disease, but it hasn’t been adapted for clinical use. Among major stumbling blocks are a lack of standard analytical methods and the wide variation in results obtained in existing studies. “Scientists know that it’s possible to detect different chemical compounds from people’s breath and relate them to illness,” explained Charlene Bayer, a GTRI principal research scientist. “Yet they haven’t been able to quantify results — such as determining a patient has a tumor because he or she has X amount of Y compounds in his or her breath.”

Bayer hopes to change that. She is leading a multidisciplinary team of researchers to identify and measure breath biomarkers for disease detection, beginning with breast cancer. (Biomarkers are biochemical features used to measure the presence of disease, its progress and the effects of treatment.) The researchers’ methodology will incorporate gas chromatography — a technique for separating complex compounds from one another — with mass spectrometry, which identifies the chemical makeup of a substance and records data electronically.

In the first phase of the project, researchers will identify different breath biomarkers in women with and without breast cancer. For this pilot study, Bayer’s team is collaborating with Dr. Sheryl G. Gabram-Mendola, a professor at Emory University’s School of Medicine and director of the Avon Comprehensive Breast Cancer Center at Grady Memorial Hospital. One of the biggest challenges in developing this measurement system is reproducibility, Bayer said. “We must reproduce results within acceptable parameters from the same patient repeatedly — and have similar results among a similar population to understand the results,” she explained. “There are a lot of factors that go into breath analysis, such as what subjects have eaten, how recently they’ve eaten and if they smoke. We need to be able to minimize those factors.”

GTRI researchers will begin looking for chemical compounds related to oxidative stress, which is the body’s response to inflammation and often an indicator of disease. Based on the results, the researchers will target specific chemical compounds and then develop statistical techniques for data analysis and interpretation. The researchers are also working with Boris Mizaikoff, an associate professor in Georgia Tech’s School of Chemistry and Biochemistry, to develop a sensor that gives real-time results.

If successful, the methodology could lead to a new breed of diagnostic instruments, such as a pre-screening tool for mammograms, which could reduce testing time and costs. Potential applications are broad, Bayer said. “Take asthma. If we’re able to identify biomarkers for inflammation in asthma patients, we could develop an instrument to help doctors know if medicine is actually working,” she explained.
EMTEF tests capabilities of a broad range of antennas.

**TESTING CAPABILITIES**

Support New Antenna Development

GTRI supports development of a wide variety of cutting-edge antennas, using capabilities based on an extensive installed testing infrastructure.

The Electromagnetic Test & Evaluation Facility (EMTEF), based at GTRI’s Cobb County Research Facility near Atlanta, uses an array of wideband electromagnetic ranges that can provide a battery of tests for virtually any antenna, from the smallest handheld devices to large satellite communications reflectors.

EMTEF’s research involves mainly work on prototype antennas for both industry and government, said Greg Hampton, a GTRI senior research scientist. Currently, he said, most testing is commercial, especially in the areas of cellular, personal communication systems and other wireless communications links.

“With the expanding commercial markets, we’ve had to adapt to different approaches to measuring antenna patterns,” Hampton said. “The new customers are more demanding. They’re looking for accuracy, but also need efficient testing.”

EMTEF has also supported projects as diverse as meteorological drop-sounding, radio telescopes, orbiting antennas and RFID devices.

The test group provides services for many local and regional companies, as well as others throughout the country, Hampton said. The facility emphasizes providing services in a way that is both flexible and cost-effective.

Characteristic of today’s emerging antenna concepts is an inflatable plastic antenna that GTRI tested recently for GATR Technologies, said Alyssa Daya, a GTRI research scientist. The large antenna weighs only 11 pounds and can be carried in a suitcase.

When GTRI engineers finished testing the device in the rooftop lab of one of EMTEF’s two Far-Field Range towers, Daya said, they dropped the antenna from the 70-foot height to demonstrate its durability.

**EMTEF’s current testing resources include:**

- **Far-Field Range**, a complete, high-precision outdoor test facility that includes a 1,100-foot antenna range, including a source tower and a receive tower with a rooftop instrumentation laboratory.
- **Near-Field Range**, an indoor range that uses a 10 by 30-foot scanner with a laser-based correction system to minimize out-of-plane probe position errors.
- **Spherical Near-Field Range**, an indoor, instrumented range that can accommodate antennas up to 8 feet in diameter, and can completely characterize devices in a single, uninterrupted scan.
- **Anechoic Test Chamber**, an instrumented chamber for indoor testing that is echo-free and is used to test small- to medium-sized antennas at frequencies from 250 MHz to 110 GHz.
- **RCS Turntable Range**, an outdoor range that supports a variety of instrumentation radars and antenna tests, generally for use on vehicles, at frequencies from 500 MHz to 110 GHz.

**ASSESSING & IMPROVING**

**Indoor Air Quality**

As scientists learn more about the potentially harmful effects of indoor air pollution, nations around the world are imposing increasingly strict regulations on chemical emissions from furnishings, paints and building materials.

Using a new, room-sized environmental test chamber, more than a dozen smaller chambers and a mass spectrometric center able to measure ultra-trace concentrations of airborne chemicals being emitted from products, GTRI scientists are helping manufacturers meet those international standards to minimize emissions.

“We can help manufacturers address regulatory issues,” said Charlene Bayer, a GTRI principal research scientist. “Because U.S. manufacturers sell their products worldwide, they must meet emission regulations imposed by nations in Europe and Asia. We make the measurements companies need to improve their products.”

For example, the testing helps manufacturers of indoor furnishings select components that have lower emissions. It also helps textile and apparel companies choose fabric finishes that both survive cleaning and minimize emissions. And it helps makers of paints and other wall coverings select biocides and other chemical constituents with the least impact on the indoor environment.

Large enough to accommodate humans or animals, the new 27.5-cubic-meter environmental chamber allows researchers to study broader concerns, including the impact of low-level indoor air pollutants on productivity and human health.

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Providing Secure Monitoring of Shipping Containers

A new shipping container security device in development by the Georgia Tech Research Institute could make U.S. ports less vulnerable to terrorist activities. The contract is funded by the U.S. Department of Homeland Security (DHS).

Containers equipped with the new devices will be continuously monitored for unauthorized attempts to open the container doors, using a novel sensing technique that is sensitive to door angular position. The system will securely communicate container information remotely to port authorities, providing a log of door activity and an alarm if an event occurs that requires immediate attention.

“The system is intended to improve port security by monitoring improper access to the container,” said lead researcher Gisele Bennett, director of GTRI’s Electro-Optical Systems Laboratory. “We need the ability to automatically detect unauthorized openings of container doors to prevent the potential introduction of illicit materials.”

The function of the device is to automatically detect the opening, closing and/or removal of container doors. A key feature of the sensing technique is that the design prevents tampering with or removal of the device from the container without an alarm being generated. This will provide a significant upgrade over current door security methods that rely on seals, which can be easily defeated, and with a major vulnerability in existing port security protocols.

Engineers are designing the system to monitor 20- and 40-foot “dry box” (non-refrigerated) containers. They are drawing upon GTRI’s expertise in integrated sensor systems development, including another DHS-sponsored project to develop concepts for an Advanced Container Security Device that was completed in October 2005.

Working with Bennett are lead GTRI optical engineers Terence Haran and Chris James. In addition, Tim Strike, David Fentem and Adam Tichelaar, with engineering expertise in packaging and electronics, were added to the original team. Work on the security device is expected to be finished by early spring 2007.

Supporting Development of the Missile Defense System

A modeling and simulation tool developed as part of a multi-organizational team, and now maintained by GTRI engineers, is helping U.S. government agencies and contractors improve the nation’s ability to defend against ballistic missile attacks.

The Ballistic Missile Defense (BMD) Benchmark is a complex computer simulation used for developing and testing the algorithms that track missiles, associate and combine sensor data, control sensor resources, and provide management and communications. Support for the U.S. Command, Control, Battle Management and Communications (C2BMC) system. The C2BMC provides the digital foundation for the nation’s Ballistic Missile Defense System.

With sponsorship from the Office of Naval Research and the Missile Defense Agency, the Benchmark has been made broadly available to the agencies and contractors working on the C2BMC and other related programs for the Department of Defense. Within this community, the modeling and simulation tool provides a consistent shared environment for the independent development and evaluation of the algorithms that make the Ballistic Missile Defense System work.

The C2BMC relies on information from multiple tracking and monitoring systems located on ships, satellites and land-based facilities. The merger of information from those systems — which were never designed to work together — has posed significant and complex challenges. By providing an accurate simulation of those systems that all agencies and contractors can use, the Benchmark creates a “level playing field” that facilitates the development and evaluation of solutions to those challenges.

