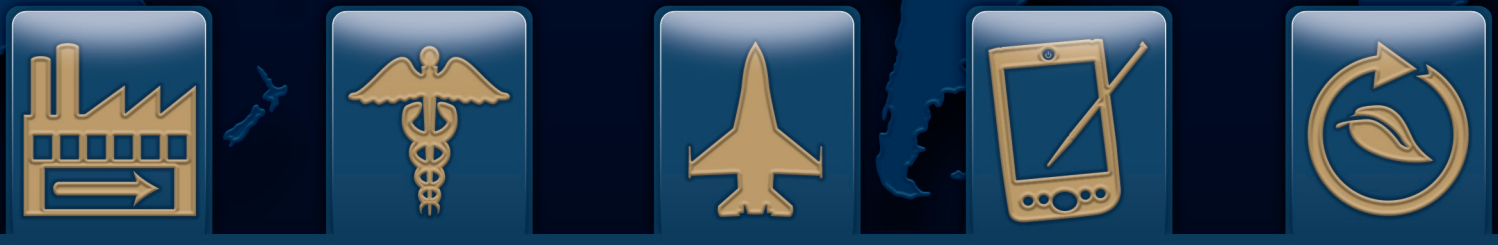
2007 Annual Report

PROBLEM. SOLVED.



Manufacturing Technologies | Health and Human Systems | Defense and Security | Information and Communication Technologies | Energy and Environment

Georgia Tech Research Institute

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PROBLEM. SOLVED.

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.

TABLE OF CONTENTS

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PROBLEM SOLVING. FUTURE BUILDING.

That's GTRI – the Georgia Tech Research Institute – a leading university-affiliated applied research center.

Our world-class scientists and engineers turn complex challenges into creative, real-world solutions for government and industry…transferring knowledge…and solving tomorrow's problems today.

Proactive and collaborative. GTRI uses an interdisciplinary, team approach to solve problems with unmatched expertise. Our people turn fresh ideas into practical and effective solutions and then put those solutions into action.

Since 1934, GTRI has served as a trusted partner to government and industry, solving challenging technical problems and serving as a source of true innovation.

Welcome to GTRI.

Problem. Solved.

Genuine Innovation

Genuine innovation takes place when unique ideas and inventions are put into action. Our researchers drive innovation beyond the basics to prototyping, field testing and real-time, real-scenario performance.

Trusted Partnerships

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

Real Value

We have a nearly 75-year history of serving the research needs of our customers by combining interdisciplinary expertise, creative thinking and real world practicality. From ideas to impact, the complex becomes simple and tough problems are solved – the right way – the first time.

Institutional Leverage

Working with GTRI helps government and industry customers open the door to the vast intellectual resources of the Georgia Institute of Technology, one of the nation's top research universities. GTRI and Georgia Tech are complementary world-class institutions, collaborating to solve the innovation equation for clients.

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Genuine Innovation.

Innovation seems to be an overused term these days. But at GTRI, it is real and it plays a vital role in all of our work. Innovation is our passion, and it is genuine.

Innovation has been the driving force behind GTRI since its creation in 1934. It therefore seems appropriate to introduce our 2007 annual report by defining what innovation means at GTRI. To summarize our culture and way of work, we have been using the tagline "solutions through innovation," which we have now restated as simply: "Problem. Solved." Anyone who knows us knows we can be counted on for innovative solutions.

During the past year, we have had visits from the president of Ireland, heads of major corporations, high-ranking government officials, and, most important, clients with difficult problems they needed solved. As you read through this annual report, you will see stories of genuine innovation in different market areas, and you will learn about some of the amazing people who made this possible. You will see three attributes reflected in all of our work that allow us to make a bold statement that GTRI drives genuine innovation.

GTRI drives innovation through three key attributes:

TRUSTED PARTNERSHIPS

The insight and invention used to define innovation is predicated on our reputation as an "honest broker" and our relationship with government and industry clients.

REAL VALUE

The implemented solutions we deliver as "problems solved" are repeatedly cited by our stakeholders for their impact on their organizations.

INSTITUTIONAL LEVERAGE

Our role as an integral part of the Georgia Institute of Technology, one of the world's great global research universities, ensures that our research and problem solving will stay at the leading edge.

In summary, what is genuine innovation? The Georgia Tech Research Institute - GTRI! Thank you for taking the time to review our 2007 annual report. Please feel free to contact me at any time.

Sincerely,

Stephen E. Cross

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

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Georgia Tech Research Institute

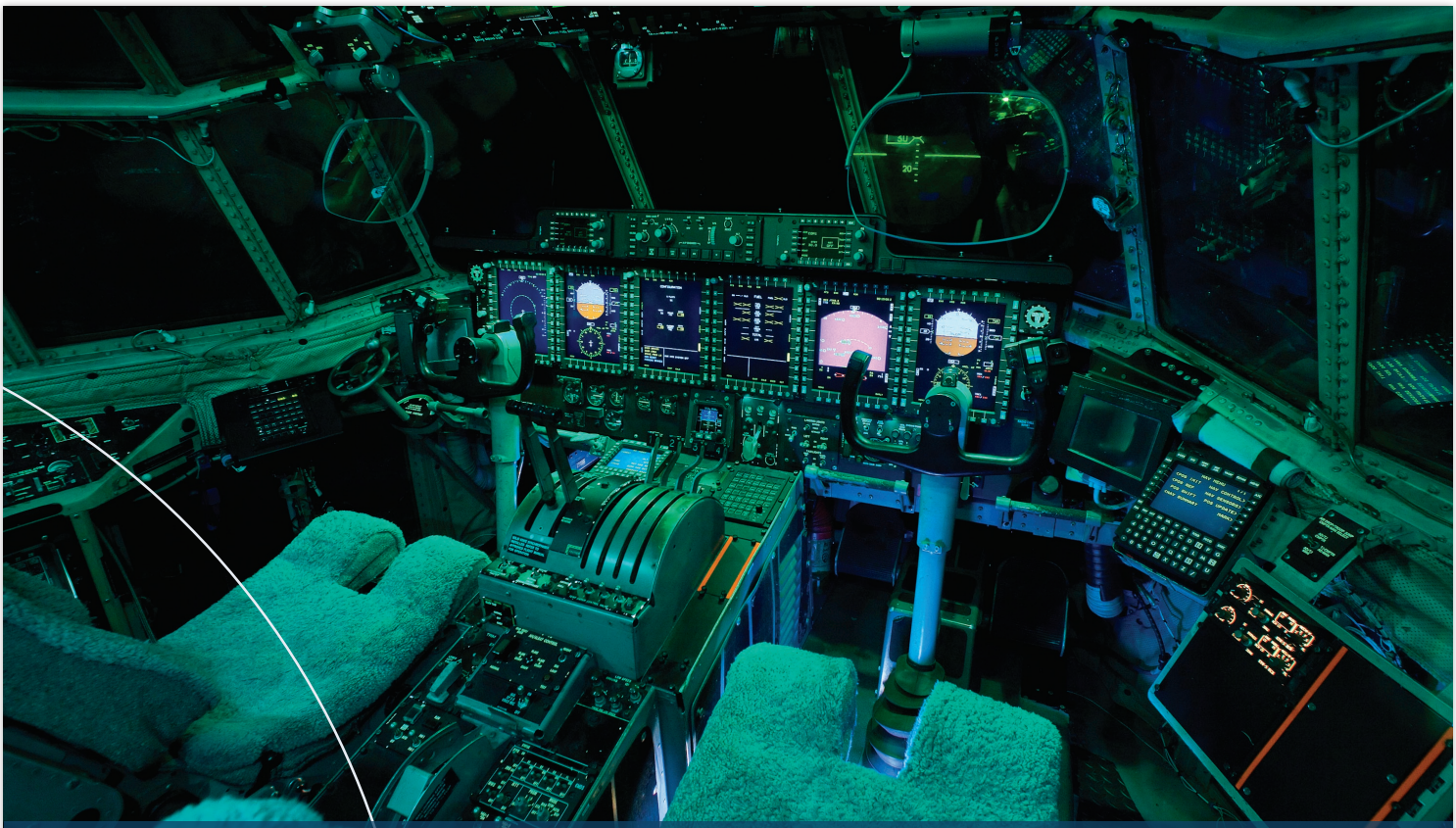
Research at GTRI solves problems for government and industry. We are uniquely positioned to transfer expertise and innovation from one market to another, which amplifies the positive impact of our work and increases the value to our customers.

Defense and Security

GTRI has a strong reputation for meeting the mission-critical needs of the U.S. military and other federal agencies supporting defense and homeland security. GTRI proudly serves the nation by providing expert solutions to tough technical problems, creating a strategic advantage and helping protect our nation.

- Test and Evaluation
- Vehicle Survivability
- Integrated Air & Missile Defense
- Integrated Sensing
- Systems Engineering
- Electro-Optical/Infrared Systems
- Radar Systems
- Unmanned Vehicles
- Command & Control
- Technology Insertion
- Logistics
- Human Systems Integration
- Threat Simulation & Data Analysis
- Counter-IED
- Modeling and Simulation

Upgrading C-130 Defensive Capability



GTRI is helping to modernize the defensive avionics of the C-130 aircraft, shown here.

GTRI is helping the U.S. Air Force improve the defensive electronic warfare technology onboard some of its largest and most widely used aircraft.

Today's military aircraft often have both a suite of advanced sensors and connections to tactical data networks. For these aircraft, net-centric warfare is today's reality. Threat information can be pushed into the cockpit from these varied sources and can change rapidly as location and conditions change across the battlefield.

GTRI's Integrated Defensive Avionics Software (IDAS) provides a proven correlation and threat response capability, complementing the core electronic warfare functions of the radar warning, missile warning and countermeasures systems. IDAS has been used on fixed-wing fighters and cargo aircraft, as well as rotary-wing platforms.

"IDAS supports rapid threat display and response and it helps present accurate and usable information to the aircrew," said Joe Brooks, a GTRI principal research engineer.

IDAS was developed in conjunction with the 542nd Combat Sustainment Squadron at Robins Air Force Base. IDAS includes a multi-hypothesis threat data correlator that fuses information from onboard sensors and data links, and it provides real-time threat response management functions required to counter radio frequency and infrared threats. It includes automated chaff and flare countermeasures.

"The IDAS design incorporates a threat response scripting language that is used by the mission data writer to build individual threat responses," said Linda Viney, a GTRI principal research engineer. "It is this flexibility that enables IDAS to be deployed across various missions and platform types."

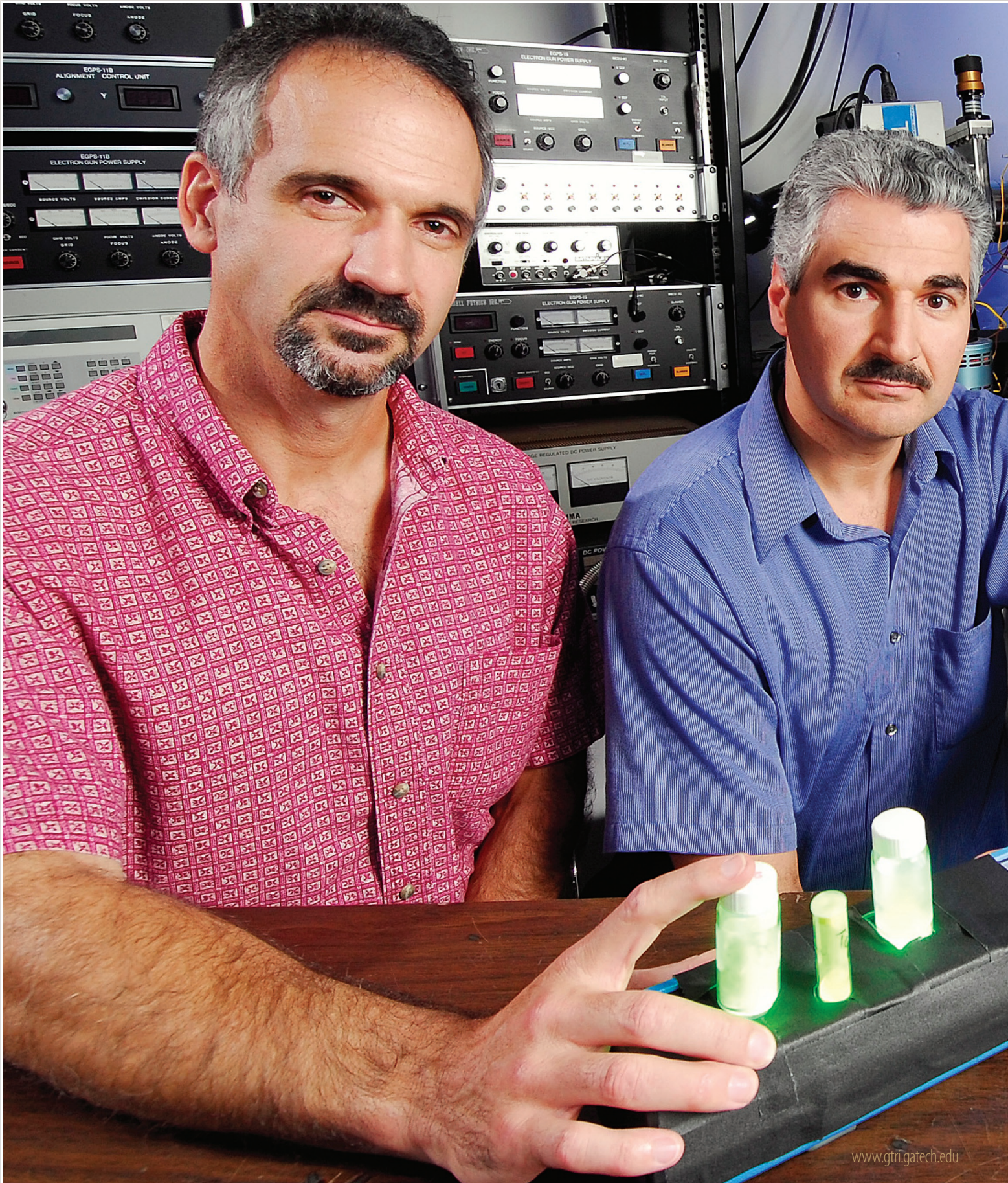
GTRI has worked with the Air Force Research Laboratory for the past five years in developing displays to enhance situational awareness. These user interface designs are used for applications of the IDAS system.

IDAS incorporates the Virtual Electronic Combat Training System (VECTS) function in its operational flight program. VECTS provides in-flight aircrew tactics training that simulates training threats, off-board contact reports, and Blue Force reports based on the VECTS Mission Data File.

Several training missions can exist in a single trainer scenario file list, each defining a training area and set of pseudo-threats and reports. VECTS also supports a mission debriefing capability.

Working with the Boeing Co., GTRI is currently updating the IDAS software under the C-130 Avionics Modernization Program (AMP) to add capability and update to open-systems standards.

Improving Anthrax Decontamination with Optimized Phosphors



In October 2001, anthrax spores delivered in letters killed five people and infected 17 others. Clearing the Senate office building of the spores cost $27 million, according to the Government Accountability Office. Cleaning the Brentwood postal facility outside Washington, D.C., cost $130 million and took 26 months.

GTRI researchers, in collaboration with Austin-based Stellar Micro Devices, Inc. (SMD), have developed prototypes of a rapid, non-disruptive and less expensive method that could be used to decontaminate future bioterrorism hazards.

Using flat panel modules that produce X-rays and ultraviolet-C (UV-C) light simultaneously, the researchers can kill anthrax spores in two to three hours without any lingering effects. The system also has the ability to kill hidden anthrax spores without causing damage. The current decontamination standard, chlorine dioxide gas, cannot reach hidden spores and people cannot enter the affected spaces until the gas is neutralized and vented from the building.

"This is certainly an improvement over previous techniques," said Brent Wagner, GTRI principal research scientist and director of its Phosphor Technology Center of Excellence (PTCOE). "The UV-C attacks spores on surfaces and the X-rays penetrate through materials to kill spores in cracks and crevices."

GTRI became involved in SMD's project, which was funded by the Air Force Research Laboratory's Small Business Innovation Research program, because the PTCOE housed UV-C phosphors created and patented by Sarnoff Corporation in the mid-1970s.

"We knew Georgia Tech had experts in powder phosphors with regard to flat panel displays and we approached them to develop new phosphors for our decontamination purpose," said Mark Eaton, president and CEO of SMD.

Wagner and senior research scientist Hisham Menkara optimized a phosphor that emits UV-C, which destroys an organism's DNA. They hope to develop more efficient UV-C phosphors for sterilizing medical equipment or purifying water.

"We may be able to use UV-C panels to clean wastewater, which would be better than the lamps currently used. In the environment where the lamps must operate, they are very difficult to clean, whereas flat panels could be cleaned with a squeegee," added Eaton.

Researchers are using improved phosphors in a combination X-ray/ UV-C system to kill anthrax spores.

Building an Autonomous Vehicle for Urban Environments

The blue Porsche Cayenne pulls up to a four-way intersection and stops. It waits for other traffic to pass, then proceeds through the intersection. This scene may sound normal enough, but this is no ordinary Porsche Cayenne—it thinks for itself and requires no driver.

The autonomous vehicle was designed by researchers from three Georgia Tech units – GTRI, the College of Computing and College of Engineering – along with Science Applications International Corporation (SAIC). Dubbed Sting 1, the vehicle was entered in the Defense Advanced Research Projects Agency's (DARPA) Urban Challenge competition during fall 2007.

The Urban Challenge is the third in a series of DARPA-sponsored competitions aimed at fostering the development of robotic ground vehicle technology. Safe operation in traffic is essential to U.S. military plans to use autonomous ground vehicles to conduct important missions and keep American personnel out of harm's way.

Sting 1 was designed to drive without any human intervention and obey California traffic laws while performing maneuvers such as merging into moving traffic, navigating traffic circles and avoiding moving obstacles.

"The car needed to detect obstacles in its path and then plan and execute a different route around the obstacles," said Tom Collins, electronics lead for the project and a GTRI principal research engineer.

Eight computers were networked together through two high speed networks and programmed to know the rules of the road. This included knowing how to stay in a lane, how to overtake another vehicle, how to make turns in city traffic, how to maneuver the waiting patterns at an intersection, how to merge into traffic and how to behave in a parking lot.

On marked paved roads, a camera kept the car in its lane by detecting the typical white and yellow lines that mark a driving lane. If the vision system was unable to find a lane, the car used lasers to follow the curb. Ten range finders sent out infrared laser beams that constantly scanned to provide Sting 1 with an accurate measurement of the distance to obstacles such as curbs and other vehicles.

Sting 1 competed against 34 other teams in the National Qualifying Event held in October 2007 at the former George Air Force Base in Victorville, Calif. Though they did not make it to the final challenge, GTRI researchers are already thinking about how the technology could take on other tasks.

"We're also looking forward to using the technologies in applications such as autonomous lane striping for the Department of Transportation," said Vince Camp, hardware lead and a GTRI senior research engineer.

Based on a Porsche Cayenne, Sting1 was developed by researchers from Georgia Tech and SAIC for the DARPA Urban Challenge.

Tracking Soldiers during Testing Exercises

The 21st century battlefield has moved predominantly from open environments to cities, towns and villages. Military Operations on Urban Terrain (MOUT) testing facilities on bases around the country allow the services to prepare to fight in these surroundings.

While soldiers test equipment, tactics and procedures for clearing buildings and patrolling urban streets, videos capture their movement in selected MOUT structures. However, the cameras are not able to capture every decision made and action taken during the test.

A team led by GTRI senior research engineer Dinal Andreasen aims to change that. The team is developing a wideband local positioning system to track the location of soldiers every second during an exercise, even when they're inside buildings.

"You can't just hand each soldier a global positioning system (GPS) device and track his or her movement," said Barry Sharp, a GTRI senior research engineer. "GPS loses accuracy and tracking ability in buildings, so it's not helpful if you're monitoring inside structures."

So Sharp, Andreasen and senior research engineers Mike Baden and Andre Lovas chose to transmit radio frequency waveforms that degrade more slowly as they pass through buildings. With four transmitters located up to a football field length away from the buildings, the GTRI researchers plan to demonstrate that they can locate a receiver-carrying soldier to within six inches.

To track the soldier, each transmitter will send out very long signals at two wavelengths – 915 megahertz (MHz) and 5.49 gigahertz (GHz). Since the higher 5.49 GHz signal can avoid most interference, including wireless networks, microwaves and walkie-talkies, it would be optimal to find a soldier's position with that signal alone. However, the Federal Communications Commission (FCC) limits the power that can be transmitted with the 5.49 GHz signal to 0.1 milliwatts.

"If the receiver searched for the 5.49 GHz signal, it would take almost 10 minutes to find its position," noted Baden.

Alternatively, the lower 915 MHz signal can be transmitted at a much higher power, allowing for better penetration through walls. The use of two frequencies is necessary to overcome the limitations of each. The researchers divide the 915 MHz signal into 128 different segments so they can quickly find an approximate position of the receiver.

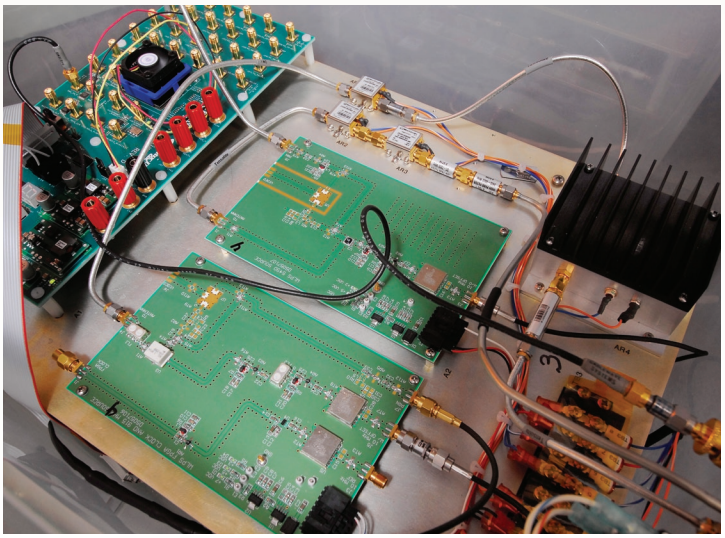
Then they search that approximate location in the 5.49 GHz signal to find the receiver's exact location, reducing the search time to approximately five seconds. Once the receiver knows its distance from four transmitters, trilateration – similar to triangulation – determines the exact location.

Beyond tracking soldiers, the GTRI researchers believe their positioning system could be helpful in tracking firefighters inside burning buildings. If four emergency vehicles arriving at a fire had GPS and a transmitter, the local positioning system could automatically configure itself to track the firefighters inside the building.

"If a firefighter is in distress and not moving, our system could guide another firefighter to the distressed firefighter's location to save him or her," explained Sharp.

GTRI researchers are collaborating with James Buxton at the Aberdeen Test Center in Maryland and local company Research Network, Inc. on this project. This research was funded by the Test Resource Management Center's Test and Evaluation/Science and Technology Program through Naval Undersea Warfare Center contract N66604-06-C-2335.

A local positioning system developed by GTRI tracks soldier locations during training exercises.



SUSTAINing a Variety of Defense Systems

SUSTAIN has added supply-chain analysis modules and extended its support for aircraft maintenance. Shown are Air Force maintenance crews.

SUSTAIN, a GTRI software suite used by the U.S. military to support aircraft maintenance by tracking obsolete parts, has added support for conventional aircraft-related maintenance and sustainability tasks.

GTRI scientists have developed new modules that offer in-depth supply chain management analysis. SUSTAIN decision aid tools can now keep managers current on everyday maintenance and sustainment by addressing such critical issues as reliability, procurability and serviceable versus unserviceable equipment.

The new modules expand the program's original focus, which centers on mission-degradation analyses that help managers forecast obsolescence issues on older systems and acquire obsolete components.

"By using SUSTAIN, many managers find that component obsolescence isn't such a major problem for them – that they can resolve issues by employing part-substitution and sub-assembly redesign," said Powers Garmon, a GTRI principal research scientist who leads the SUSTAIN program. "What concerns them most is being sure they can meet mission requirements, and that includes monitoring the reliability of their key assemblies and the necessity of keeping a certain number of items serviceable."

SUSTAIN includes decision-aid modules for supportability, mission degradation and technology insertion. Each module allows managers to look at maintenance and sustainability from different perspectives, ranging from high-level overviews to detailed parts-level information.

GTRI began SUSTAIN by custom developing software for specific Air Force programs. In a typical SUSTAIN project, GTRI scientists extract and analyze maintenance data. Then they transfer that work to SUSTAIN software, which analyzes and models the data and allows managers to track their maintenance situation more clearly.

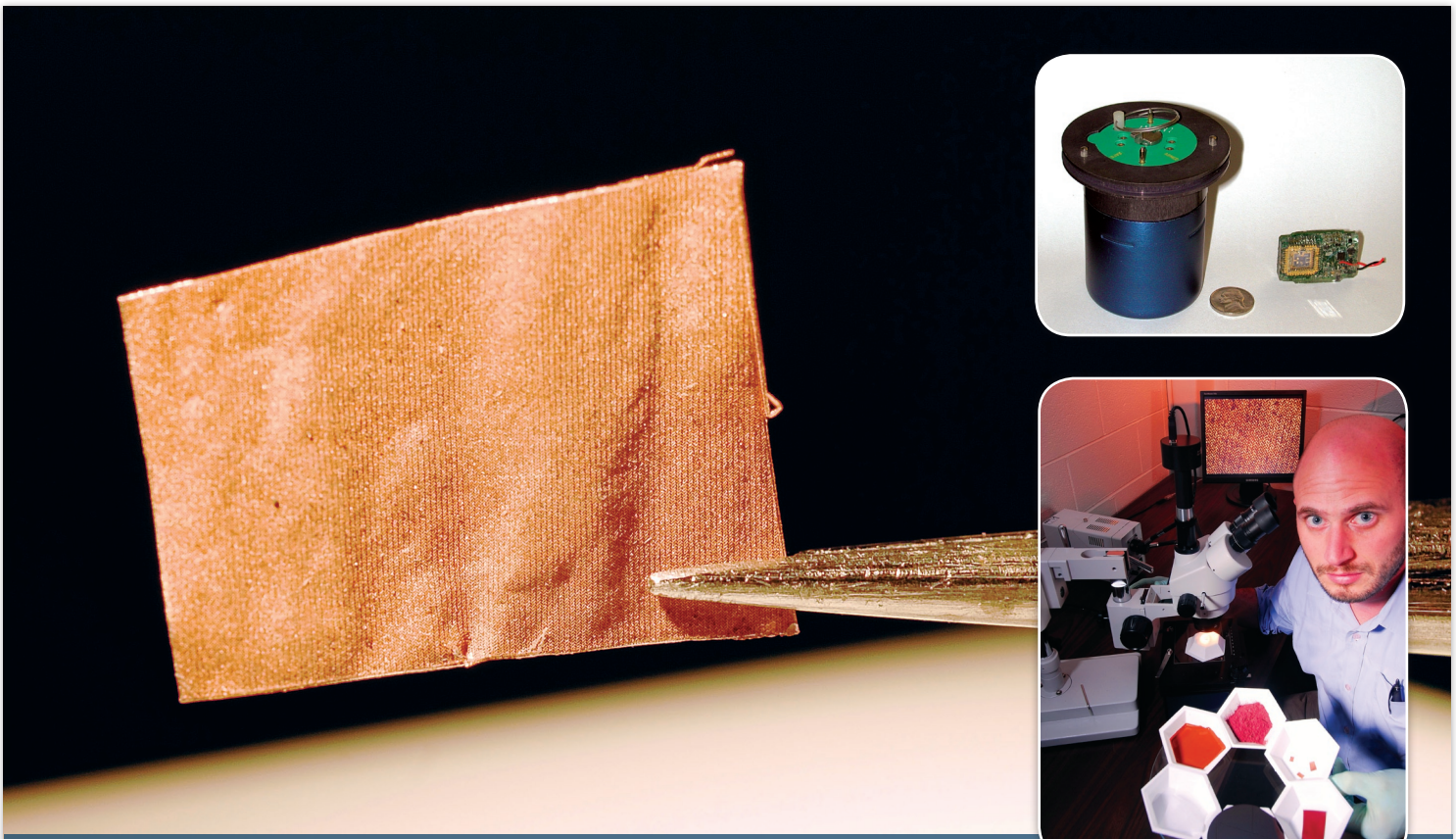
SUSTAIN's designers have increasingly automated the software over the years. They have found that extensive automation can allow a small staff to support an entire sustainment program, while limiting the need to use commercial databases to obtain maintenance-related information.

SUSTAIN can be used for an array of defense maintenance tasks. For example, it is currently supporting an extensive GTRI technology-insertion project involving a large number of military air traffic control radios. (See page 39)

Garmon believes SUSTAIN can be used effectively for most defense-related maintenance and sustainment tasks. Moreover, he adds, SUSTAIN is cost-effective, typically offering a 20-to-one return on investment. "SUSTAIN can analyze the procurability status of essentially any type of component," he said.

SUSTAIN currently includes seven modules: mission degradation, supportability assessment, technology insertion, depot repair assessment, inventory assessment, reliability assessment and repair and cost assessment.

Enabling a New Generation of Munitions



For the Naval Surface Warfare Center, GTRI researchers have developed an improved technique for fabricating an explosive precursor material based on copper.

Tiny copper structures with pores at both the nanometer- and micron-size scales could play a key role in the next generation of detonators used to improve the reliability, reduce the size and lower the cost of certain military munitions.

Developed by a team of scientists from GTRI and the Indian Head Division of the Naval Surface Warfare Center, the highly uniform copper structures will be incorporated into integrated circuits – then chemically converted to millimeter-diameter explosives. Because they can be integrated into standard microelectronics fabrication processes, the copper materials will enable micro-electromechanical systems (MEMS) fuzes for military munitions to be mass-produced like computer chips.

"An ability to tailor the porosity and structural integrity of the explosive precursor material is a combination we've never had before," said Jason Nadler, a GTRI research engineer. "We can start with the Navy's requirements for the material and design structures able to meet those requirements. We can have an integrated design tool able to develop a whole range of explosive precursors on different size scales."

Nadler uses a variety of templates, including microspheres and woven fabrics, to create regular patterns in copper oxide paste whose viscosity is controlled by the addition of polymers. He then thermochemically removes the template and converts the resulting copper oxide structures to pure metal, retaining the patterns imparted by the template. The size of the pores can be controlled by using different templates and by varying the processing conditions. So far, he's made copper structures with channel sizes as small as a few microns – with structural components that have nanoscale pores.