“The BMD Benchmark software provides designers an independent and in some ways peer-reviewed model representation that they can use to solve their tracking and sensor-networking challenges,” said Phillip D. West, a GTRI principal research engineer. “By providing a standardized development and testing environment, it allows different groups to work together to solve problems of national importance.”

Tracking even a single missile can be extremely complicated. To provide decision-makers with high-level information, the C2BMC must separate tracks on the harmless boosters and debris from the track on the warhead, determine which tracks represent real threats, and associate information provided by different sensor systems — integrating all the information to help make evaluations that can be used for rapid decision-making.

“To develop the algorithms for forming an accurate track picture, you have to very carefully model the properties of the sensors and trackers involved, the networks that carry the information from the radars back to the central processors, and the phenomenology associated with the missile complex,” noted William Dale Blair, also a GTRI principal research engineer.

GTRI is responsible for maintaining and improving the BMD Benchmark for the approximately 40 agencies and contractors that use it. As lead for the development, GTRI integrates the contributions of other organizations and small businesses into the modeling simulation infrastructure. Part of that support involves conducting periodic courses that train new users and user meetings that communicate enhancements in the simulator.

Written in Matlab, the Benchmark is designed to run on desktop computers so it can be used by individuals or smaller organizations without large computer centers.
Chemical Companion provides first responders with critical information about hazardous materials. Launched in early 2006, the software tool is now being expanded from 120 to more than 1,000 chemical agents.

Sponsored by the federal government's Technical Support Working Group with funding from the Department of Homeland Security (DHS) and the Department of Defense (DoD), the Chemical Companion helps hazmat teams make decisions about:

- Chemical reactivity that could result in toxic fumes, fires and explosions.
- Which protective clothing and respirators to wear.
- How long responders can remain in a contaminated zone.
- Boundaries to establish for isolation and protective zones.
- Appropriate medical aid.

"Chemical Companion provides quick and easy access to knowledge about chemical reactions and containment," said Gisele Bennett, director of GTRI's Electro-Optical Systems Laboratory. Before first responders can aid victims and decontaminate the scene of an accident — be it a truck spill or terrorist attack — they must first determine what substances are present and understand risks, she explained.

Although other tools exist for hazmat teams, such software programs can cost as much as $5,000 per license. Not only does Chemical Companion offer a greater depth of information, but the software is also free to the military, law enforcement agencies and fire departments.

“We’re also working out a plan to give commercial entities access to the software for a nominal fee,” Bennett added. “For example, after a natural disaster like a hurricane, energy companies may encounter unknown liquids or gases while their workers are restoring power.”

Other new developments include:

- A Web site (www.chemicalcompanion.org) where users can register, download the software and access updates.
- A section on decontamination.
- A “help” section that clarifies acronyms and features.
- A desktop version.

Currently, the software runs on Windows CE-based personal digital assistants (PDAs). During beta testing, we got a lot of feedback from users who would like to use the program on their laptops,” explained Benjamin Medlin, a GTRI research scientist. “The desktop software will contain the same information as the PDA version, but we’ll make changes to the user interface since there’s a lot more screen space to work with.”

The PDA version, he explained, features many drop-down menus and automatic filters to minimize the amount of typing required from first responders who typically wear bulky hazmat suits and gloves.

As Chemical Companion becomes more robust, Bennett envisions additional applications. “It could be an interesting screening tool at airports,” she said, referring to new restrictions on liquids for air travelers. “Security officers could use this tool to see what sort of reactivity might result from a combination of products that, by themselves, are benign.”

Researchers demonstrate use of the Chemical Companion. Chemical Companion screens display vital information about chemical hazards. A researcher models a data destruction circuit for erasing sensitive data.
CYBER SAFETY for Kids

With the proliferation of Web communities aimed at young people, child molesters are no longer hiding out at playgrounds—the Internet has become their new venue for finding victims. To combat this threat, GTRI's Foundations for the Future (F3) is developing a cyber-safety program for children and teens.

Launched in 1996, F3 is a group of GTRI researchers that seeks to improve learning in K-12 classrooms through technology. Initially, F3 focused efforts on connecting schools to the Internet and bridging the digital divide; but in recent years, the group's work has broadened.

"Today there's a new emphasis on safety," said Claudia Huff, F3's director, referring to danger from both network hackers and online predators. "Students need to be protected while they're connected. Our initiative will help youngsters change their online behavior so they're not targets for predators."

F3 is modeling its cyber-safety program after NetSafe, a highly successful program in New Zealand that takes a community approach to online safety. Joining F3 as program partners are the Georgia Bureau of Investigation, the Georgia Department of Education, the Georgia Emergency Management Agency and Georgia Public Broadcasting.

In addition to new technology solutions, Georgia's cyber-safety program will help schools set policies on how to handle incidents, such as discovering child pornography on someone's computer. "There are certain procedures that must happen for evidence to be valid in court," explained Dana O'Neil, an F3 staffer and GTRI researcher.

"Students need to be protected while they're connected. Our initiative will help youngsters change their online behavior so they're not targets for predators."

Awareness training is large component of the program, O'Neil added. She referred to MySpace.com, an online community where participants can create custom Web pages, post pictures, write blogs and exchange e-mails. In an effort to get more kids on their Web pages, many young men and women have posted revealing photographs of themselves along with personal information that could be used to identify and locate them, such as what school they attend.

"They don't realize that by doing this, they're making themselves vulnerable to online predators," O'Neil said. "Educators, parents and children need to take responsibility."

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INFORMATION TECHNOLOGY

CREATING an Integrated Development & Test Environment

Engineers at the Georgia Tech Research Institute (GTRI) have developed a new Mission Systems Testbed that combines the capabilities of several different simulators into a single integrated system that provides a realistic model of the information flowing into the cockpit of a modern military aircraft.

The testbed provides a realistic environment for developing and testing new mission software for increasingly "network-centric" aircraft systems that can access information previously available only at central command facilities. The new testbed also helps software developers address the challenges of correlating data to help aircrews better understand the information coming in.

"We've had independent simulators for onboard electronic systems, radar warning receivers and data link simulations for tactical data links, fighter networks and ground control networks," noted Joe Brooks, a GTRI principal research engineer. "We've also had systems for simulating the intelligence provided by satellite systems. In the Mission Systems Testbed, we've put all these together with some additional capabilities to create a fully integrated environment for testing and developing new mission software."

Previously, different aircraft avionics systems were created and tested by independent developers, then brought together and integrated into the aircraft. Availability of the new testbed allows software development and testing to take place in a more realistic environment where these systems must work together.

Just as computer networks have given the business world access to crucial supply chain and similar information, military networks have also made aircraft crews better informed about the threats around them. As a result, crews on transports, helicopters and fighters now know what's happening on other aircraft, and can get information directly from satellites, ground stations and other sources. But all this information can increase the workload for crews that were already busy.

"One of the key challenges ahead is correlation of all the data that comes in from the different networks," Brooks explained. "The type of data provided by those sources may appear to be somewhat different, but it may be pointing to the same threat. So it will help aircrews if we can correlate information to let them know what refers to the same threat—not two different threats. We will be working in that area to write software and develop systems to solve that correlation challenge, and this testbed will support that work."

Initially, the Mission Systems Testbed will be used internally by GTRI researchers, but plans call for it to be made available to outside organizations also working in the area. Supported by GTRI independent research and development funds, the new testbed can be easily expanded as new mission system capabilities are added to U.S. aircraft.
Pavement marker placement is controlled by an in-cab system. Researchers examine pavement marker placement system.

AUTOMATED SYSTEM Places Pavement Markings

On rainy nights in Georgia and across the nation, drivers greatly benefit from small, reflective markers that make roadway lanes more visible.

There are more than 3 million of these safety devices, called raised pavement markers (RPMs), in service on Georgia highways. They are installed and then need to be replaced about every two years by road crews who consider the task one of the riskiest they face. Workers typically ride on a seat cantilevered off the side of a trailer just inches from highway traffic.

Manual RPM placement is not only risky for personnel, but it is also expensive and time-consuming. A typical RPM placement operation includes four vehicles and a six-person crew. All the vehicles must stop at each marker location, so there is tremendous wear on the equipment and increased fuel use.

The Georgia Department of Transportation (GDOT) believed there was a better way to do it and funded the Georgia Tech Research Institute (GTRI) to develop a first-of-its-kind system capable of automatically placing RPMs along the lane stripes while in motion. After almost three years of research and development, a prototype system is completed.