Based on feedback from the Navy scientists, Nadler can tweak the structures to help optimize the overall device – known as a fuze – which controls when and where a munition will explode.

The copper precursor is a significant improvement over the copper foam material that Indian Head scientists had previously been evaluating. Produced with a sintered powder process, the foam was fragile and non-uniform, meaning Navy scientists couldn't precisely predict reliability or how much explosive would be created in each micro-detonator.

"GTRI has been able to provide us with material that has well-controlled and well-known characteristics," said Michael Beggans, a scientist in the Energetics Technology Department of the Indian Head Division. "Having this material allows us to determine the amount of explosive that can be formed in the MEMS Fuze. The size of that charge also determines the size and operation of the other components."

Improving Reliability of Radar Warning Receivers

GTRI researchers have patented a discovery that could significantly increase the reliability and reduce the cost of equipment that helps protect U.S. military aircraft from attack.

The patent covers a device called a digital crystal video receiver, a vital part of the radar warning receiver system that alerts an aircraft crew to enemy ground-radar activity. GTRI researchers Michael Willis and Michael McGuire, working with Air Force scientist Charlie Clark, have patented a way to use digital circuitry to perform many functions formerly allotted to more problematic analog chips.

Specifically, the researchers have moved a critical operation – the logarithmic transfer function – from the analog to digital domain. The logarithmic transfer function coordinates the input and output of a radar warning receiver's signal processing system.

"Electronic analog technologies have a number of error sources and limitations when subjected to the extended temperature range that our military requires," said Willis, a GTRI principal research engineer. "By moving the logarithmic transfer function into the digital signal processing domain, we've improved the stability of the circuit."

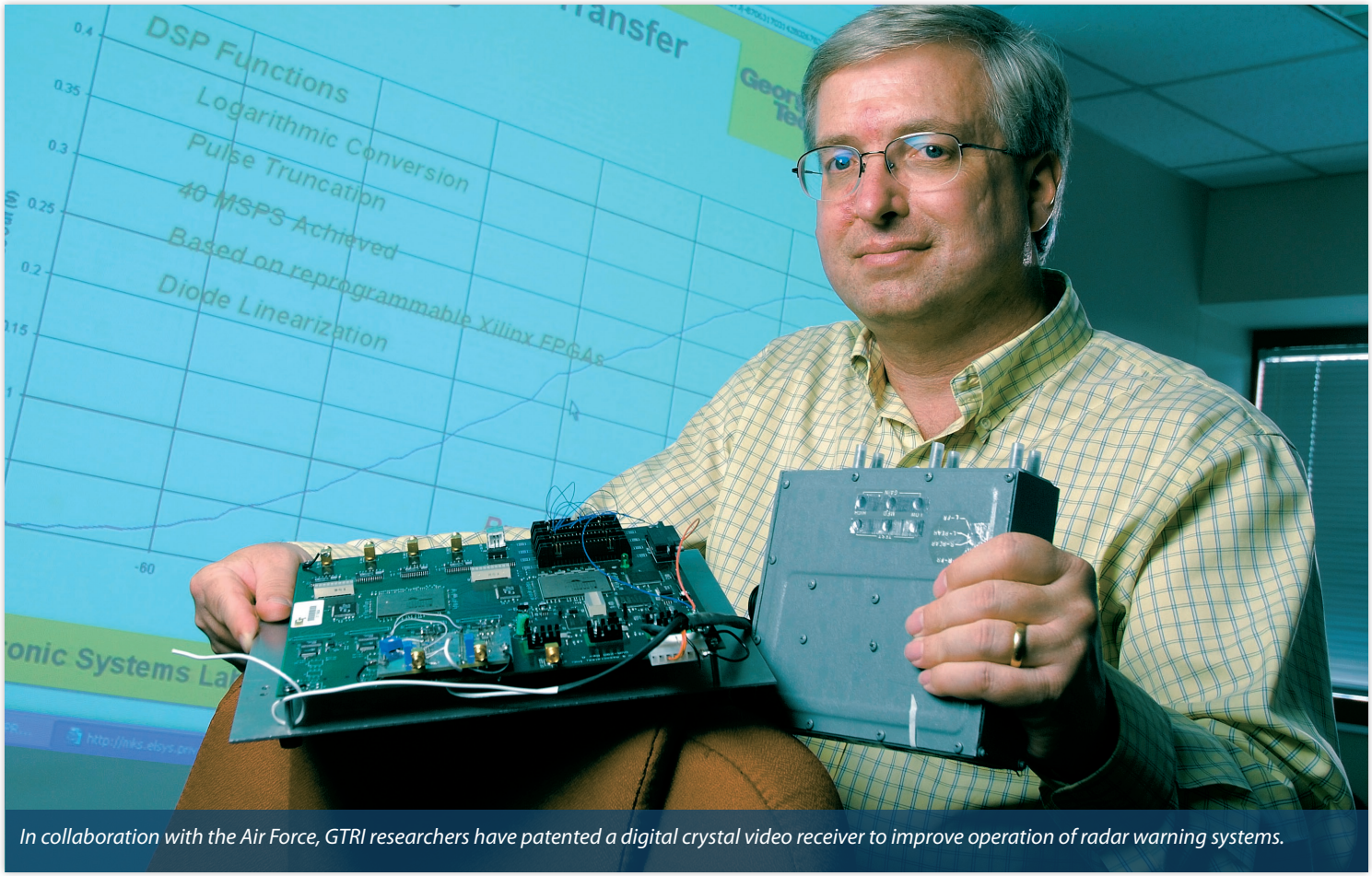
Analog circuits, traditionally used to detect real-world phenomena such as sound or temperature, hold a multitude of continuous values across any given range. By contrast, digital circuits process information in discrete steps governed by the binary code that computers use.

In radar warning receivers, Willis explained, the continuous-scale analog implementation has been difficult to calibrate and maintain. By contrast, the digital domain needs no calibration and is more robust. The digital version is also far less expensive to manufacture.

"Moving the logarithmic transfer function from analog to digital probably reduces production costs of a radar warning receiver by a factor of between five and 10," he said. "The cost of the digital video portion could become nearly insignificant in comparison to the cost of the remainder of the system."

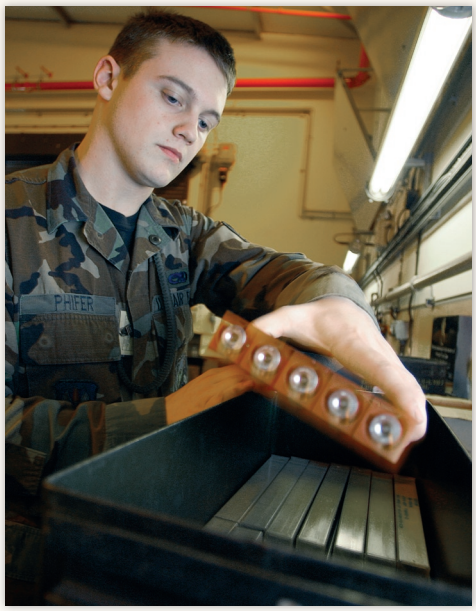
The new digital crystal video receiver is composed of an analog-to-digital converter and programmable logic component. Together, they're able to transfer most received analog signals to the more reliable digital domain.

Commercial applications are also possible for the technology. The discovery could be applied to any receiver that requires a logarithmic transfer function, including many types of radios and other devices that involve signal receiving and processing capabilities. GTRI is currently studying how to implement the new technology, Willis added.



In collaboration with the Air Force, GTRI researchers have patented a digital crystal video receiver to improve operation of radar warning systems.

Improving Missile Warning Systems with Genetic Algorithms



GTRI is helping improve missile warning systems. An Air Force technician, left, loads a chaff dispenser while an AC-130H Gunship, above, jettisons flares to distract missiles.

GTRI researchers are using genetic algorithms to improve the missile warning systems that alert pilots to approaching threats.

Senior research engineer Greg Rohling is optimizing the detection software that distinguishes missiles from background signals. Many constants in the code are good candidates for optimization, according to Rohling, who aims to detect all threats not identified by existing software – while not increasing the number of false alarms.

"The code might say 'if X is greater than three, then do something.' That three is a magic constant," said Rohling. "Would changing the constant to 3.1 or 2.5 allow the program to detect more missiles?"

With funding from Warner Robins Air Logistics Center and Naval Air Systems Command (NAVAIR) Tactical Aircraft Protection Systems (PMA-272), Rohling found hundreds of these constants in the software.

"Think of each constant as a knob. I can turn the hundreds of knobs a little bit and every time I might get a different detection rate," said Rohling. "But evaluating all of the knob combinations would take years, and we don't have that kind of time."

To evaluate the best value for each constant, Rohling uses a computing concept called genetic algorithms to speed up the optimization process. By mimicking the same processes Mother Nature uses, such as selection, mating and mutation, genetic algorithms evolve solutions to problems to find the best one.

He begins with many different sets of knob combinations; each set is called an individual. Principal research scientist Ed Patterson creates missile data that allows each individual to be tested using computer simulations.

After a round of simulations, poor performing combinations of constants are thrown out and remaining individuals can be selected, mated or mutated. Individuals that performed well are selected to move on to the next round. Then, based on their performance, the remaining individuals have a certain probability of mating and a new individual is created by selecting half of the constants from one individual and half of the constants from another individual. Mutation involves tweaking a few knobs in one individual to create a new individual.

New individuals are tested until the detection rate no longer improves. The team tested more than one million different constant combinations to find the best. "This optimization provides a quantitative way of measuring the success or failure of the computer program that detects missiles," explained Rohling.

Principal research engineer Jeff Hallman and research engineer Garth Girman verified that the optimized software remained compatible with the system hardware by testing thousands of recorded test range files and synthetic missile shots.

"We found that the optimized program improved the hardware's missile detection rate and did not increase the false alarm rate compared to the current software," said Hallman.

The optimized software will be submitted to Alliant Techsystems, which subcontracted GTRI for the testing part of the project. Later, it will be tested by the U.S. Navy.

The GTRI researchers working on this project are among more than 50 teams performing research and development activities through SENSIAC, the Military Sensing Information Analysis Center. SENSIAC is operated by the Georgia Institute of Technology and provides information and research services to all defense-related elements of the U.S. government.

Health and Human Systems

Manufacturing Technologies

GTRI develops solutions for government and industry that address accessibility and point-of-care needs. Our ability to deliver innovative technologies through interdisciplinary teams of scientists, engineers and clinicians provides systems-based, real-world solutions to complex health-related problems.

- Accessibility/Assistive Technologies
- Medical Device Technologies
- Dental Technologies
- Health Information Technologies
- Clinical Performance Systems
- Community Clinic Technologies
- Workplace Safety/OSHA
- Air/Water Quality

Investigating the Causes of Asthma Attacks

GTRI researchers have developed a sensor system that continuously monitors the air around people prone to asthma attacks. Worn in the pockets of a vest, the new system could help researchers understand the causes of asthma attacks.

"We are investigating whether we can go back after an asthma attack and see what was going on environmentally when the attack started," said Charlene Bayer, a GTRI principal research scientist. The research was supported by the U.S. Department of Housing and Urban Development and initial funding from the GTRI Independent Research and Development (IRAD) program.

The battery-powered system fits into the pocket of a vest and contains commercially available sensors that were integrated into a single system by Mark Jones, chief executive officer of Keehi Technologies.

"The device weighs less than one pound including batteries. It takes a measurement of air every two minutes, stores the data in on-board memory and then sleeps to conserve battery power," noted Jones.

The sensors measure airborne exposure to formaldehyde, carbon dioxide, ozone, nitrogen dioxide, temperature, relative humidity and total volatile organic compounds. In addition, a special mesh filter collects particles that are counted and analyzed at the end of the sampling period.

Bayer and GTRI research scientist Robert Hendry calibrated and tested the sensors in a large room-sized chamber that simulates real-world environmental conditions inside buildings. Coupled with sensitive mass spectrometers, the chamber allows changing indoor air chemistry to be studied in detail.

Six adult volunteers have tested the vest for comfort and the effectiveness of the sensor system under actual use conditions. And that has already brought benefits for one volunteer, whose vest detected higher volatile organic exposures in his home than anywhere else. That led researchers to discover a pollutant pathway from the volunteer's basement garage into the living areas that was allowing automobile exhaust and gasoline fumes to invade the house.

With future funding, Bayer hopes to develop a smaller and more sensitive sensor system, test the current vest in population studies of asthmatic children, and develop software to process the sensor data as they are collected.

A new wearable sensor system will help researchers better understand the causes of asthma attacks.

Detecting Avian Influenza Virus More Rapidly

Quick identification of avian influenza infection in poultry is critical to controlling outbreaks, but current detection methods can require several days to produce results.

A new biosensor developed at GTRI can detect avian influenza in just minutes. In addition to being a rapid test, the biosensor is economical, field-deployable, sensitive to different viral strains and requires no labels or reagents.

"We can do real-time monitoring of avian influenza infections on the farm, in live-bird markets or in poultry processing facilities," said Jie Xu, a GTRI research scientist.

Outbreaks of the disease – primarily spread by migratory aquatic birds – have plagued the poultry industry for decades, with millions of dollars in losses. The only way to stop the spread of the disease is to destroy all poultry that may have been exposed to the virus.

A virulent strain of avian influenza (H5N1) has begun to threaten not only birds but also humans, with more than 300 infections and 200 deaths reported to the World Health Organization since 2003. Of concern is the threat of a pandemic, such as the 1918 Spanish flu that killed about 40 million people, health officials say.

"With so many different virus subtypes, our biosensor's ability to detect multiple strains of avian influenza at the same time is critical," noted Xu.

The work was funded by the U.S. Department of Agriculture's (USDA) Agricultural Research Service (ARS), the Georgia Research Alliance and the USDA's Cooperative State Research, Education and Extension Service program titled "Prevention and Control of Avian Influenza in the U.S." It was reported in the journal *Analytical and Bioanalytical Chemistry*.

"The technology that Georgia Tech developed with our help has many advantages over commercially available tests: improved sensitivity, rapid testing and the ability to identify different strains of the influenza virus simultaneously," said David Suarez, a collaborator on the project and research leader of exotic and emerging avian viral diseases in ARS' Southeast Poultry Research Laboratory in Athens, Ga. Suarez is providing antibodies and test samples for GTRI's research.

The biosensor is coated with antibodies specifically designed to capture a protein located on the surface of the viral particle. The sensor utilizes the interference of light waves, a concept called interferometry, to precisely determine how many virus particles attach to the sensor's surface.

Beyond the waveguide sensor, field-testing the GTRI biosensor requires a sample-delivery device, a laptop computer for data collection and a swab taken from a potentially infected bird. The waveguides can be cleaned and reused dozens of times, decreasing the per-test cost of the chip fabrication.

"We are continuing our collaboration and have provided additional money to Georgia Tech to move the project along faster," added Suarez. "Since this technology is already set up so that you can use multiple antibodies to detect different influenza subtypes, we are going to extend the work to include the H5 subtype."

A GTRI-developed biosensor can detect avian influenza in minutes.

Aiming for Intuitive Prosthetic Control

A peripheral nerve interface being developed at Georgia Tech could lead to more intuitive control of prosthetic limbs.

Prosthetists can fashion artificial limbs that look remarkably like the real thing. Getting them to perform like the real thing is the goal of a National Science Foundation-funded project conducted by GTRI senior research scientist Dinal Andreasen along with professor Ravi Bellamkonda and graduate student Isaac Clements, both of the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University.