“Manual placement methods are labor-intensive, time-consuming, dangerous, and expensive,” said project manager Wiley Holcombe, a GTRI senior research engineer. “The advantages of our automated system are that it’s less labor-intensive, it’s faster and safer, uses less fuel, and it causes less wear and tear on GDOT equipment,” explained project manager Wiley Holcombe, a GTRI senior research engineer.

Engineers conducted the work in two phases. First, they designed an RPM-placement mechanism using pressure-sensitive adhesive and a lane-stripe tracking system. Then, they developed a full-scale, truck-mounted RPM placement system.

After some field-testing, the project resulted in a prototype system capable of dispensing an RPM onto the pavement, along with the necessary hot-melt adhesive, all applied while traveling at 5 miles an hour. A pattern-change mechanism can position two placement mechanisms to accommodate any of GDOT’s five specified RPM placement patterns, Holcombe explained. Operation of the system requires only two people.

“The GDOT’s primary use for the automated RPM placement machine will be placing markers on the skip lines for interstate and multi-lane highways,” said GDOT spokesperson Karlene Barron. “These types of issues pose the highest safety risks to our employees and equipment. The GDOT also plans to use the system on high-traffic-volume secondary or two-lane roads, when possible.”

In June 2006, researchers conducted four test flights that validated their design tools and methodologies. The research team – which also included doctoral students Tom Bradley and Blake Moffitt – faced slim performance margins. By developing innovative computer tools to analyze and model performance, they were able to optimize the propulsion system and aircraft design.

In June 2006, researchers conducted four test flights that validated their design tools and methodologies. The research team – which also included doctoral students Tom Bradley and Blake Moffitt – faced slim performance margins. By developing innovative computer tools to analyze and model performance, they were able to optimize the propulsion system and aircraft design.

Although other research groups have also flown UAs on compressed hydrogen, these planes were designed at a much smaller scale and had to be hand launched. In contrast, Georgia Tech’s demonstrator vehicle operates like a full-sized aircraft, requiring no auxiliary batteries or boosters for takeoff.

To build the power plant, researchers used a commercial proton exchange membrane (PEM) fuel cell that they modified extensively, adding systems for hydrogen delivery and refueling, thermal management and air management.

Because of the power plant’s heavy weight and low output, the research team – which also included doctoral students Tom Bradley and Blake Moffitt – faced slim performance margins. By developing innovative computer tools to analyze and model performance, they were able to optimize the propulsion system and aircraft design.

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The project is supported with internal funding from GTRI, along with grants from the National Aeronautics and Space Administration (NASA) and the National Science Foundation (NSF).

FLYING on Hydrogen

Georgia Tech researchers have developed a hydrogen-powered aircraft believed to be the largest unmanned aircraft to fly on a fuel cell using compressed hydrogen.

The fuel cell system that powers the 22-foot wingspan aircraft generates only 500 watts. “That raises a lot of eyebrows,” said Adam Broughton, a research engineer in Georgia Tech’s Aerospace Systems Design Laboratory (ASDL). “Five hundred watts is plenty of power for a light bulb, but not for the propulsion system of an aircraft this size.”

A collaboration between ASDL and GTRI, the project was spearheaded by David Parekh, ASDL’s deputy director and founder of Georgia Tech’s Center for Innovative Fuel Cell andBattery Technologies. “A fuel cell aircraft is more compelling than just a lab demonstration or even a fuel cell system powering a house,” Parekh observed. “With an airplane, you really push the limits for durability, robustness, power density and efficiency.”

Fuel cells, which create an electrical current when they convert hydrogen and oxygen into water, are attractive energy sources because of their high energy density and low environmental impact.

“The range of potential applications is tremendous,” said Dimitri Marinis, ASDL director and Boeing Professor in Advanced Aerospace Systems Analysis in Georgia Tech’s School of Aerospace Engineering. “Improvements in power densities for fuel cell systems will enable new aircraft and aircraft subsystem concepts, particularly in UAVs (unmanned aerial vehicles).”

For example, hydrogen-powered UAVs could be used for weather monitoring, storm tracking, border patrol and surveillance, disaster relief imaging and communication capabilities.

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To build the power plant, researchers used a commercial proton exchange membrane (PEM) fuel cell that they modified extensively, adding systems for hydrogen delivery and refueling, thermal management and air management.

Because of the power plant’s heavy weight and low output, the research team – which also included doctoral students Tom Bradley and Blake Moffitt – faced slim performance margins. By developing innovative computer tools to analyze and model performance, they were able to optimize the propulsion system and aircraft design.

In June 2006, researchers conducted four test flights that validated their design tools and methodologies. The research team – which also included doctoral students Tom Bradley and Blake Moffitt – faced slim performance margins. By developing innovative computer tools to analyze and model performance, they were able to optimize the propulsion system and aircraft design.

The project is supported with internal funding from GTRI, along with grants from the National Aeronautics and Space Administration (NASA) and the National Science Foundation (NSF).
MODERNIZING Sweden’s HAWK Air Defense System

GTRI engineers have worked with the government of Sweden to modernize that country’s HAWK Air Defense System with a new fire control post that works closely with Sweden’s HAWK Air Defense System. The modernized fire control system relies on rugged, commercial-off-the-shelf systems. The modernized fire control system also includes an embedded training system to help maintain operator readiness.

The HAWK Air Defense System provides the ability to combat medium-range aircraft and missile threats. At the heart of each HAWK battery is a fire control system that tracks targets, communicates with commanders, processes commands and controls missile firing. The Swedish government wanted to upgrade the system to use modern software and digital components compatible with other equipment used by its military.

First fielded in 1960, the HAWK system has undergone many improvements over the years and remains a formidable air defense system. But because it includes some older analog components, the GTRI task included development of interfaces that allow legacy equipment to work with modern digital hardware.

GTRI engineers were familiar with the HAWK system through their earlier assistance to the Swedish government, as well as the shelters built to house the fire control system and its operators. GTRI researchers were an integral part of the first fire control firing exercise with the new system, and this past fall, provided technical support for a second test firing.

“The new system allows them to interface with their modern hardware, including their new radars and their command-and-communications systems,” explained David Pyne, a GTRI research scientist who headed up the project’s final phase. “This allows the system to be more scalable, and provides more information so operators can make better decisions. This will improve their overall combat effectiveness.”

Beyond the fire control tasks, the new system also includes an embedded program that allows training to take place apart from major components of the missile system. Simulating radar inputs and the missiles, the program reduces the cost of training.

“They don’t have to set up the whole system every time they want to train,” Pyne added. “There are scenario situations that can be created that give them flexibility in training their soldiers.”

Though the project is now winding down, GTRI is looking ahead to future cooperation with the Swedish government. Other GTRI researchers who worked on the HAWK modernization project include Patrick Dowdy, Robert Kearney, Brandon McMahon, James Smith, Glenn Parker and Ken Hudson.

UNIFYING Military Communications Software

GTRI is integrating several versions of its military communications network testing software into a single centralized approach, while also adding new capabilities for tactical training.

Called the Network Centric Test/Training System (NeTTS), the new program contains core elements of GTRI’s test and training tool suite, used for evaluating communications effectiveness on today’s battlefield. Other tools and capabilities will be added as NeTTS continues to develop.

Joshua Davis, a research scientist who is a key member helping to shape the NeTTS vision, described the project as an evolutionary advance. Inspired by civilian open-source models, NeTTS will provide a cooperative code base that will speed development and increase usability.

“We’re developing a framework to give engineers throughout GTRI an infrastructure, one that will allow upgrades and improvements to become available to the entire organization as well as end users,” Davis said.

Since 1997, GTRI has developed test and training tools for distributed, “network-centric” environments of the military’s Command, Control, Communications, Computers and Intelligence (C4I) environment. The work has been funded largely under the Department of Defense’s Resource Enhancement Program.

The first of these tools, the Realistic Operational Communications Scenarios (ROCS) System, pioneered a systematic approach to C4I testing, focusing on ground combat elements. Successor systems – the Commander’s Air Defense Environment Test Tool (CADETT) and the Integrated Broadcast Service Test and Analysis Tool (ITAS) – focused on air operations and intelligence systems.

These related tools have been used in developmental and operational test and evaluation performed for all four military services and other DoD agencies. Originally conceived by GTRI principal research engineer Fred Wright, NeTTS offers the same capabilities as the earlier programs – as well as the new training components.

But NeTTS will be much less costly to maintain and upgrade; as ongoing development becomes significantly more flexible and transparent,” Davis said. The centralized code base will allow rapid deployment of updated code, new plug-ins and drivers, new development language versions, troubleshooting and other changes.

The NeTTS training component will emphasize realism. “This approach will focus on software that can merge training with actual tactical communications systems to offer a true hands-on experience,” Davis said, “It’s a whole different kind of experience.”
PROVIDING

Low-Cost, Rangeless EW Training

Engineers at GTRI are helping Air Force crews rehearse for enemy attack. The Virtual Electronic Combat Training System (VECTS), an in-flight training program, can mimic enemy threats with both realism and convenience.

Working with the Advanced Airlif Tactics Training Center (AMTTC) in St. Joseph, Mo., researchers are providing VECTS technology that simulates enemy threats using an aircraft’s built-in electronic warfare (EW) warning devices.

Such “rangeless” EW training works without the need for the aircraft to fly over an electronically equipped military range. This approach lets crews experience and react to apparent enemy attacks during otherwise routine training flights.

“Rangeless tactical training allows aircrews to drill on EW systems that they usually don’t even see operating,” said Joe Brooks, a GTRI principal research engineer. “Generally, crews don’t have much interaction with their defensive systems because they’re not part of normal flying.”

Traditionally, Air Force crews have used handheld flash cards to initiate a defensive-system drill during flight, an approach that lacks realism. Alternatively, aircrews trained while flying over military ranges that electronically stimulated the aircraft’s onboard EW systems. But range flyovers are costly and involve availability and scheduling issues, resulting in limited training opportunities for many aircrews.

By contrast, VECTS is low-cost and allows flexible training schedules. It also uses existing on-aircraft defensive-system displays and audio.

Currently, VECTS is being deployed or prepared for deployment on three different front-line military aircraft, and is being considered for use on additional platforms.

VECTS training simulations are hosted on a military-approved laptop computer that records data used for debriefings, and also serves as a planning station for training missions using FalconView, a GTRI-developed program. Alternatively, VECTS can be embedded into an aircraft’s onboard operational flight program.

Either way, VECTS is the training component of the aircraft’s vital defensive system.

“VECTS provides realistic training when aircrews see threat symbols on their display and hear the threat audio. It is as though there is a real threat on the ground,” said Linda Viney, a GTRI senior research engineer who serves as program manager for VECTS. “It simulates exactly what the threat system is doing, whether it’s just out there searching, or it’s tracking an aircraft – or it’s actually launching a missile.”
Technology and public policy may seem like strange bedfellows, but there is a long-standing affair. Scientific innovations often spark changes in public policy, and conversely, our country’s laws, regulations and funding programs can affect what goes on in technology circles.

This give-and-take has only grown stronger in recent years because of the accelerated pace of technology, observed Randy Case, director of GTRI’s Information Technology and Telecommunications Laboratory (ITTL). “Today, we need to give policy-makers more details about emerging technologies,” he said. “We also need to better inform our researchers about the direction of public policy, and any constraints it might have on their projects.”

In response, GTRI launched the Office of Policy Analysis and Research (OPAR) in 2004. Among its services, OPAR provides briefings that give researchers a high-level view on specific issues, agencies or pieces of legislation; outreach that connects subject-matter experts with policy-makers; information about funding opportunities and public policy assistance to technology projects.

“Policy research isn’t something that scientists and engineers typically are interested in — or equipped to handle,” said Brett Walkenhurst, a GTRI research engineer who OPAR assisted this spring with a proposal to fund a project that involves multiple antenna processing and cognitive radio.

Although scientists and engineers may intrinsically understand technology’s potential impact on government activities, putting that into language that resonates with policy analysts is difficult. “Having a resource like OPAR really fills in the gaps,” Walkenhurst added.

In late 2005, OPAR began working with the Georgia General Assembly. In her role as a legislative fellow, GTRI-research associate Marlit Hayslett provides policy analysis through issue briefs and expert testimony to the House Science and Technology Committee. She also serves as a conduit to GTRI and Georgia Tech by identifying scientists to testify on topics under the committee’s consideration. For example, in 2005, the House Science and Technology Committee heard testimony on the role of nanotechnology in economic development, Internet safety for children and K-12 science and math education.

In November 2006, OPAR hosted a legislative roundtable previewing technology issues that may emerge in Georgia’s upcoming 2007 legislative session. Five state legislators served on a moderated panel before an audience of more than 60 members of industry, government and academic sectors. New areas for the future will include health information technology, alternative energy and identity management.
AUTOMATING the Endoscope

Although colon cancer is a leading cause of cancer deaths, it can be cured if detected early, which makes the colonoscopy a critical procedure. Yet existing endoscopes – the medical devices used to inspect a colon – are cumbersome instruments that require multitasking. Doctors must guide the endoscope through the patient’s colon by pushing the endoscope and controlling the orientation of the instrument’s tip while simultaneously watching a video monitor that displays images captured by the endoscope’s camera. “Because the colon has several 90-degree turns, it’s not easy to navigate,” said Gary McMurray, a GTRI senior research engineer who likened the process to pushing a wire through conduit. “If doctors push too hard, it’s possible to tear the colon, which could mean emergency surgery.”

Leading a team of robotics experts, McMurray is developing a new breed of endoscope that will allow doctors to focus their attention on inspecting the colon rather than manipulating the medical device. In this project, the Georgia Tech team is collaborating with Dr. C. Daniel Smith and Dr. Edward Lin at Emory University, who are providing insights into the clinical side of the problem. Researchers initially are tackling two tasks: developing automated control for the tip of the endoscope and adding sensors along the sides of the device to detect force and deflection. Both improvements would minimize stress on the colon and reduce risk of tearing tissues.

The longer-term goals are:

- Correlating data collected in a virtual colonoscopy (done without an endoscope via a spiral CT scan over the abdomen) to the real procedure – something that isn’t possible with existing tools.
- Establishing virtual markers to help doctors return to the same spot in the colon months after surgery to biopsy the area.
- Incorporating multispectral imaging. Existing endoscopes use visible light; whereas multispectral imaging would provide far more information, especially about cancer lurking beneath the surface of tissue.
- Creating a complete system that would enable doctors to perform colonoscopies from a remote location.

“If we can automate the endoscope as planned, then it’s only a small step to telemedicine,” McMurray said. Especially for more difficult cases, such as young children and elderly adults, it’s important to have a skilled physician perform the colonoscopy, he explained, but not every town has a resident expert. “We’re not trying to replace the doctor,” McMurray stressed. “Yet an automated endoscope will let doctors do what they do best – inspection and analysis. Everything else is a robotics problem.”

LEARNING from the Nation’s Worst Chlorine Spill

The United States’ worst-ever chlorine gas spill killed nine people and injured 258. Eighteen months later – despite efforts to clean and restore the textile mill affected by the spill – 4,083 people lost their jobs, and a longtime, family-owned textile company went out of business.

Perhaps the only good thing to come out of the disaster is that, if such an accident occurs again, authorities will have better guidelines for first responders and cleanup crews. These guidelines will be the product of two years of testing and research by scientists and engineers at the Georgia Tech Research Institute (GTRI) and the Georgia Institute of Technology.

They became involved in cleanup efforts within a few days after the train wreck that caused the release of 70 to 80 tons of chlorine gas on Jan. 6, 2005 in the small town of Graniteville, S.C. The corrosive gas – and acid formed from its interaction with moisture – heavily damaged equipment in facilities owned by textile company Avondale Mills and utility company South Carolina Electric & Gas. Both companies hired GTRI to conduct materials testing and an assessment of restoration efforts.

“Basically, you had items sitting in an acid bottle for days,” said Lisa Detter-Hoskin, a GTRI senior research scientist who led the research and helped coordinate the mill’s expert evaluations. “Chlorine corrosively ate away at surfaces and moved inward like a cancer in the human body. Much of the mill’s equipment was beyond repair because of the severity of the acid attack and the result of ineffective cleaning and restoration attempts.”

Detter-Hoskin compiled all of the research and recommendations into a report for Avondale. That report is now the basis for a white paper Detter-Hoskin is writing for the U.S. Department of Homeland Security. She will explain what researchers have learned about the relationship between acid concentration, exposure effects and possible degrees of material damage. She also will document cleaning protocols most effective to decontaminate and restore an area affected by an aggressive chlorine spill. Detter-Hoskin believes the paper ultimately will become a handbook for first responders, disaster cleanup companies and the chemical industry.

GTRI and Georgia Tech have a unique database of information resulting from 18 months of testing and assessment of samples from Avondale’s Graniteville facilities. This information may be able to help in the event of another accident, or even a terrorist attack, Detter-Hoskin said.
GTRI researchers are reducing aircraft noise to facilitate new air travel options.