The research team is working on a peripheral nerve interface to capture the nerve signals between the brain and a lost limb, according to Andreasen. Those signals could be used to operate a prosthesis.

The device consists of a cap placed over the stump at the time of amputation. Inside the cap is a scaffold of parallel polymer nanofibers that acts as a kind of trellis.

"The idea is to encourage regeneration of the neurons into the scaffold, which also contains electrodes that the neurons grow over and come into contact with," Andreasen said.

Nerve signals intended for the lost limb are picked up by the electrodes and sent to the outside of the cap, where special receivers enable researchers to monitor signals transmitted from individual nerve fibers. The nerve impulses can be converted into multi-channel electrical signals, which would then be used to control a prosthetic device.

Bellamkonda illustrates with the example of an artificial hand. "Right now you would control that artificial hand through certain muscle groups — by moving your shoulder, for example," he says. "It is very crude and has nothing to do with thinking about using your hand. If I put this cap on the nerves that used to control your hand and use those signals, you will be able to operate that hand in a much more natural and intuitive way."

Since nerves carry both motor and sensory information, the technique could also lead to prosthetics that provide sensory input.

"A major part of the research involves sending stimulation signals back into the peripheral nerve," Andreasen noted. That would allow the user of a prosthetic hand, for instance, to also experience the sensation of the fingers moving through the air or grasping objects. "Working with information flowing both ways through the peripheral nerves is an interesting and challenging part of the project," he added.

Improving School Environment and Performance

Research underway at GTRI suggests that environmental improvements to schools can raise student scores on standardized tests. "Green schools" programs, already in operation in several states, are touted mainly for saving energy, said Charlene Bayer, a GTRI principal research scientist.

Yet Bayer's research indicates that bettering a school's environment also increases health and comfort, which in turn promotes increased attendance, student attentiveness and teaching effectiveness.

"There is a direct correlation between decreased absenteeism and increased test scores," said Bayer, a specialist in indoor-air health issues. "Everyone thinks that being green means primarily energy saving, but in fact green schools can have a major productivity impact."

Test scores in environmentally improved schools can increase as much as 3 to 5 percent, according to the *National Review for Green Schools: Costs, Benefits, and Implications for Massachusetts*.

GTRI's research indicates that asthma is a major health issue affecting school attendance. At least 10 percent of Georgia children are asthmatic, with some urban areas topping 25 percent. The problem can be triggered by environmental factors, such as:

- Mold, which is a particular problem in Georgia because of high humidity. Damp outside air can seep into buildings, creating unseen mold inside walls;
- Building materials, which can give off volatile organic compounds (VOCs), aggravating asthma and other respiratory conditions;
- Diesel school bus emissions, which can cause significant indoor pollution when the vehicles are allowed to idle near school buildings.

GTRI recommends ways to reduce these problems, often at little cost. Among the recommendations are careful adjustment of school heating, ventilation and air conditioning (HVAC) systems to increase outside air exchange, reducing mold and other pollutants.

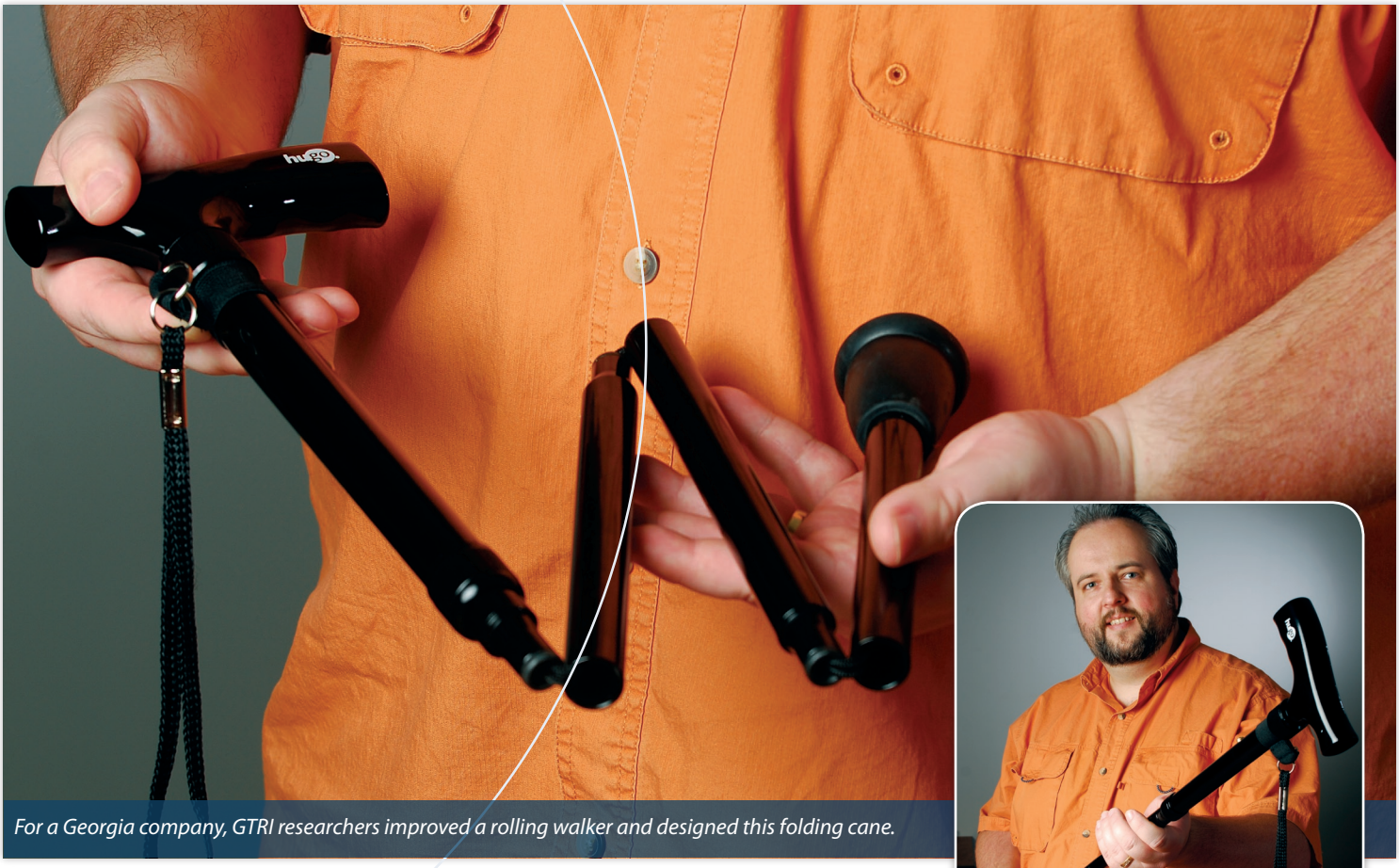
In other cases, new HVAC components, including sophisticated control units, can increase air flow and reduce pollutants. School renovation can eliminate mold hidden in walls, as well as construction materials that give off VOCs.

And the simple expedient of turning off school bus engines until students leave can improve school air quality. Other measures to aid existing schools include increasing non-glaring daylight in classrooms and improving cleaning practices to minimize mold, bacteria and dust.

GTRI recently sent every Georgia school system a publication titled *Green Schools for High Performance*, said Ken Johnson, a GTRI senior research scientist who is working with Bayer on school-health issues. The publication details 19 health- and energy-related steps that schools can take at little or no cost.

Georgia Tech researchers inspect the exterior of a school as part of a project to improve health and comfort levels for students.

Helping Seniors "Walk and Roll"



For a Georgia company, GTRI researchers improved a rolling walker and designed this folding cane.

When a Georgia company's rolling walker couldn't be sold in Wal-Mart stores because the box wouldn't fit on the shelves, the company came to GTRI for help.

A group led by GTRI senior research scientist Brad Fain solved the problem. The researchers reduced the volume of the cardboard box by 51 percent, while still allowing someone with a disability to remove the walker from the box and use it without assistance.

"The carton became much smaller than we thought it could get," said Phil Willis, president of the durable medical division for Alpharetta-based Access Product Marketing (APM). "We were very impressed with the way GTRI researchers aggressively and professionally attacked the problem."

According to Fain, finding a new way of folding the walker to fit inside a smaller box was an engineering challenge. GTRI also kept the cost low with the changes, allowing APM to sell the rolling walker at discount chain Wal-Mart. GTRI's assistance was instrumental in helping APM market its Hugo® rolling walker to seniors around the country.

When APM took the next step in elderly mobility devices from rolling walker to cane, it wasn't a surprise that the company returned to GTRI for assistance. This time APM asked Fain and his team to design a sturdy folding cane from scratch.

GTRI research technologist Tedd Toler and Michelle Berryman of local design company Echo Visualization joined Fain to work on the project. Since many older persons perceive folding canes to be weak and unsafe, they designed the new cane with a tip that could bear heavy loads and be highly resistive to slipping.

"We chose a dome-shaped design with a convex interior surface so that it deforms to the floor and maintains more surface area with the floor as more pressure is put on it," explained Fain.

The Hugo folding cane was successfully tested with 550 pounds of weight applied, while competitors broke at around 250 pounds, according to Willis. The canes are currently sold in Sam's Club, Wal-Mart and Costco warehouse stores.

Once the basic structure of the cane shaft was designed, Fain's team moved its attention to the handle. Cane users feel a handle is the most personal part of the cane, according to Willis. For this reason, the Hugo folding cane was designed with a removable handle so that each user's personality could be on display.

The personalized handle feature came to the attention of the producers of the FOX television show *House, M.D.* The main character, Dr. Gregory House, used a Hugo folding cane with a customized handle in more than eight episodes last season.

Energy and Environment

Health and Human Systems

GTRI is a top research and development organization for energy and environmental solutions. Working with the U.S. Department of Energy, NASA, the National Science Foundation, OSHA and industry, GTRI researchers are developing new and alternative energy sources, improving air and water quality, enhancing energy efficiencies and improving workplace safety.

- Fuel Cells/Alternative Energy
- Green Technologies/Energy Efficiency
- Workplace Safety/OSHA
- Food Processing/Agricultural Technologies
- Air/Water Quality
- Energy and Environmental Modeling
- Severe Storm Research

Boosting the Efficiency of Solar Cells

Unique three-dimensional solar cells that capture nearly all of the light that strikes them could boost the efficiency of photovoltaic (PV) systems while reducing their size, weight and mechanical complexity.

GTRI researchers have developed the new 3D solar cells, which capture photons from sunlight using an array of miniature "tower" structures that resemble high-rise buildings in a city street grid. The cells could find near-term applications for powering spacecraft, and by enabling efficiency improvements in photovoltaic materials, they could also change the way solar cells are designed for a broad range of applications.

"Our goal is to harvest every last photon that is available to our cells," said Jud Ready, a GTRI senior research engineer. "By capturing more of the light in our 3D structures, we can use much smaller photovoltaic arrays. On a satellite or other spacecraft, that would mean less weight and less space taken up with the PV system."

The 3D design was described in the journal *JOM*. The research has been supported by the Air Force Office of Scientific Research, the Air Force Research Laboratory, NewCyte, Inc., and Intellectual Property Partners, LLC.

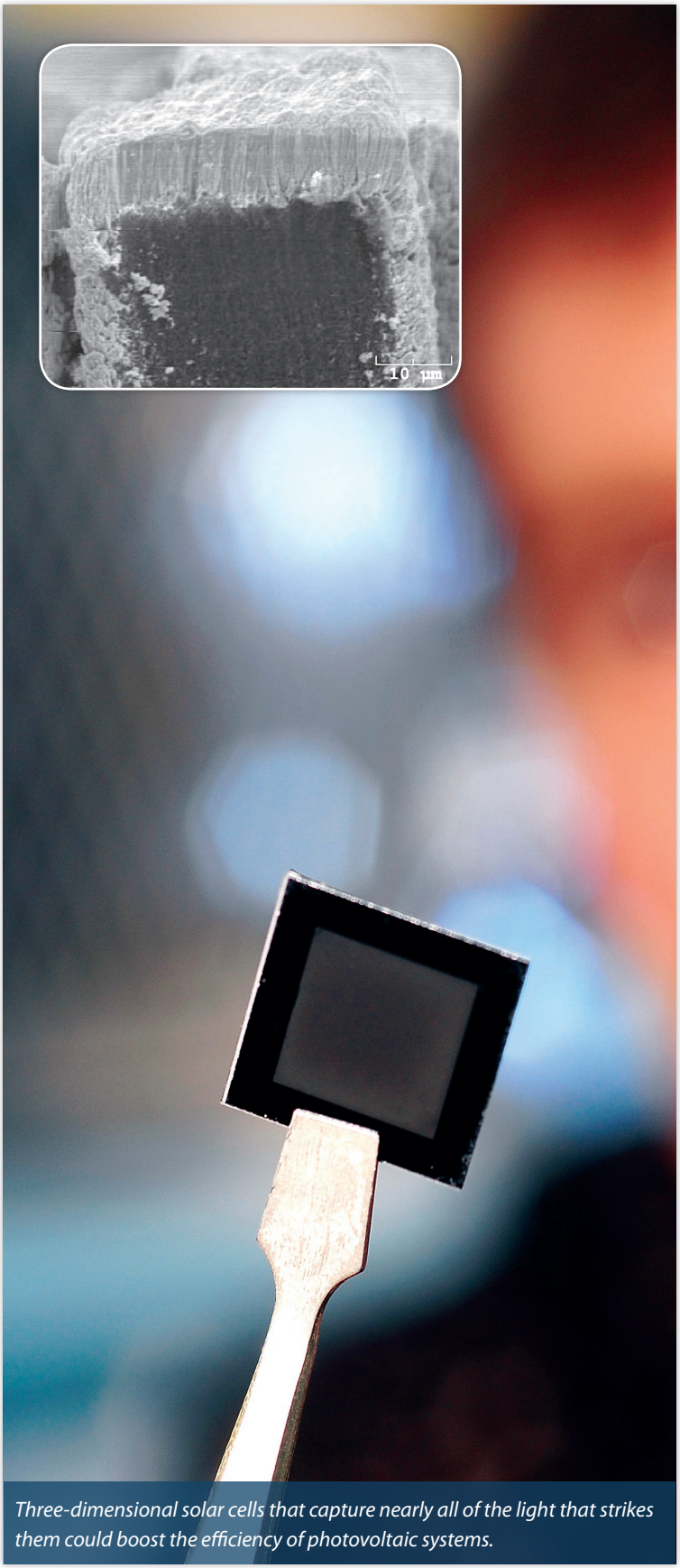
The GTRI photovoltaic cells trap light between tower structures that are about 100 microns tall, 40 microns by 40 microns square, 10 microns apart – and built from arrays containing millions of vertically aligned carbon nanotubes. Conventional flat solar cells reflect a significant portion of the light that strikes them, reducing the amount of energy they absorb.

Because the tower structures can trap and absorb light received from many different angles, the new cells remain efficient even when the sun is not directly overhead. That could allow them to be used on spacecraft without the mechanical aiming systems that maintain a constant orientation to the sun, reducing weight and complexity – and improving reliability.

The ability of the 3D cells to absorb virtually all the light that strikes them could also enable improvements in the efficiency with which the cells convert the photons they absorb into electrical current.