Business travelers often have to deal with congested airports that delay flights at major air transportation hubs.

One proposed solution is for travelers taking shorter, regional trips to fly on 4- to 10-passenger advanced aircraft based at smaller, municipal airports. Such an air transportation system could improve safety, efficiency, reliability and affordability. But communities surrounding these facilities sometimes object.

“Noise is a big concern for these communities,” said acoustics expert Krishan Ahuja, a Georgia Tech Research Institute (GTRI) Regents Researcher and Regents Professor of Aerospace Engineering. “Finding ways to make aviation quieter in these areas is the focus of some of my research.”

Ahuja is involved in four initiatives that are addressing the future of aviation, including noise issues. He and his colleagues at GTRI and Georgia Tech are contributing their expertise, while seeking potential research opportunities.

In particular, researchers hope to design a helicopter-based transportation system using an aircraft tracking technology demonstrated by GTRI during the 1996 Centennial Olympic Games in Atlanta. Called Heli-Star (Helicopter Short-Haul Transportation and Aviation Research), the project showed for the first time that communications and navigation equipment based on the Global Positioning System could be used to reliably track aircraft operating in large metropolitan areas without the need for a ground-based radar infrastructure.

But noise is an obstacle. One solution could be the construction of helicopter-landing pads near highway ramps, where noise is not as big of an issue, Ahuja said.

Ahuja brings such ideas, along with his expertise, to his involvement with NASA’s Small Aircraft Transportation System (SATS), which is developing “a safe travel alternative, freeing people and products from transportation system delays by creating access to more communities in less time.”

He is also an appointed member of the Next Generation Air Transportation System (NGATS) Institute, federally funded by the Joint Planning & Development Office. The goal is to streamline all aspects of future aviation.

In another effort, Ahuja is providing acoustics expertise to Groen Brothers Aviation, which is developing an aircraft that combines features of airplanes and helicopters. The DARPA-funded vehicle, called a Heliplane, takes off like a helicopter and then flies like an airplane.

In addition, the National Academy of Engineering (NAE) invited Ahuja in 2005 to participate in its workshop titled “Technology for a Quieter America.” Now, he is serving on a recently formed subcommittee on NAE’s consensus study group focused on this goal.
MEASURING Shrinkage in Dental Fillings

Polymers that make up dental fillings are designed to be strong when hardened in a tooth. However, they are subject to shrinkage when they harden, which can lead to failure of the repair and a number of problems including a cracked tooth or bacteria penetrating the tooth and causing new decay.

Kondor is developing a measurement system to observe in real-time how shrinkage affects polymer dental filling materials. Researchers are working to develop a way to simulate shrinkage in a more realistic setting.

Researchers test shrinkage in polymer dental filling materials.

Researchers at Georgia Tech’s GTRI Senior Research Engineer, Shayne Kondor, is working with Dr. Dan Han, a professor at the Medical College of Georgia, who is advising from the clinical side.

They are working on a new test methodology that could lead to more durable fillings. Shayne Kondor, a GTRI senior research engineer, is working with Dr. Dan Chan, a professor at the Medical College of Georgia, who is advising from the clinical side.

Researchers usually study shrinkage by measuring changes in the volume of a drop of material, cured outside of a cavity. Yet this approach doesn’t provide a comprehensive picture of what happens in a tooth cavity, Kondor says.

“The form of the cavity preparation has a lot to do with how the filling material adheres to its floor and walls,” he explained. “What’s more, the penetration of the curing light also has an effect on shrinkage. If you don’t replicate that, then you’re not going to see exactly how the filling material flows.”

To observe shrinkage in a more realistic setting, Kondor has developed an optical measurement system. He first simulates a cavity by drilling a 5-millimeter hole in a plate of aluminum. Then he pours dental filling material that contains tracking particles (called “probe” particles) into the hole, using a blue light to both cure the material and provide illumination under the microscope. Spatial displacements of the tracking particles are optically measured throughout the curing process to determine deformation fields on the surface.

In essence, Kondor is transferring particle image velocimetry, an aerospace technology used to study flow fields around aircraft wings and how air loads cause the wing structure to deform over time. “This technique can be easily adapted to dentistry because you can detect very small deformations that occur over time,” Kondor explained. “Shrinkage is really a liquid flow problem. Like ice freezing, the filling material is first a liquid that turns into a solid.”

Kondor is first studying shrinkage at the surface level, but he also plans to take measurements in a cross-section simulation to determine how filling material flows inside the cavity preparation as it cures. “Then we can look at different cavity preparation shapes to see which ones cause less stress,” Kondor said.

“Most practitioners are aware of the shrinkage problem, but don’t understand its magnitude,” observed Chan. “Our method will help them better visualize shrinkage – we can show it in real-time media and also calibrate the force and direction of shrinkage, which is unique.”

In addition to helping dentists find ways to prevent and remedy shrinkage, the optical measurement system will help manufacturers design better materials. Chan added. In fact, the researchers recently signed an agreement with an industrial partner to evaluate a new filling material.

Researchers test shrinkage in polymer dental filling materials.

HUNTING DOWN Workplace Hazards

Although workplace safety has come a long way since the Industrial Revolution, occupational hazards remain a challenge for U.S. employers, especially smaller companies with fewer resources. In response, Georgia Tech’s Safety & Health Consultation Program provides technical expertise and training to help Georgia companies reduce illness and injuries for workers.

In 2005, GTRI consultants visited more than 350 companies and identified 3,838 serious hazards, saving employers about $3.8 million in potential penalties from the U.S. Occupational Safety and Health Administration (OSHA). “Yet that’s just the tip of the iceberg,” said Dan Ortiz, manager of the consultation program which is housed in GTRI. “It’s hard to put a number on costs because any accident has far-reaching effects that go beyond workers’ compensation and lost time,” he explained.

Funded by OSHA, Georgia Tech’s safety-and-health consultation services are free to companies with fewer than 250 workers. What’s more, the program is confidential. Therefore, just one requirement: companies must agree to correct all hazards and provide written verification of their actions within a reasonable time frame.

When consultants arrive on the scene, they focus on three key areas:

- Safety issues like fire protection, machine hazards, electrical safety and fall protection.
- Health hazards, such as exposure to chemicals, noise and blood-borne pathogens.
- Ergonomic problems that can cause musculoskeletal disorders.

Consultants also evaluate safety programs that may already be in place and help strengthen them.

Workplace safety is constantly changing because of new technologies and regulations. Demographic shifts have also introduced new challenges in worker safety, such as the increasing number of Spanish-speaking immigrants in Georgia’s workforce.

“Many of these immigrants work in industries where English is not the primary language or in shifts that have large numbers of Spanish speaking workers. To help increase awareness, consultants have been translating many of OSHA’s training materials into Spanish and offering free safety training seminars in Spanish.”

Partnerships have become an important tool for outreach. For example, in May 2004 Georgia Tech teamed with Brasfield & Gorrie, the general contractor for the Georgia Aquarium, a $200 million project that required several hundred workers. By the time the project was completed in late 2005, there were no fatalities, and the injury rate had dropped from 7.5 to 2 per 100 workers – with average cost per injury falling from $11,000 to $3,000.

Safety and health consultants help companies identify potential hazards.
In an early-stage project, researchers in the Georgia Tech Research Institute (GTRI) are leading a Georgia Tech initiative to integrate the university’s expertise in foreign cultures and technology development to improve cultural competence among the military and law enforcement.

“We’re combining our subject matter expertise for cultural competence with the development of tools to increase the speed and ease of deliverability for both training and intelligence analysis,” said Jennie Lincoln, a GTRI principal research associate.

“Both the Department of Defense and law enforcement agencies recognize there is a critical deficit in cultural understanding as we’re faced with diversified threats,” Lincoln explained. “Our key question as researchers is how we can increase cultural awareness and understanding to contribute to a more efficient response to these new threats.”

Training tools such as computer simulations often don’t include any cultural aspects, said Margaret Loper, chief scientist for GTRI’s Information Technology and Telecommunications Laboratory. Some existing technologies – both those developed at GTRI and elsewhere – could be modified to include cultural differences, while some training and decision-making tools will require development from the ground up, Loper added.

To begin this “grassroots” initiative, Lincoln, Loper and several other GTRI researchers are evaluating current DoD cultural training tools and related research at DoD’s request. They are also tapping the expertise of six other researchers from Georgia Tech’s Ivan Allen College of Liberal Arts and the College of Computing.

The goal of cultural competency in the military is necessitated by what Lincoln calls the 21st century’s new battlefield. Few troops – from the youngest soldier to the senior decision-makers in the field – have had extensive training in cultural interactions; yet they frequently interact with local people, especially in Iraq and Afghanistan, Lincoln noted.