Fabrication of the cells begins with a silicon wafer, which serves as the bottom junction. Using photolithography, the wafer is then coated with a thin layer of iron in a grid pattern. Carbon nanotubes are then grown atop the pattern.

Once the nanotubes are in place, researchers use molecular beam epitaxy to coat them with cadmium telluride and cadmium sulfide, which serve as the p-type and n-type photovoltaic layers. Atop that, a thin coating of indium tin oxide, a clear conducting material, is added to serve as the cell's top electrode.



Three-dimensional solar cells that capture nearly all of the light that strikes them could boost the efficiency of photovoltaic systems.

Modeling Energy Systems Interactively

As energy costs continue to rise, organizations need to be able to evaluate the economic and technical feasibility of energy technologies for both off-grid and grid-connected power systems.

Researchers in GTRI and the Aerospace Systems Design Laboratory (ASDL), part of Georgia Tech's School of Aerospace Engineering, have developed a new modeling and simulation-based energy systems analysis tool that allows organizations to evaluate different energy portfolio strategies before investing.

"Our interactive tool analyzes thousands of energy options in seconds, while being easy for anyone to use," said Tommer Ender, a research engineer with a joint appointment in GTRI and ASDL.

With funding from GTRI's independent research and development (IRAD) program, Ender is collaborating with senior research scientist Kevin Caravati and senior research engineer Comas Haynes to formulate a process for developing tools that support decision-making.

The modeling platform begins with a hybrid energy modeling tool, such as HOMER, a computer energy model developed by the National Renewable Energy Laboratory. The researchers expanded the tool into an interactive model that shows the impacts of decisions immediately. The platform can also predict how an increase in prices will affect the energy system and how long it will take to produce savings on energy costs, according to Jonathan Murphy, a graduate student working on the model.

The model analyzes both conventional and renewable energy technologies, including solar photovoltaics, wind turbines, hydropower, fuel cells, electric utility grid and generators operating on diesel, gasoline, biogas and alternative fuels.

The researchers are collaborating with SkyBuilt Power, a leading renewable energy systems integration company located in Virginia, to develop concepts for maximizing the efficiency of SkyBuilt's mobile power stations. Skybuilt's solar, wind and generator systems are designed for disaster relief, backup power and military use.

Instead of submitting a long report to the military, the model allowed the researchers to demonstrate how different energy scenarios would operate in six different cities throughout an entire year.

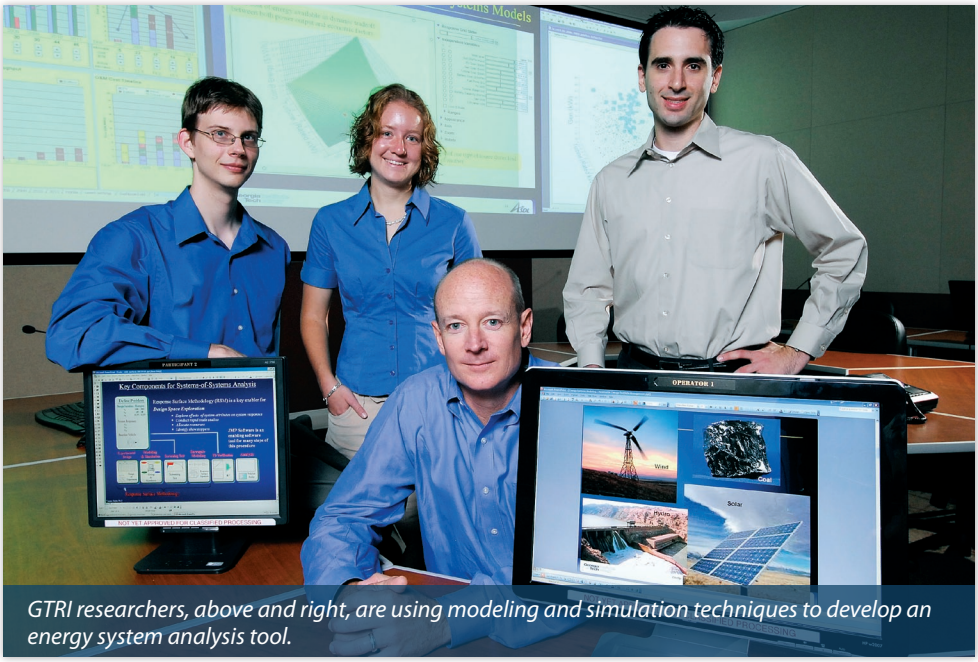
"GTRI's modeling capabilities help us to more rapidly optimize our products, whether it's solar and wind systems in a suitcase or larger systems in trailers and freight containers," said Dave Muchow, SkyBuilt's president and CEO.

With additional IRAD funding, graduate student Katherine Yakubisin is developing an energy model for future facility improvements in Yellowstone National Park.

"Yellowstone wants to expand the use of renewable energy systems and improve energy efficiency at their facilities," noted Caravati. "With this model, Yellowstone can develop scenarios to evaluate energy costs under a variety of system combinations."

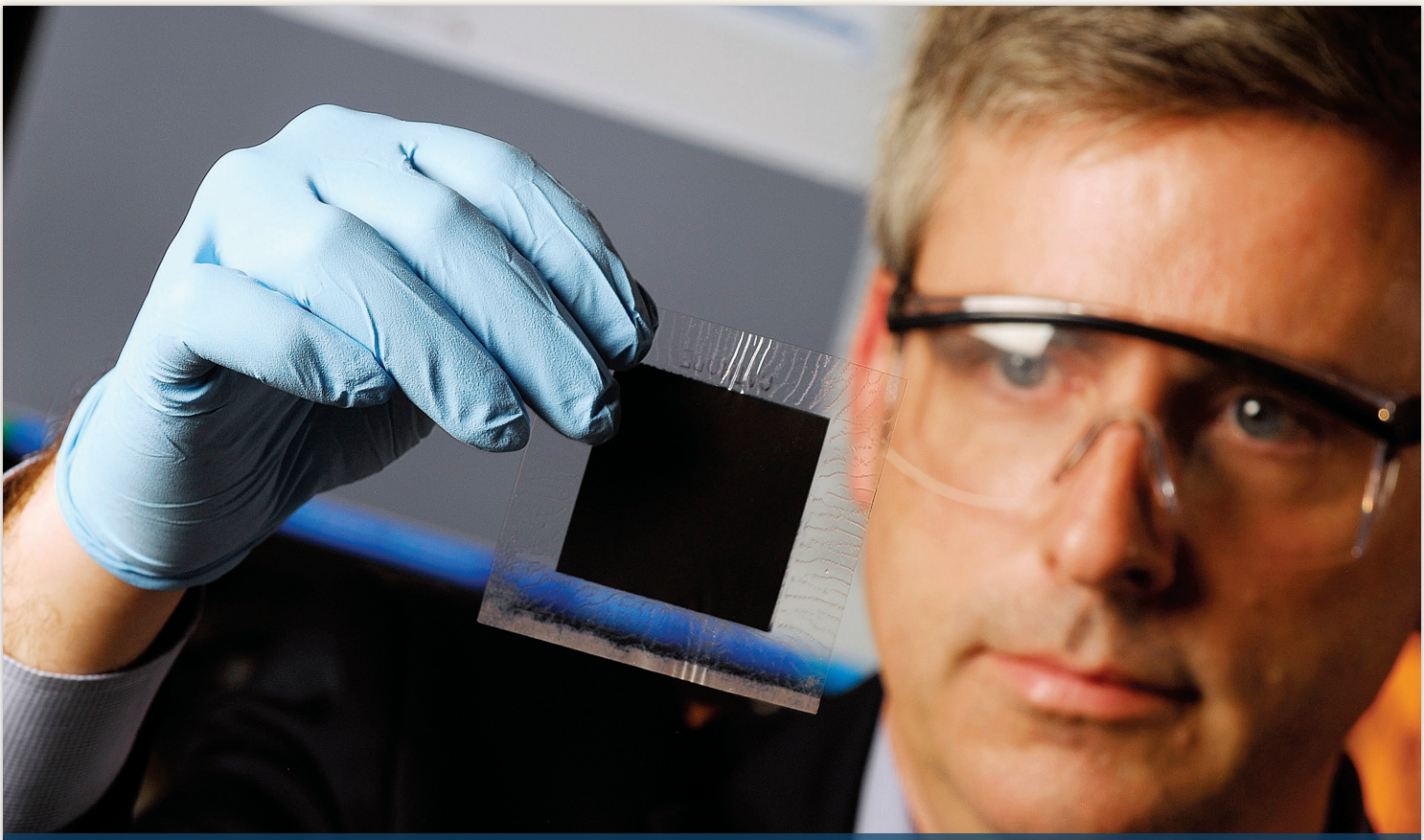
The new energy systems modeling tool allows energy decision-makers to test multiple options and investigate the implications.

"Decisions are frequently made early on in the design process with very little information, and only 20 years later do people realize the impacts of the decision," added Haynes. "If you use our model to bring physics in earlier in the process, you can validate your design much earlier."



GTRI researchers, above and right, are using modeling and simulation techniques to develop an energy system analysis tool.

Improving Fuel Cell Durability through Failures



GTRI researchers are studying fuel cell durability to guide the development of new materials.

Fuel cells can be expensive and typically don't last as long as their internal combustion counterparts. Tom Fuller, director of GTRI's Center for Innovative Fuel Cell and Battery Technologies, believes that understanding how and why fuel cells fail is the key to both reducing cost and improving durability.

"By understanding the failure mechanisms, we can guide the development of new materials or system approaches to mitigate these failures," said Fuller, who is also a professor in Georgia Tech's School of Chemical and Biomolecular Engineering (ChBE).

Since he joined GTRI three years ago, Fuller has been trying to solve what he deems the top three fuel cell durability problems: chemical attack of the membrane, carbon corrosion and platinum instability.

Professor Dennis Hess and research scientist Galit Levitin, both from ChBE, collaborated with Fuller to show that the fuel cell membrane, commonly made of a synthetic polymer, is prone to attack by free radicals that create holes in the barrier. Knowing this can guide the creation of new membranes and degradation testing. This work was funded by GTRI, ChBE and the Lawrence Berkeley National Laboratory (LBNL).

Another challenge is that a blockage can occur on the anode side of the fuel cell, causing carbon to corrode. This can be catastrophic because without carbon, the platinum catalyst layer collapses.

"We're building physics-based detailed models to evaluate different fuel cell designs that will reduce the susceptibility to this type of corrosion," said Fuller, who is working on this project with Toyota's Norimitsu Takeuchi with funding from Toyota.

The third durability issue is that platinum is soluble in the acidic membrane, given the high electrical potential and oxidizing environment at the cathode. When the platinum layer dissolves, a band of platinum typically forms inside the membrane.

Fuller and GTRI senior research engineer Gary Gray have developed a model to predict where the platinum band would form to help understand why it forms. This work was funded by Hyundai Motors Corporation.

A recent gift of $200,000 from the Hartley Foundation will allow Fuller to purchase new research equipment, continue studying the degradation of fuel cells and learn how to improve and extend the life cycle and technology of these energy devices.

The LBNL funding came from the Assistant Secretary for Energy Efficiency and Renewable Energy in the Office of Hydrogen, Fuel Cell and Infrastructure Technologies of the U.S. Department of Energy under contract number DE-AC02-05CH11231 through subcontract 6804755.

Measuring Optical Turbulence to Create a Clear Future

GTRI researchers are using lidars to study the optical turbulence that makes ground-based astronomy difficult.

GTRI researchers are laying the foundation for techniques that could do for ground-based imaging what the Hubble Space Telescope did for astronomy.

The matter under study is called optical turbulence, the distortion of light caused by its passage through the atmosphere. Optical turbulence causes stars to twinkle and a desert horizon to shimmer – and makes accurate, detailed ground-based observation of distant objects all but impossible. The phenomenon also inhibits long-range "free-space" laser applications – that is, laser light moving through the air rather than through a medium such as fiber optic cable.

With a laser radar (lidar) developed at GTRI, "We can point that system in any direction in the sky and measure the strength of the turbulence effect," said Gary Gimmestad, the Glen Robinson Chair in Electro-Optics and senior faculty leader in remote sensing technology. "That has never been accomplished before."

The three-year Department of Defense project represents a crucial step toward controlling the effects of optical turbulence. But first, "it must be measured and characterized and monitored," Gimmestad noted.

The eventual development of algorithms or other techniques to compensate for optical turbulence could provide Earth-based telescopes with Hubble-like clarity and dramatically improve the quality of long-distance imaging, particularly for satellite imaging and surveillance.

Mitigating optical turbulence could also set the stage for a range of free-space laser applications. One example cited by Gimmestad involves laser-beam data links or "free-space optical communication." A commercial version already exists, but atmospheric effects limit its range.

"At some point when you get enough optical turbulence, the whole thing becomes totally inoperative," he said. "So again, characterizing the level of turbulence out there becomes an issue."

Another potential benefit of the work involves use of ground-based lasers to recharge satellite batteries by aiming the light at a recharging panel on an orbiting satellite.

"The big problem is that turbulence is worse by the ground, right where your transmitter is, and it tends to spread the laser beam and make it wander all over the place," Gimmestad explained. Compensating for that "spread" either at the transmission point, the receiving point or both, could not only have an enormous impact on satellites, but also open the door to a number of new laser-operated tasks.

Preparing Students for Safety in the Workplace

As part of an effort to increase job safety training and awareness among younger Americans, GTRI scientists have joined with the U.S. Occupational Safety and Health Administration (OSHA) and other groups to introduce health and safety training to Georgia high schools.

The aim is to ensure that young workers grasp job-safety basics before they ever reach the workplace. The effort stems from a 2006 agreement between OSHA, GTRI, Georgia schools and other groups to make safety and health training more available to the state's students.

"Today, it's an effort for many people in the workforce to remember safety basics – for example, to put their safety glasses on when working with chemicals," said Michelle Dunham, a GTRI research scientist. "We want to make it automatic for young people joining the workforce to take those kinds of precautions – the same way they always put on a seatbelt in a car because that's what they've grown up doing."

Students attend a 10-hour course that is team-taught by OSHA and Georgia Tech instructors, as well as industry representatives. The modular course covers general safety and health information, as well as instruction pertaining to students' areas of work specialization.

"There are lots of different modules, and depending on the school, they'll vary," Dunham said. "We've started out teaching students going into the construction trades, but the course could be helpful to students in other study areas, such as automotive and medical services."

Those graduating from the course receive the OSHA 10-hour card, which can give them an advantage with employers wanting to comply with OSHA regulations.

The course is rigorous, Dunham notes, and missing even a single class means a student will not receive the card. "We decided that this was an adult learning process," she said. "Students had to learn that this was like being on a job."

Dunham, an industrial hygienist, explains that the Georgia Tech Safety and Health Program also works directly with industry. Georgia Tech staff members perform on-campus training and consultation at the OSHA Training Institute Education Center, and also at job sites throughout Georgia and the Southeast.

A GTRI scientist conducts OSHA workplace-safety classes at a metro-Atlanta high school.

Measuring the Impact of Boutique Fuels

When Atlanta began fueling its vehicles with reduced-sulfur, low-volatility gasoline in 1999, the Environmental Protection Division of the Georgia Department of Natural Resources (DNR) needed to evaluate whether the new gasoline formulation reduced emissions as promised. Fortunately, since 1993 the Georgia DNR had been supporting a program in which Georgia Tech researchers monitored Atlanta area vehicle emissions to evaluate the state's vehicle inspections and maintenance program.