“It’s one thing to secure a battlefield and quite another thing when your troops have to deal with the local people, which we’re doing in these post-conflict situations,” she said. “Instead of winning the battle and going home, we’re staying to work on building a nation. You have to be able to work with the local people across language and cultural barriers. It requires a new approach to training and learning in cross-cultural communication.”

The need for increased cultural competency in the military and law enforcement agencies is immediate, Loper said, but this project will be one for the long term. “With the so-called ‘flattening’ of the world, people in all walks of life will need more education to understand other cultures,” she added.
Two long-term Georgia Institute of Technology research programs migrated to the Georgia Tech Research Institute in the fall of 2005, adding to its areas of expertise the fields of air quality and environmental radiation monitoring.

Both programs have compiled valuable, long-term research databases that are meeting the needs of Georgia’s state government and revealing significant insights that help direct both research and policy.

In GTRI’s Environmental Radiation Center directed by Bernd Kahn, researchers have 30 years of data analysis on the state’s drinking water and various samples from nuclear energy facilities in Georgia. The testing fulfills Georgia’s regulatory mandates and provides peace of mind to the public, said GTRI senior research scientist Robert Rosson.

Researchers, who were previously based in the Office of Interdisciplinary Programs, continue to analyze 1,400 drinking water samples a year to screen for contamination by naturally occurring radiation in the environment.

“We’re making sure everything is safe,” Rosson said. “We have found a few problems through the years, including some areas of the Piedmont that are at higher risk because of natural radioactive material in the granite, which can leach into aquifers and contaminate drinking water. In some cases, the state has had to shut down wells and drill new ones because of our findings.”

Rosson and his colleagues also annually test numerous air, water, fish and produce samples taken from sites near Georgia’s nuclear energy facilities. They look for radioactive contaminants from both natural and industrial sources. In some cases, they have found cause for concern that has led to additional monitoring activities, particularly near the U.S. Department of Energy (DOE) Savannah River site near Augusta, Ga., Rosson noted.

In addition to this monitoring work, the Environmental Radiation Center has conducted radioactive materials testing for DOE and the U.S. Department of Health and Human Services’ Agency for Toxic Substances and Disease Registry. One of the center’s significant contributions was an approved methodology for monitoring radium in drinking water, Rosson added. Also, Kahn and his staff will soon publish a radioanalytical chemistry textbook and laboratory manual based on their 30 years of research in the field.

In GTRI’s Aerospace, Transportation and Advanced Systems Laboratory, began monitoring vehicle emissions in 1991 in metro Atlanta with a pilot program, which began in the Georgia Tech School of Earth and Atmospheric Sciences. With funding from the Georgia Department of Natural Resources, he and his staff designed the Continuous Atlanta Fleet Evaluation (CAFÉ) study and have systematically collected this data using remote sensing technology since the spring of 1993.

The study continues to validate the effectiveness of the state’s vehicle emissions inspection program in a 20-county area in and around Atlanta, Rodgers said. Residents in the region spend about $80 million a year on vehicle inspections and repairs to fix emissions problems found in the checkups.

“That’s a major chunk of change, so you want to make sure the inspections program is working,” Rodgers said. “We’ve found that it is indeed reducing vehicle emissions in the region. The state is investing less than 1 percent of the cost of the program to monitor it. So that’s a cost-effective solution.”

In addition to its inspections program monitoring value, the vehicle emissions database continues to reveal some interesting trends, Rodgers noted.

“It’s important to gather systematic data over a long period of time so you can better understand how things change,” he said. “For example, we’ve found that the newer, cleaner-burning fuels have had a very positive effect – comparable to the inspections program – in reducing vehicle emissions.”

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Researchers screen drinking water for radiological hazards.

Remote sensing monitors Atlanta-area air pollution emissions.
The Georgia Tech Research Institute (GTRI) is headquartered on the Georgia Tech campus in Midtown Atlanta, where four of the organization’s seven research laboratories are also located. Two laboratories operate at a major off-campus research facility approximately 15 miles north of Atlanta in Cobb County, adjacent to the Dobbins Air Reserve Base. Additionally, GTRI operates a laboratory in Huntsville, Ala. On-site research and business services also take place at a number of GTRI offices around the nation, with locations in Alabama, Arizona, California, Florida, Georgia, New Mexico, Virginia, Ohio, and at GTRI’s newest location in Athlone, Ireland.

GTRI Intergovernmental Personnel Assignments

Huntsville, Alabama
- U.S. Army Lower Tier Project Office/Program Executive Office, Air, Space, and Missile Defense

Redstone Arsenal, Alabama
- U.S. Army Aviation and Missile Research, Development, and Engineering Center (AMRDEC) (2)
- U.S. Army Program Executive Office, Missiles and Space (PEO M-S)
- Threat Systems Management Office, PEO STRI

Eglin Air Force Base, Florida
- Air Armament Center Capabilities Integration Directorate

Wright Patterson Air Force Base, Ohio
- Advanced Strategic Command Center/ Campaign, Simulation, & Missile Analysis Branch
- National Air & Space Intelligence Center (NASIC) Engineering Division (2)

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GTRI Research Facilities, Fiscal Year 2006

On-campus research space
322,803 square feet
Off-campus research space
152,543 square feet
Total
475,346 square feet

Information Technology and Telecommunications Lab

During fiscal year 2006, GTRI’s Information Technology and Telecommunications Laboratory left its longtime campus home in the Electronics Research Building, which was demolished to make way for Georgia Tech’s new Nanotechnology Research Center. The lab now resides in a beautiful 88,434-square-foot facility several blocks from the main campus. The building features state-of-the-art research labs, a 10,000-square-foot conference facility available to research sponsors, and a multimedia production studio supporting research projects and communication activities.

International Location in Athlone, Ireland

Georgia Tech’s newest international campus – Georgia Tech Ireland – is based at the Garrycastle Business & Technology Park in Athlone, Ireland. The headquarters has both office and laboratory space, which includes a digital media lab that will serve as a testbed for Internet Protocol Television (IPTV) capable of sourcing both linear and video-on-demand (VOD) content to industrial and academic researchers, as well as students in Irish colleges and universities. The lab will serve dual roles as both a cultural and educational network to the student body and a platform for IPTV research.
During the 2006 fiscal year, GTRI reported $112.7 million in contract awards and grants. Major customers for GTRI research included U.S. Department of Defense agencies, the state of Georgia, non-defense federal agencies and private industry. Overall, contracts and grants from Department of Defense agencies accounted for nearly 80 percent of GTRI’s total funding.

FT 06 Major Customers

Independent Research and Development

GTRI’s independent research and development program supports the GTRI Strategic Plan through investment in programs with anticipated long-term return. Independent research investment is intended to expand capability and sustain a competitive position in critical research and technology in the United States and Ireland. During the 2006 fiscal year, GTRI reported $112.7 million in contract awards and grants. Major customers for GTRI research included U.S. Department of Defense agencies, the state of Georgia, non-defense federal agencies and private industry. Overall, contracts and grants from Department of Defense agencies accounted for nearly 80 percent of GTRI’s total funding.

Supporting GTRI: Investing in the Future

GTRI has been an integral part of Georgia Tech for almost 75 years. As the largest employer of co-op students, GTRI has helped to launch the careers of several generations of engineers and scientists and has been the catalyst for research that has made profound changes in the way we interact with our world.

Today, GTRI is looking for partners who want to help it inspire, innovate, equip and energize the people who will help us to new research frontiers we can’t even imagine today. The goal in the next five years is to raise money to support students and early-stage researchers and subject area experts who have remarkable ideas with great potential, but who need significant resources to pursue promising research. For the past year, GTRI dedicated more than $4 million to independent research and development. We need to do more. For the first time in 2006, GTRI began to aggressively pursue philanthropy as a source of revenue. Opportunities are now available to make investments in people and research in health care, energy and technology in the United States and Ireland.

For more information, please contact:
Betsy Plattenburg
Director of Development & Corporate Relations
betsy.plattenburg@gtri.gatech.edu
404-407-7889

The Georgia Tech Research Institute attracts local, state, national and international news coverage in media ranging from top-tier outlets such as National Geographic Magazine, Technology Review, CNN and The Economist to technical media such as Electronic Engineering Times, National Defense and Mechanical Engineering to influential online media such as Scientific American.com, MSNBC.com and LiveScience.com. Below are a few examples of coverage received by GTRI’s cutting-edge research.