"It would have been difficult, if not impossible, to have analyzed the effect of the new fuel on vehicle emissions if data hadn't been collected before the new fuel was required," said Michael Rodgers, a GTRI principal research scientist.

The composition of Atlanta's gasoline, considered a boutique fuel, is unique compared to the rest of the country. Its reduced sulfur content helps automobile catalytic converters operate more efficiently and its lower vapor pressure requirement reduces emissions of volatile organic compounds (VOCs) that contribute to ground-level ozone. Atlanta must reduce ozone production because the area has been designated as an ozone nonattainment area under the federal Clean Air Act.

To examine whether Atlanta's boutique fuel decreased emissions, Rodgers' research team – which included senior research scientist Mikhail Fogelson and research scientists Olga Kemenova and Alex Samoylov – compared emissions data from areas across the state. The emissions of passing vehicles were measured remotely so that motorists were minimally aware of the equipment and did not alter their natural driving behavior. Rodgers' team measured hydrocarbons, carbon monoxide and nitrogen oxides in each vehicle's exhaust.

For the first three years, the fuel program ran from March until October in 25 counties surrounding Atlanta. After the first year, the results showed an improvement in vehicle emissions of approximately 9 percent in the counties that sold the new fuel.

"We found that the reduction in emissions as a result of repairing vehicles to pass vehicle inspection is comparable to the reduction we get from newer vehicles that are operating on cleaner fuels," explained Rodgers, who is also director of the Air Quality Laboratory in Georgia Tech's School of Civil and Environmental Engineering.

With this information, the Georgia DNR successfully petitioned the U.S. Environmental Protection Agency to allow Georgia to sell the cleaner fuel year-round in 45 counties surrounding metropolitan Atlanta.

"We were very fortunate to have a long-term record of Atlanta fleet emissions from the Georgia Tech remote sensing data, which provide a unique perspective on vehicle emissions that is not available elsewhere in the country and ensure that our programs meet the needs of Georgia residents," said Tim Smith, former manager of the motor fuels program and current manager of the vehicle inspection and maintenance program for the Georgia DNR.

Researchers collect emissions data from passing vehicles to assess the impact of boutique fuels.

Moving an Airborne Test Platform to the Next Phase

It's not quite "plug-and-play" technology, but Oculus is designed to come pretty close.

Oculus is the name for an airborne test platform under development by GTRI researchers in collaboration with West Virginia University. The project is sponsored by the U.S. Department of Defense.

"It's used for airborne testing of sensors and high-speed communications links," said Bill Robinson, a GTRI senior research scientist. The platform can also accommodate testing and evaluation of mission computers.

The base system consists of two palletized modules. One is the operator's station and includes the mission computer, power supplies for payload, command and control modules for payload, and data collection equipment. The other pallet is a mounting platform for the devices to be tested.

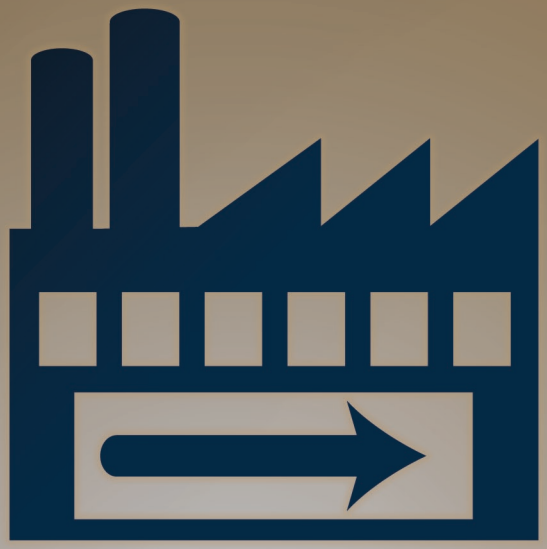
Recent improvements to Oculus include removable modular electronics enclosures and a removable modular sensor pod, the addition of electromagnetic interference shielding and larger electrical work areas.

Besides its favorable performance-to-cost ratio, another benefit of Oculus is its ease of use, Robinson says. "It's a roll-on, roll-off platform with no modifications necessary to the aircraft," he explained, meaning that both pallets are designed to load onto C-130E or C-130H models just as cargo would be loaded. The process takes fewer than 45 minutes, and testing can begin within three minutes after takeoff.

Safety-of-flight testing with an Oculus prototype was completed in the spring of 2007. The next tasks are to conduct an operational utilization evaluation and obtain flight certification approval for an integrated payload.

According to Robinson, future Oculus enhancements might include standardized sensor interfaces, a larger operator's station, satellite communications and GPS antenna installed in Oculus' upper hatches, a tracking microwave or optical high-bandwidth data link and new designs to accommodate Oculus in other C-130 models as well as in other types of aircraft.

Researchers assess the operation of the Oculus test platform from a C-130.



Manufacturing Technologies

GTRI is widely known for innovation in manufacturing technologies – particularly in the food processing industry. From helping manufacturers design and build better products to streamlining logistics, enhancing efficiency and solving tough engineering challenges with high-tech automation, GTRI is a hub for manufacturing innovation.

- Machine Vision
- Logistics
- Radio Frequency Identification
- Food Processing/Agricultural Technologies
- Technology Insertion
- Accessibility/Assistive Technologies
- Robotics

Advancing Disinfection Technology in Food Processing

Georgia Tech researchers have developed an improved disinfection system for the food and beverage industry.

Investigators are field testing an advanced disinfection technology developed at Georgia Tech that uses ultraviolet (UV) light as an alternative to thermal pasteurization.

GTRI is working with two industrial collaborators to evaluate the effectiveness of this patented UV disinfection method in the food and beverage industry. The collaborators are Air Products and Chemicals, Inc., a leading supplier of industrial gases and process technology for various industrial segments, which is based in Allentown, Pa., and Atlanta-based Southern Company, one of the nation's largest generators of electric power.

Eliminating organisms such as bacteria during the production of liquid products, which is required under U.S. Food & Drug Administration (FDA) rules, can be problematic for the food processing industry. The traditional thermal approach, which dates back to the 19th century, has a number of drawbacks.

"The industry's current liquid disinfection technology – heating and pasteurizing – affects taste, appearance and nutritive value," said John Pierson, a GTRI principal research engineer. "We believe the Georgia Tech UV disinfection system can alleviate or significantly reduce these problems."

Developed in collaboration with principal investigator Larry Forney, an associate professor in the Georgia Tech School of Chemical and Biomolecular Engineering, the Georgia Tech UV disinfection process kills bacteria, mold and viruses. Of the three types of ultraviolet light, two types – UV-B and UV-C – can destroy germs, viruses and other pathogens.

Standard low- and medium-pressure UV lamp technology can be used for this kind of disinfection, but such light effectively penetrates opaque liquids for only fractions of an inch as light transmittance decreases. The Georgia Tech approach provides better disinfection than similar current UV technologies because its novel mixing technique ensures a more uniform UV exposure, while also using less electrical energy.

The Georgia Tech process, which will require eventual FDA approval, uses a phenomenon called a Taylor vortex to move liquids through UV-lighted regions. At the heart of the system are two nested clear cylinders – a stationary outer cylinder containing UV lamps and a rotating inner cylinder. Fluids swirl through the gap between the cylinders in a way that allows UV light to strike every particle of the liquid more evenly.

The device was originally used to disinfect rinse water used for food processing tasks. Georgia Tech researchers have modified the system so that even an opaque fluid such as juice or brine can flow in such a way that it receives full UV disinfection.

"As a next step in the development of the technology, the team is planning a pilot-scale field test to confirm the capability of the technology in an industrial setting," Pierson said. "By bringing companies that need a technology together with the university that has the technology, we expect to get this important process out into the marketplace faster."

The project began six years ago with funding from Georgia's Traditional Industries Program for Food Processing. (FoodPAC). Since then, it has received support from the Southern Company and Air Products.

Developing a "Washable" Robot for Poultry Processing

Even a hard-working robot needs a good bath at the end of the day. That was the issue facing GTRI researchers as they delved into one of the big challenges in food-processing automation.

Robots have begun to be deployed in many areas of food production, but their use for handling fresh meat has been hampered because such machines would also have to withstand cleaning with high-pressure water spray and corrosive sanitizing chemicals.

At GTRI's Food Processing Technology Division, research engineer Jonathan Holmes led a project to develop a robot that packs fresh meat into trays, but with a design and construction that withstands the harsh conditions created by routine washing in a way that is more consistent with the rest of the machines.

Georgia Tech researchers have teamed with CAMotion, Inc. of Atlanta and are working in collaboration with Cargill Meat Solutions of Newnan, Ga.

The robot's job is to grasp raw meat products from a conveyor and place them onto foam packaging trays. The task requires considerable dexterity to pick up the products without causing damage, place them within the boundaries of the trays in an aesthetically pleasing manner, and provide one more visual inspection. And it has to be done fast – one per second.

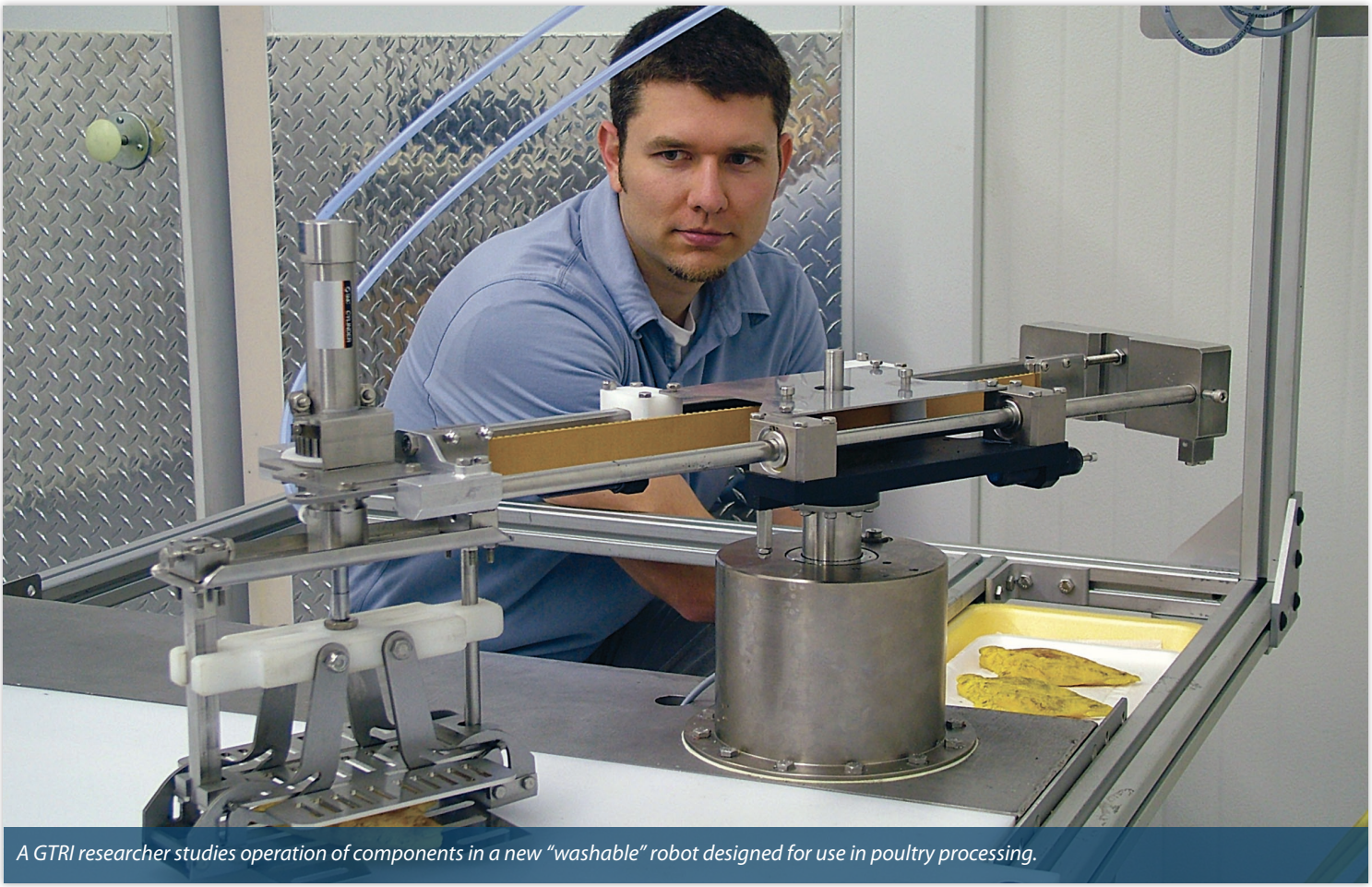
But that was the easy part, relatively speaking.

"We're used to building automated machines, so the automation side was something we're accustomed to," Holmes explained. "The wash-down side of it was brand new for us – it's new for most people – and that was very challenging. We had to go through a lot of component testing initially just to find components we could use."

The current prototype uses special protective coatings and plating on its metal parts, shaft seals on its motors and other moving parts, and special watertight bearings that are little affected by the wash-down process.

The tray-filling stage of the poultry processing line may require up to a half-dozen human workers and often results in a bottleneck to the process. The hope is that automation of this type would result in increased throughput and lower costs for the industry. In addition, the wash-down technologies devised in this project could find their way into other areas untouched by automation because of cleaning requirements.

This project was funded in part by Georgia's Traditional Industries Program for Food Processing.



A GTRI researcher studies operation of components in a new "washable" robot designed for use in poultry processing.

Taking Aim at Worker Injuries

New technology for tracking the movement of poultry processing workers could help reduce the potential for injury.

New technology is positioning an old injury-prevention program at the cutting edge of the poultry industry.

Nearly 10 years ago, GTRI collaborated with Georgia Tech's School of Applied Physiology to create an Ergonomic Work Assessment System (EWAS) to track the positioning and arm movements of workers as they deboned poultry. The idea was to identify and then avoid the factors leading to repetitive stress injuries.

The improved EWAS, developed in cooperation with the poultry industry, provides a more accurate and detailed assessment by taking advantage of technology that wasn't available in the '90s – namely position-tracking technology typically used to create computer animation.

"It measures arm position in three dimensions," said GTRI research engineer Jonathan Holmes. "You strap the system onto your arm and move your arm around, and you can watch it moving on a screen beside you."

The system measures forearm and wrist orientation as well as upper arm and shoulder activity. Separate modules provide a global reference for the position sensors. Muscle response is monitored through electromyography, a procedure for determining the level of electrical activity in muscles. Grip force on the knife is calculated by a technique developed by Liberty Mutual Research Institute for Safety, which is teaming up with the Georgia Tech design team for that part of the system development.

The aggregate data of shoulder and arm position, muscle response and grip force of a worker cutting poultry are transmitted wirelessly to a computer for analysis. EWAS will be used in field studies to assess the dynamics of muscle group interactions in job rotation schemes designed to reduce repetitive motion disorders such as carpal tunnel syndrome.

"By monitoring these forces and positions, you can put numbers to physical motions and get a better idea of what is good and what is risky," said Holmes. "You can hopefully determine if someone is using certain muscles too often, or if they are bending their wrists too far. This opens the door for studies that can eventually help us determine which risk factors are more likely to lead to injuries."

The group is also investigating the development of a second system to monitor the back. They ultimately hope to pursue studies that can help reduce back injuries resulting from back instability conditions.

Improving the Lifetimes of OLEDs

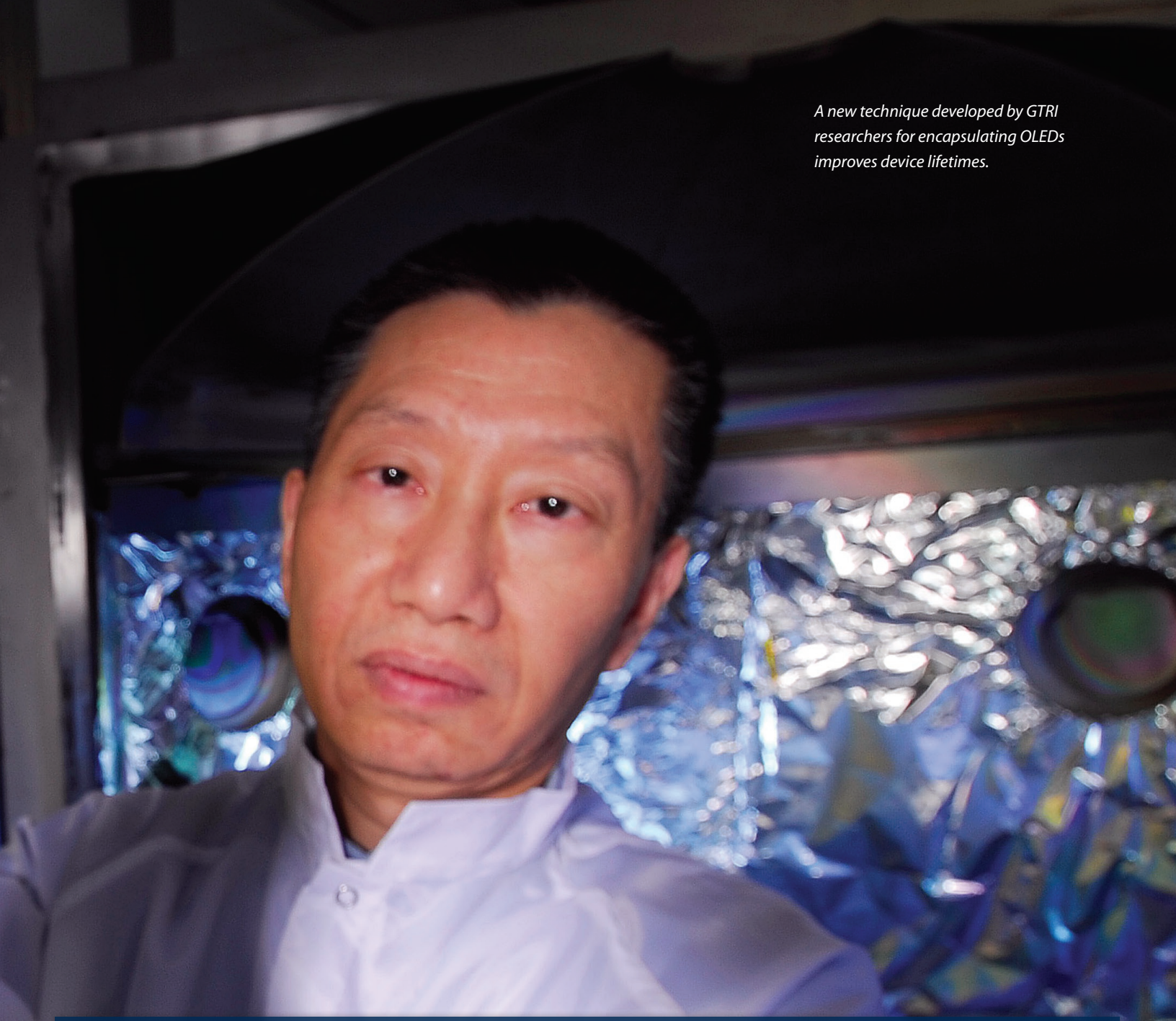
Organic light emitting diodes (OLEDs) are promising for the next generation of displays and solid state lighting because they use less power and can be more efficiently manufactured than current technology. However, the intrusion of moisture into the displays can damage or destroy an OLED's organic material.

"OLEDs have better color and flexibility and the capability of larger displays, but companies still need an inexpensive encapsulation method that can be used to mass produce organic electronics that don't allow moisture in," said Wusheng Tong, a GTRI senior research scientist.

Tong and his collaborators – senior research scientist Hisham Menkara and principal research scientist Brent Wagner – have developed an improved OLED sealing process to reduce moisture intrusion and improve device lifetime.

Manufacturers now seal displays in an inert atmosphere or in a vacuum environment. They glue a glass lid on top of the display substrate with a powder inside the display to absorb moisture that diffuses through the glue. These seals are expensive and labor-intensive to assemble.

With funding from GTRI's independent research and development program, the researchers have replaced the glass enclosure with a thin-film barrier formed by a less expensive conventional deposition



A new technique developed by GTRI researchers for encapsulating OLEDs improves device lifetimes.

method. "We chose a passivation coating process that could be performed at room temperature so that the organic material remained intact," said Tong.

The researchers selected advanced ion assisted deposition, which utilizes reactive ions to deposit a high-density, pinhole-free thin silicon oxynitride (SiON) film on the OLED surface. "Ideally, the film should be as thin as possible, but if it's too thin, a pinhole or other defect could appear and cause a problem," explained Tong. "We found that a film of 50-200 nanometer thickness was perfect."

During testing, the SiON-encapsulated OLEDs showed no sign of degradation after seven months in an open-air environment, while the OLEDs without the coating degraded completely in less than two weeks under the same conditions.

When Tong conducted accelerating aging tests in an environmental chamber that maintained a temperature of 50 degrees Celsius and 50 percent relative humidity, the OLEDs encapsulated with SiON films showed little degradation for at least two weeks. The OLEDs without encapsulation, however, decomposed immediately.

"We've demonstrated that this deposition process improves the lifetime of the OLEDs by blocking the intrusion of moisture, so now we're hoping to work with industry partners to develop a mass production process for our encapsulation technique," added Tong.

Information and Communication Technologies

Defense and Security

From communications and networking to modeling and simulation, GTRI's world-class scientists and engineers help customers find practical and effective solutions to tough information technology problems. These solutions improve productivity, performance and reliability – while accelerating delivery, lowering costs and reducing risks.

- Communications and Networking
- Emergency Management
- Visualization
- Internet Protocol Television/Digital Media
- Software Engineering
- Information Sharing
- Information Security
- Modeling and Simluation

Maintaining Air Traffic Radios with Redesigned Modules

GTRI engineers are helping keep air traffic control radios on the job until newer designs can replace them. The radios – known as AN/GRT-21 and AN/GRT-22 transmitters and AN/GRR-23 and AN/GRR-24 receivers – first went into service in 1968, and about 7,500 are still on the job.

"Many parts now unavailable were originally manufactured by hand, and would be very expensive to reproduce today because of the manual labor involved," said Russell S. McCrory, a GTRI senior research engineer. "Even more challenging are semiconductor components, such as transistors and diodes, that are no longer manufactured."

Eventually, all Department of Defense radios are due to be replaced by a reprogrammable software-based technology known as the Joint Tactical Radio System (JTRS). Under current timetables, however, the GRT/GRR ground radios will wait for replacement until 2020-2025.

In 1999, engineering responsibility for the radios was moved to the Warner Robins Air Logistics Center in Georgia. Currently, GTRI has a contract to redesign five major assemblies within the GRT/GRR. A $750,000 award is funding the first redesign -- the system's 10-watt dual-band power amplifier unit.

Instead of trying to reproduce the original technology, GTRI engineers are designing replacement units that use only modern off-the-shelf parts. The aim is to provide a readily available replacement module that is plug-compatible with the original unit and does exactly the same job.

GTRI's approach enables the military to ask for competitive bids from numerous manufacturers rather than relying on a sole source. "This should result in major savings for the Air Force, versus trying to remanufacture the original components," McCrory said.

If GTRI redesigns all five GRT/GRR units listed in the current contract, overall funding is expected to total $5.4 million. In addition to the dual-band power amplifier, the contract covers redesign of an IF amplifier, a mixer-multiplier, a power supply unit and a synthesizer.

In many cases, McCrory said, his team's redesigns may allow radios to not only keep working but also to operate more effectively. For example, a redesigned synthesizer unit could dramatically reduce the complexity of tuning GRT/GRR radios, which currently are retuned through laborious settings changes. In addition, the new dual-band power amplifier is expected to replace three older models, easing parts inventory tasks.

One of GTRI's top goals is to make it cheaper for the Air Force to simply plug in a new module than to repair an old one. The difference could save not only money and man-hours, but also bring broken units back online faster.

GTRI researchers are using modern off-the-shelf components to replace obsolete parts in vital military air traffic control radios.

Merging Design Analysis and Decision-Making

GTRI has opened the Secure Collaborative Visualization Environment (SCoVE) on its Atlanta campus.

From homeland security to power and energy to industrial automation, researchers at GTRI are addressing some of the nation's most pressing problems. Their solutions often involve complex designs with highly integrated systems – which can be difficult to present to stakeholders due to the enormous amounts of data inherent in these designs.

In June 2007, GTRI opened the Secure Collaborative Visualization Environment (SCoVE) – a unique environment where systems engineers, analysts and decision-makers can discuss sensitive projects and view all the information associated with solutions in a highly comprehensible way.

The SCoVE features a 7x24-foot, high-resolution display wall and seats up to 30 individuals. Its state-of-the-art computer network and audio-visual system supports:

- Almost unlimited video feeds
- Remote video inputs and cameras
- DVD, VHS, satellite and CATV
- TCP/IP and UDP encoded video feeds

What's more, the SCoVE features secure real-time connectivity, which will link the Georgia Tech campus with GTRI field offices and government facilities across the country.

"The Secure CoVE enables GTRI to develop robust system solutions for government customers at an unprecedented rate," said Allan Williams, a GTRI senior research engineer. "Instead of going from lab to lab, customers and researchers now can assemble in one room and access all of GTRI's tools."

The SCoVE was modeled after CoVE, launched in 2004 at Georgia Tech's Aerospace Systems Design Lab (ASDL). Both environments signal a dramatic change in design reviews. Instead of crowding around a single computer or using static PowerPoint presentations where a limited amount of information can be displayed, decision-makers can view Georgia Tech system solutions in their entirety.

CoVE and SCoVE manipulate data on the spot so decision-makers can ask what-if questions and see – in real time – how altering parameters will affect various aspects of a design. The end result: a dynamic environment where participants can interact with data to make faster, better decisions about systems designs.

In the SCoVE, researchers can apply techniques developed by ASDL and other Georgia Tech departments along with GTRI's extensive portfolio of network-centric and visualization tools. In addition to providing collaborative visualization for systems design, modeling and optimization, SCoVE can also be configured to provide a command-and-control center environment.

"This allows us to provide real-world testing of solutions before they're delivered to customers," explained Williams. For example, GTRI's FalconView (a mapping system for flight-planning software) and GTVC (which allows law enforcement, emergency services and other agencies to collaborate online and respond to events) are available at the SCoVE.

Crafting a Robust Interoperable Network

Working with the Georgia Emergency Management Agency (GEMA) - Homeland Security, GTRI engineers are helping develop a statewide system that will connect existing radio communications systems in each Georgia county – along with selected state agencies and the city of Atlanta – to an Internet-Protocol (IP)-based network.

When the network is complete, Georgia public safety personnel will be able to contact colleagues in other counties almost instantly using their own native radio systems. The network will link the radios of different counties regardless of their technology, which could be VHF, UHF, 800 megahertz, iDEN or others.

Sponsored by the U.S. Department of Homeland Security, through the Law Enforcement Terrorism Prevention Program (LETPP), the Statewide Gateway Interoperability Project will also reach into the neighboring states of Alabama, Florida, South Carolina and Tennessee.

As part of a team that includes GEMA, the Georgia State Patrol, Motorola, the Georgia Technology Authority, AT&T and SpaceNet, GTRI engineers have been supplying technical project management, organizational design and testing services to the venture since it began in 2005.

"By the time we finish Phase Four in mid-2009, our GTRI team will have met and worked with nearly all of Georgia's 159 counties in one way or another," said Douglas Cobb, a GTRI principal research engineer who leads the Georgia Tech team.

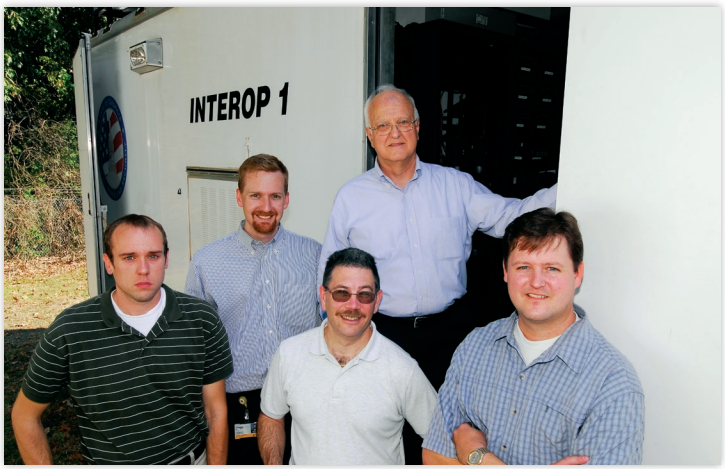
While communication between neighboring locales is usually the most vital, Cobb explains, a major emergency could demand extensive conferencing among field and headquarters personnel in various counties. For example, police and fire/rescue personnel along an interstate hurricane-evacuation route should be able to talk to their counterparts to check conditions, set up detours or call in aid.

The Georgia-based system doesn't upgrade existing public safety communications. Rather, it's an add-on that connects existing radio equipment to an adaptable IP backbone statewide. Using Microsoft Windows-based custom software, county and municipal dispatchers will employ a familiar interface to seamlessly connect wide-ranging wired and wireless users whenever needed.

GTRI is serving as the technical systems integrator for the Gateway Interoperability Project. GTRI's job includes major responsibilities in site, network and satellite communication design; simulation and testing; facilitating meetings and information exchange, and extensive system trouble-shooting.

The federal government is paying most of the system's installation cost. The state is currently paying for the recurring connectivity and maintenance costs for the network, and the completed system will be managed by the Georgia State Patrol.

GTRI researchers are helping develop a network connecting all Georgia public-safety radio systems via a wired Internet-protocol backbone.



Tracking the Location and Availability of Emergency Resources

Tracking the location and availability of resources such as hospitals, transportation equipment and water during an emergency situation can be life-saving. A collaborative mapping tool developed by GTRI is helping emergency management officials better coordinate event and incident planning – and real-time response.

GTRI has teamed with Atlanta-based company Emergency Visions to provide mapping capabilities for a resource database the firm developed to identify, activate, track and coordinate response assets. The tools were selected by the Florida Division of Emergency Management in June 2007 as part of a solution that combines these comprehensive technology tools with the training and management expertise of a team led by the International City/County Management Association (ICMA).

"A lot of mapping systems are pretty complex to operate. Our system was deliberately designed to be easy to use for people who are not mapping experts," said Kirk Pennywitt, a GTRI senior research engineer.

The Geographic Tool for Visualization and Collaboration (GTVC) can track chemical or smoke plumes and help management personnel plan evacuation routes for emergencies such as hurricanes, fires or flooding. To do this, the system tracks resources including the locations of hospitals, fire stations, schools, nursing homes, sand bags, dump trucks, water, personnel and supplies in an affected region. The map can also indicate the status of those assets, such as the number of beds available in a specific hospital.