GTRI Fellows Council

The GTRI Fellows Council assesses future technological directions and makes recommendations for GTRI’s research program. Composed of the organization’s most senior and distinguished research faculty, the council also evaluates proposals for funding through GTRI’s independent research and development program. Members are nominated by their GTRI colleagues and elected by current fellows and laboratory directors. The council is also an internal advisory board for GTRI’s senior leadership on research-related items.

Current Members:
- Krishen Alujas, Aerospace, Transportation and Advanced Systems Lab
- Eric Bamhart, Information Technology and Telecommunications Lab
- Ron Bohlander, (Chair), Information Technology and Telecommunications Lab
- Betty Whitaker, Information Technology and Telecommunications Lab
- Mike Harris, Electro-Optical Systems Lab
- Tom Puffer, Aerospace, Transportation and Advanced Systems Lab
- Larry Corey, Sensors and Electromagnetic Applications Lab
- Dennis Folds, Electronic Systems Lab
- Lon Priting, Signature Technology Lab

Independent Research and Development Funding

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- Test flights of a fuel-cell powered unmanned aerial vehicle generated attention in broadcast, online and print media. Powered by compressed hydrogen, the 22-foot wingspan UAV made several flights of up to a minute in duration. It was designed and built by students and researchers from Georgia Tech’s Aerospace Systems Design Laboratory and GTRI.
- The Atlanta Journal-Constitution, Defense News, MSNBC, Scientific American, LiveScience.com and Discovery Channel Canada covered the work. Atlanta TV station WXEL (CBS 46) and Dial Networks’ HD News also reported on it.

(See the article on page 16 of this annual report).

GTRI's Chemical Companion, a PDA-based system designed to help first responders identify chemicals spilled at the site of an accident – or potential terrorist attack. Beyond helping to quickly identify the spilled chemicals, Chemical Companion also recommends steps to be taken in treating victims, protecting the area and cleaning up the problem.

(See the article on page 11 of this annual report).

A new environmental test chamber large enough to accommodate full-sized office furnishings drew media attention from technical and trade publications – as well as the Web site for National Geographic Magazine. The chamber is helping manufacturers meet increasingly strict requirements regarding emissions from products, and is also helping advance knowledge of indoor air quality issues.

(See the article on page 8 of this annual report).

GTRI's involvement in evaluating the impact of a major chlorine spill and recommending remediation steps was reported in a number of key newspapers throughout the Southeast. The work took place, in part, in Graniteville, S.C., where a train accident resulted in the release of as much as 80 tons of gas. Outlets reporting on the project included The Atlanta Journal-Constitution, Charlotte Observer, Charleston Post & Courier and Columbus State.

(See the article on page 24 of this annual report).

More than 150 news outlets covered GTRI's work on improving accessibility of products and technology for disabled people. GTRI's Accessibility Evaluation Facility was described in an Associated Press wire service article that reached news outlets around the world.

(See the article on page 12 of this annual report).

GTRI's AES Medical Device EI Test Center gained attention in technical and trade publications. The Center tests implantable medical devices to help their manufacturers protect them against potential interference from inventory control systems and other emitters of electronic signals. The Center's work was reported in Mechanical Engineering, Medical Design and Medical Product Manufacturing.

(See the article on page 8 of this annual report).

Technology Review, Electronic Engineering Times, InfoWorld, Network World and Machine Design were among the media outlets reporting on a project known as "Guard Dog," which developed several rapid ease measures for removing sensitive information from magnetic storage media. The work, done in collaboration with U.S. Communications Corp., resulted from a real-world incident in which a U.S. aircraft was forced to land in China. Using high-strength permanent magnets, the prototype systems can quickly and completely erase VHS tapes, floppy disks, data cassettes and small computer hard drives.

(See the article on page 12 of this annual report).


(See the article on page 8 of this annual report).
Aerospace, Transportation and Advanced Systems Laboratory (ATAS)
James McMichael, laboratory director
770.252.7626
ATAS develops advanced systems concepts, performs research and develops technologies related to aerospace and ground transporta-
tion systems, power and energy systems, threat systems, intelligent auton-
omy systems for military and commercial systems, and systems engineering
methodologies. Current research areas include aerodynamics and
flow control, aeroacoustics, computational aeroelasticity, wind tunnel
testing, aircraft structural analysis, robotics, intelligent systems, fuel
cell and battery technologies, biofuels, smart small-scale projectiles,
unmanned aerial vehicles, machine vision, automated highway main-
tenance and air-quality issues.

The lab also performs applied research and development of radar-
related technologies in support of national defense preparedness. The
lab's prototype development capabilities span the spectrum from
mechanical and electronics design and fabrication to full system
integration, including embedded computing and control systems.
ATAS has also achieved a national reputation for its expertise in threat
systems, advanced transmitter technology, radar system development
and weapon system integration.

ATAS conducts significant research directed toward improving the
production and quality of food while minimizing the environmental
impacts of the industry. This program is designed to enhance the
productivity of Georgia's agribusiness and the competitiveness of
Georgia's food processing by applying computer vision, robotics,
plant engineering, bioinformatics and wearable computer technology.
The lab also conducts air quality and transportation research related to
monitoring and reducing the environmental impact of vehicular emissions.

Electronics Systems Laboratory (ELSYS)
Thomas McDermott, laboratory director
404.467.8240
ELSYS focuses on systems engineering solutions in electronic defense
modeling, simulation and analysis; countermeasures technique devel-
oment; sensors performance analysis; electronic warfare systems in-
tegration; standardized test procedures; flight test support; laboratory
support stations and test systems; missile warning system improve-
ments; technology insertion and human systems engineering.

The lab’s researchers are nationally recognized for their contributions
in national defense in countermeasures technique development; employ-
ing an end-to-end approach to countermeasures development. ELSYS
provides high-quality solutions to new development processes and practices
that were assessed as Software Engineering Institute’s Capability Maturity Model Level 3 in a Software Capability
Maturity Assessment (CCEV) conducted in 2003.

ELSYS human systems research includes support to key U.S.
Evaluation (SCEV 3.0) conducted in 2003.

Institute’s Capability Maturity Model Level 3 in a Software Capability
processes and practices that were assessed as Software Engineering
The lab’s researchers are nationally recognized for their contributions to
detailed mathematical modeling and analysis of dynamic systems, specialized instrumentation
and real-time simulation.

ELSYS sensor performance analysis includes intercept receiver analysis,
advanced radar concept 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.

Electro-Optical Systems Laboratory (Eosl)
Gisele Bennet, laboratory director
404.467.5100
Eosl performs cutting-edge research in electro-optical modeling and analysis,
microelectronics and nanotechnology, and remote sensing in
a wide spectrum from acoustics to UV light. The lab's researchers are
organized into agile and flexible technology working groups to enable
multidisciplinary teams to focus on solutions.

Technology areas of pre-eminence include LIDAR systems development,
hyperspectral and multispectral image ultraviolet/irradiated stimula-
tor development; EO countermeasures technology and analysis, wide-
band-gap semiconductors; and advanced packaging for transmit/receive
modules used in active phased array radars. The lab also performs ap-
plied research in the growth and application of carbon nanotubes, multi-
functional materials, RFID and optical tagging and tracking atmospheric
modeling and validation using field data collection and analysis; geopa-
tical information systems and analysis; environmental impacts on human
health; waste-to-energy conversion and human vision modeling.

In addition, Eosl has specially configured research centers: 1) Sen-
sors and Sensing Systems Information and Analysis Center (SENSIAC),
which serves as a military-sensing community as a repository for
design, provider of symposia and specific technical tasks related to sensing
technology; 2) Logistics and Maintenance Applied Research Center (LAMARC),
which provides analysis and solutions to support complex systems; 3) Phosphor Technology Center of Excellence, performing
research and development of phosphor-based light-emitting materials,
devices, and displays; 4) Environmental Radiation Center performing
radiation monitoring of drinking water supplies; 5) Center for Optima-
zation of Simulated Multiple Objective Systems (COSMOS), with expertise
in the use of genetic algorithms for task optimization; 6) Center for Geo-
ographical Information Systems; and the 7) National Guard Technology Program Office, a technology resource center for the National Guard
Counter Counter Drug Operations.

Huntville Research Laboratory (HRL)
Barry Bullard, laboratory director
256.462.1381
Located in Huntsville, Ala., this laboratory primarily supports the U.S. Army
Aviation and Missile Research, Development and Engineering Center
(USA AMRDEC) in its aviation and missile R&D efforts. The laboratory’s
multidisciplinary research skills include battlefield command and
control simulation and analysis, analysis and modeling of complete air
and missile defense systems; sensor and fuse simulation and analysis,
and avionics mission planning software engineering. Other research
involves field and hardware-in-the-loop testing of air defense weapons
equipment, war gaming and force-on-force simulations, guidance and
control simulations, and tactical software development.

Information Technology and Telecommunications Laboratory (ITT)
Randolph Case, laboratory director
404.467.6456
ITT conducts a broad range of research in areas of computer
information and technology, communications and networking, and
develops commercial products from university research. ITTL conducts
research that solves complex problems involving information process-
ing, storage, representation and exchange; Internet and database tech-
nologies and applications; information security and assurance; 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, infor-
mation warfare and assurance, communications networks and network
management, technology assessment, application integration and soft-
ware 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
analysis, capabilities and functional requirements analysis to various
service components across the Department of Defense in northern and
eastern Virginia.

Sensors and Electromagnetic Applications Laboratory (SEAL)
Bill Melvin, laboratory director
770.258.7915
SEAL researchers investigate and develop RF sensor systems,
with particular emphasis on radar systems, electromagnetic environmental
effects in radar system performance modeling and simulation, signal
and array processing, and antenna technology. 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 assessment, signal
processing techniques; space-time adaptive processing; ground and
airborne moving target indication, synthetic aperture radar, and
system sustainment technology development.

Antenna-related research programs characterize antenna gain characteristics, 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, metrology, space-
based surveillance and detection, transportation applications, and
electronic data analysis and modeling for sustainment of complex
electronic systems. SEAL also provides customer-tailored short courses in
electronic defense.

Signature Technology Laboratory (STL)
John Meadors, laboratory director
404.894.2570
STL main focus is the development of technologies for the
management and control of multiprojects, shadow objects and images
observed by sophisticated sensors. STL conducts research and development
devoted to a broad range of topics, including electromagnetic
materials and structures, electromagnetic antennas and scattering,
innovative and infrared physics and phenomenology, secure information
systems and networks and technology assessment of advanced waveform
and sensor technologies, for electronic attack and protection, terahertz
sources, magnetic resonance 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
EM phenomena from quasi-static to UV wavelengths.

Extensive facilities are devoted to optical measurements specialized in
laser and light-wave scattering, electromagnetic materials charac-
terization, radar cross-section measurements, antenna characterization
and computational electromagnetics. These are applied to the
design, fabrication and testing of thixotropic compositional doped tailored
performance and controlled impedance surfaces for management/control
of signature characteristics from systems level to components. Numerical
methods and algorithms has recently been expanded to nano- and micro-
materials and structures, which are used for complex system modeling
and simulations. Novel techniques for correlating optical and infrared
scattering properties with material composition have been developed and
deployed for application to paint and holographic film character-
ization, optical signature control, and the detection of sensors and
image-based tracking algorithms. This lab's secure information systems
work is nationally recognized for the design, development and deploy-
ment of enterprise information systems requiring state-of-the-art
data bases, platform and Internet security.
facilities, property control and administration. There were also 270 full-time professional staff members who have administrative duties and assist both GTRI researchers and customers. They include skilled technical specialists and others working in the areas of business services, budgeting, information technology, security, communications, facilities, property control and administration.

The Georgia Tech Research Institute hires, equips and supports the best research faculty and support personnel in the business. GTRI’s staff has expertise in most recognized fields of science and technology. As of June 2006, GTRI had 1,290 employees, including 347 full-time engineers and scientists. Among GTRI’s full-time researchers, 70 percent hold advanced degrees. Other employees include additional faculty members, students and consultants, who work in the research program on a part-time basis.

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**OUR PEOPLE:**

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**OUR STUDENTS:**

GTRI is the largest employer of bright and eager Georgia Tech graduate and undergraduate students who work alongside full-time researchers, making unique contributions to real projects for real sponsors.

Many of the highly skilled researchers now employed by GTRI began their careers as student employees. Each year, as many as a quarter of GTRI’s new full-time researchers are hired from among former Georgia Tech students. GTRI also has relationships with other prominent universities, providing opportunities for their students to work with Georgia Tech researchers to gain practical engineering experience.

**PEOPLE PROFILES**

**Rebecca Caravati**

First “Rate” Singer

Rebecca Caravati, GTRI’s rate management manager, has been singing her entire life. At only four years old, she was a soloist at her church. In college, she received an accounting degree, but also studied music. After graduation, she traveled across the state with the Miss Georgia Superstars performance troupe. She has even made a brief appearance on NBC’s Today Show, but the most exciting experience in her musical career was singing with the Peter Duchin orchestra. Rebecca has recorded her very own Christmas CD, and currently lends a hard to the children’s music program at St. Anne’s Episcopal Church in Atlanta.

**Rusty Embry**

Keeping Buzzy

GTRI Maintenance and Construction Manager Rusty Embry may be a Georgia Tech Yellow Jacket fan, but he’s also a top-notch beekeeper. For nearly a year, he has tended to his buzzing buddies who live in two hives at his home in the Atlanta suburb of Powder Springs. Starting with only 2,000 bees, his hives now have more than 80,000 bees. He says bees are fascinating creatures and are surprisingly gentle — unless you get them upset — which he admits he learned the hard way. The hives produce about 20 gallons of honey each year, which usually makes its way into care packages for family and friends.

**Grover Richardson**

Scorching Heavy Metal

Nearly 24 years ago, GTRI Electronics Specialist Grover Richardson attended a blacksmithing event at the Atlanta History Center and he’s been bending hot metal ever since. As a member of the Alex Bealer Blacksmith Association of Georgia, he travels around the Southeast teaching seminars and giving demonstrations. You can say he’s literally written the book on blacksmithing — it’s called Impressions, Blacksmithing Made Easy. Grover says he does it because it’s fun and “hand-forged iron will last a lifetime, and if well maintained, a little bit longer.”

**Dennis Crain**

Racking Up the Miles

Dennis Crain really loves his job as budget manager for GTRI, and the mileage on his car proves it. He lives in Columbus, N.C. — 200 miles from his office on the Georgia Tech campus in Midtown Atlanta. He travels to town on Tuesday morning and heads home on Thursday evening. He’s kept up the routine for four years and has plans to keep on trucking. He says his commute “isn’t really that bad,” and only puts 23,000 miles a year on his trusty 1988 Acura.

**Bobby Golden**

Rock Star Researcher

In 1972, several musicians got together and after a few jam sessions the band Stillwater was born. In fact, Cameron Crowe, writer for Rolling Stone magazine, went to several of Stillwater’s gigs and wound up using the name for the fictional band in his movie “Almost Famous.” Stillwater released two albums on Capricorn records: “Stillwater” (1977) and “I Reserve the Right” (1979). The top-40 single “Mindbender” was released in 1977 and was number one in Atlanta. Stillwater guitarist Bobby Golden now devotes his time to his work in electronic warfare at GTRI and to an occasional Stillwater concert.

**Dave Roberts**

A Passion for Pictures

Senior Research Scientist Dave Roberts has always been fascinated by art, especially art dealing with the natural world. He says photography allows him to interact with the subject more than other art forms, and his specialty is nature photography. “It’s a very creative activity and parallels the creativity that I have to bring to my work,” Dave said. “It also helps that photography involves optics, which I am passionate about and is the focus of much of my research.” He’s been snapping away for 10 years and hopes to see his work hanging in galleries some day. Some of his pictures have already graced the pages of GTRI publications.

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Composed of leaders from both government and industry, GTRI’s External Advisory Council brings an outside perspective to the organization’s management. The Council helps GTRI stay current with industry trends and meet the changing needs of government contractors. Council members include:

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Georgia State Representative, District 46

Dr. Robert S. Cooper  
President & CEO, Atlantic Aerospace Electronics Corporation

Mr. Alan J. McLaughlin, (External Advisory Council Vice Chair)  
Director, Lincoln Labs/MIT, Ret., Strategic Planning & Technology Consultant

Ms. Susan M. Coughlin  
President & CEO, Aviation Safety Alliance

Mr. Glen P. Robinson Jr.  
Chairman & CEO, LaserCraft

Dr. Bart Barthelemy  
Executive VP, Scientific-Atlanta

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Mr. H. Allen Ecker  
Executive VP, Scientific-Atlanta

The Hon. James W. Tysinger  
Former Georgia State Senator

Dr. John F. Cassidy Jr., (External Advisory Council Chair)  
Senior VP of Sciences & Technology, United Technologies Corporation, Ret., Consultant

The Hon. Jack Hill  
Georgia State Senator, District 4

Ms. John J. Welch Jr., (USAF, Ret.)  
Technology Consultant

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THE 2006 GTRI TEAM

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