Emergency planners can immediately get a snapshot of what is going on without relying solely on traditional voice communications. The symbols displayed on the map are the Department of Homeland Security's official emergency management icons.

During an event, electronic feeds can alert users to new incidents and display the location of the events live on the map. Also, GTVC records every user's actions so that those in command can review them after the event to improve planning for future events.

The combined mapping and database system provides Florida with a robust networked emergency management system that it plans to implement in all 67 of the state's counties.

The Georgia Emergency Management Agency has been using the system since 2005 to track forest fires and hurricanes. Hillsborough County, Fla. and Dakota County, Minn. have also licensed the emergency management software for their incident preparedness plans.

"We've also had interest from more than 100 other cities, counties and local agencies," added Pennywitt.

GTRI's mapping tool, GTVC, can identify, track and coordinate emergency response assets.

Helping Young Minds Tackle Technology

Young scholars hone their podcasting skills at GTRI's Interactive Media Technology Center during the Summer Extravaganza science camp.

GTRI has been helping Atlanta-area youngsters find new ways of looking at their world.

Summer Extravaganza, a science-oriented day camp, brought budding scientists and engineers from DeKalb County schools to the Georgia Tech campus for an intensive daily round of activities during the summer of 2007. The program, administered by GTRI research staff, enabled 72 fourth- and fifth-grade youngsters and 17 teachers to focus full-time on the STEM disciplines -- science, technology, engineering and mathematics.

"Kids should continue to have learning experiences in the summer, and that's also a prime time for professional development for teachers," said Claudia Huff, a GTRI principal research associate.

The campers spent six hours daily at Georgia Tech, tackling subjects that included unmanned aerial vehicles, solar power, podcasting, fuel cells, environmental studies, digital photography and "claymation."

Divided into groups of 18 with four teachers and two assistants, students attended demonstrations by Georgia Tech professors and graduate students, and also toured facilities that included GTRI's recording facility, a fish hatchery, and Georgia Tech's Interactive Media Technology Center.

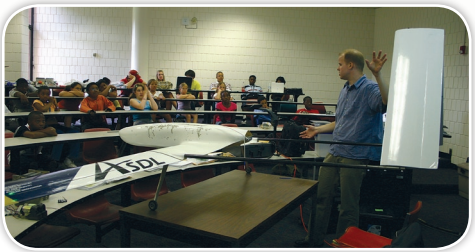
Funded by the DeKalb County School System, the program sought out capable boys and girls of varying backgrounds rather than focusing on youngsters deemed particularly gifted in science.

As important as the science education, Huff believes, was the experience of being on a college campus. "This program is as much about inspiring and building students' confidence as it is about direct learning," she said. "It says to them, 'You belong here – study hard and you can come to Georgia Tech.' "

Campers and teachers spent two weeks on campus, with a third pre-camp week just for teachers.

The daily lunch hour at Georgia Tech was also something of an education for campers. Tech's Student Center Food Court, with its many types of domestic and international cuisine, was a different experience for the youngsters than the average school cafeteria.

This was the sixth summer that Georgia Tech and GTRI have hosted DeKalb K-12 students and teachers at education programs focused on science and engineering.



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

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Georgia Tech Ireland

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(See page 48 for details and contact information)

The Military Sensing Information Analysis Center (SENSIAC)

www.sensiac.gatech.edu

SENSIAC is an information analysis center (IAC) serving the U.S. Department of Defense. It replaces IRIA, a center that focused primarily on infrared technologies. SENSIAC has broad mission and scope, providing information on all sensing-based technologies related to defense activities, including infrared, laser, radar, acoustic, electro-optical, aroma, chemical and other sensors. In addition to being a clearinghouse for information, SENSIAC conducts research projects and educational programs. The Center draws upon experts across the Georgia Tech campus, as well as seven other universities that serve as SENSIAC team members.

Center for Innovative Fuel Cell and Battery Technologies

www.fcbt.gatech.edu

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

Environmental Health and Occupational Safety Center

http://maven.gtri.gatech.edu/esoh/about.html

The Environmental Health and Occupational Safety Center oversees programs in compliance, environmental emergency response and occupational safety and health issues. It bridges the communications gap between constantly updated government regulations and Georgia business, industry, community organizations, and individuals.

Test & Evaluation Research and Education Center

www.terec.gatech.edu

The Test & Evaluation Research and Education Center (TEREC) serves as a focal point for solving the problems of the test and evaluation community. Leveraging the Georgia Tech academic environment and decades of T&E experience, TEREC is defining the future of test and evaluation by advancing knowledge, education and training.

Dental Technology Center

www.dentec.gatech.edu

The Dental Technology Center — DenTeC@ Georgia Tech — is a multi-disciplinary research center focused on advancing dental and craniofacial science and technology. By integrating engineering knowledge and dental science, DenTeC is introducing new products and technologies for dentistry and craniofacial medicine via research, testing and education.

Logistics and Maintenance Applied Research Center

landmarc.gtri.gatech.edu

The Logistics and Maintenance Applied Research Center (LandMARC) provides commercial and government organizations the means to enhance performance of their existing systems and processes, while reducing total operating costs. LandMARC develops performance-centered systems that deliver quality information to decision makers in all parts of the supply chain.

Severe Storms Research Center

www.gtri.gatech.edu/seal/radar/facil_ssrc.html

The Severe Storms Research Center (SSRC) is a focal point for severe storm research in Georgia. The Center also serves the state by providing quick response information to weather and emergency agencies.

Center for International Development and Cooperation

www.gtri.gatech.edu/seal/cidc.html

The Center for International Development and Cooperation (CIDC) develops low-cost radar and phased-array concepts through joint international research activities. CIDC also provides an international forum for technical interchange and seeks dual-use applications for foreign radar technologies.

Commercial Product Realization Office

www.gtri.gatech.edu/cpro

The Commercial Product Realization Office (CPRO) assists companies across both technical and business domains in getting new technology products to market. CPRO also connects research customers to a broad array of services including advice on technology selection, product design, prototyping, production preparation, product data documentation, and testing assistance.

Office of Policy Analysis and Research

www.opar.gtri.gatech.edu

The Office of Policy Analysis and Research (OPAR) integrates public policy considerations into GTRI's technical research and facilitates GTRI's input into the science and technology policy debate. Specifically, OPAR supports the Georgia General Assembly with policy analysis and subject matter expertise in science and technology issues such as nanotechnology for economic development, health information technology, and stem cell research.

Aerospace, Transportation and Advanced Systems Laboratory (ATAS)

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ATAS develops advanced systems concepts and performs research on technologies related to aerospace, transportation, power and energy, threat systems, food processing and system sustainability. Research areas include aerodynamics, flow control, aero-acoustics, aero-elasticity, flight dynamics, smart projectiles, unmanned aerial vehicles, structural analysis, rotorcraft, fuel cell and battery technologies, bio-fuels, and complex energy and power system modeling. To enhance the productivity of Georgia's agribusiness and the competitiveness of Georgia's food processing industry, ATAS conducts significant research on food quality and safety, along with research aimed at minimizing environmental impacts by applying computer vision, robotics, plant ergonomics, biosensors and wearable computer technologies.

The lab conducts air quality and transportation research related to monitoring and reducing the environmental impact of vehicular emissions. It also conducts modeling and simulation of complex dynamic systems. A current example is an integrated model capturing interactions between air, rail, highway and maritime shipping modalities. ATAS researchers conduct applied research and development of radar-related technologies in support of national defense preparedness that spans the spectrum from mechanical and electronic system design and fabrication to full-scale system integration, including embedded computing and control. ATAS has a national reputation for its expertise in threat systems, advanced transmitter technology, and weapon systems interpretation.

Electronic Systems Laboratory (ELSYS)

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ELSYS focuses on systems engineering solutions in the areas of electronic defense and human systems integration. Current projects include research in modeling, simulation and analysis; countermeasures technique development; sensors performance analysis; systems integration; flight test support; missile warning; tactics development and evaluation; mission data development; technology insertion; command and control; network-centric warfare; data links; and C4ISR.

ELSYS researchers are nationally recognized for their contributions to national defense in countermeasures technique development, employing an end-to-end approach to countermeasures development. ELSYS also provides operational embedded software and has designed hardware modifications for several production systems that are fielded on military aircraft worldwide.

ELSYS human systems research includes support to key U.S. government agencies in the areas of aircraft and ship crew station design, traffic management and first responder actions. These researchers also run the Georgia consultation program and provide training as an OSHA Training Institute Education Center for the U.S. Department of Labor. ELSYS performs commercial product evaluations to determine their accessibility to the widest user community. ELSYS sensor performance analysis includes intercept receiver analysis, advanced radar concepts analysis, electronic countermeasures analysis, specialized instrumentation and real-time simulation. Over the past decade, ELSYS has supported flight tests covering all aspects of airborne testing.

Electro-Optical Systems Laboratory (EOSL)

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The Electro-Optical Systems Laboratory (EOSL) conducts research in broad areas in electro-optical systems including remote sensing, modeling and analysis, integrated sensing systems, optical device technology, LIDAR system design and measurement, microelectronics, nanotechnology, solid state lighting, performance support systems, sensor data collection and analysis. Technology areas of pre-eminence include LIDAR systems development; multispectral imaging; EO countermeasures technology and analysis; wide band-gap semiconductors; and advanced packaging for transmit/receive modules used in active phased array radars. The lab performs applied research in the growth and application of carbon nanotubes, multi-functional materials, RFID and optical tagging, and chem-bio sensors. It also operates the Medical Device Test Center, which examines the interactions between medical devices and security and logistical systems.

EOSL has specially configured research centers: Sensors and Sensing Systems Information and Analysis Center (SENSIAC), serving the military sensor community as a repository of information; LandMARC Research Center, formed to provide solutions for mobile, wireless and performance-based tasks; Environmental Radiation Center performing radiation monitoring; Environmental Health and Occupational Safety Center (EOSH), providing compliance oversight for environmental emergency response, and occupational safety and health issues; Phosphor Technology Center of Excellence; and the Center for Optimization of Simulated Multiple Objective Systems (COSMOS).

Huntsville Research Laboratory (HRL)

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Located in Huntsville, Alabama, HRL conducts world-class applied research for several government agencies located at the U.S. Army Redstone Arsenal and the local Huntsville area, including the U.S. Army Aviation and Missile Research Development and Engineering Center, U.S. Army Program Executive Office Missile and Space, U.S. Army Program Executive Office Aviation, U.S. Army Aviation and Missile Command and the Department of Defense Missile Defense Agency. The laboratory's multi-disciplinary systems and software research skills include battlefield command and control modeling, simulation and analysis, analysis and modeling of complete air and missile defense systems and software

development and engineering of rotary-wing aviation mission planning systems. The lab also conducts applied research in testing and evaluation of air and missile defense and aviation systems including hardware-in-the-loop, live field testing and system-of-systems interoperability. Other significant research areas include war gaming and large-scale force-on-force simulations, missile guidance and control, and safety critical tactical software development.

Information Technology and Telecommunications Laboratory (ITTL)

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ITTL conducts a broad range of research in areas of computer science and information technology and communications and networking, and develops commercial products from university research. ITTL conducts research that solves complex problems involving information processing, storage, representation and exchange; Internet and database technologies and applications; information security and assurance; privacy, knowledge management, data visualization, mapping/geographical information, distributed simulation and enterprise information systems. Researchers work in broadband telecommunications, wireless access systems, network security, multimedia information systems, tactical communications, communications surveillance and disruption, information warfare and assurance, communications networks and network management, technology assessment, application integration and software radio systems.

In commercial product realization, multi-disciplinary research teams drawn from across GTRI and Georgia Tech apply product research and development toward product commercialization. Other researchers provide policy monitoring and assessment to facilitate responsiveness to changes in the technological research environment. ITTL also provides C4I capabilities and functional requirements analysis to various service components across the Department of Defense in northern and eastern Virginia.

Sensors and Electromagnetic Applications Laboratory (SEAL)

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SEAL researchers investigate and develop RF sensor systems, with particular emphasis on radar systems, electromagnetic environmental effects, radar system performance modeling and simulations, 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 analysis; signal processing techniques; space-time adaptive processing; ground and airborne moving target indication; synthetic aperture radar; and system sustainment tool development. Antenna-related research programs characterize antenna properties, develop phased-array antenna concepts, and develop various kinds of reflector-type and lens antennas.

In the field of electromagnetic environmental effects, SEAL researchers analyze, measure and control the electromagnetic interactions among elements of an electronic system and between the system and its environment. Additional research areas include sensor development for ballistic missile defense, physical security, meteorology, space-based surveillance and detection, transportation applications, and engineering data analysis and modeling for sustainment of complex electronic systems. SEAL also provides customer-tailored short courses in electronic defense.

Signature Technology Laboratory (STL)

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

Georgia Tech Research Institute

Georgia Tech Ireland Bridges the Gap to Innovation

Athlone, Ireland, is home to GTRI's first applied research facility outside the United States.

In the year since opening its doors in December 2006, Georgia Tech Ireland (GTI) – GTRI's first applied research facility outside the United States – has made significant strides and is months ahead of schedule. Already, GTI has begun developing research test beds and has initiated work in each of its four strategic research markets: Internet protocol television (IPTV), radio frequency identification (RFID), health care technologies and sustainable energy.

Enda Connolly, division manager for IDA Ireland, the Irish Government's economic development agency, says the organization has been very pleased with GTI's progress.

"From a strategic perspective, the main reason we engaged with Georgia Tech and GTRI was recognition that we needed to increase our competency level in applied research," he said. "We are creating a cluster of collaborative research in Ireland and Georgia Tech is one of the key players in this regard."

Overseeing GTI's efforts is Krishan Ahuja, Regents Professor in the School of Aerospace Engineering, who was appointed director and general manager of GTI in September 2007. In that role, he is working with Irish corporations and universities, the Georgia Tech research community and U.S. companies to provide businesses on both sides of the Atlantic with industry-focused research and development that bridges the gap between academic discovery and commercial success.

Constituted as an Irish non-profit company, GTI operates as a partner and collaborator with Irish universities, research centres and companies with reach-back into the research capabilities of Georgia Tech. Research and development at GTI is funded primarily by industry and IDA Ireland. However, contributions from interested donors have been critical in jump-starting early stage research and funding student research experiences and will play an important role in the future.

"Georgia Tech is very well-respected here because of the intellectual brainpower we can access across the pond in Atlanta," said Ahuja, who previously led the Aerospace and Acoustics Technologies Division of GTRI's Aerospace, Transportation and Advanced Systems Laboratory. "The goal is to make Georgia Tech Ireland a huge success."

GTI's offices are located in a 115-acre industrial park in the city of Athlone on the Shannon River in the heart of Ireland. The location is a strategic one: Athlone is centrally located to Galway, the Irish center of biomedicine; Cork, the center of the pharmaceutical industry; and Dublin, the center for information communication technology.

Over the past year, GTI has worked to develop a national test bed for IPTV, a fully interactive digital television service offered to subscribers via an Internet-based broadband connection, which will be built upon the new fiber being installed between all of Ireland's research universities, colleges, technical institutes, hospitals and non-profits. When completed, it will be the largest IPTV test bed in the world.

According to Steve Cross, director of GTRI and executive director of GTI, a test bed will simultaneously be developed in Georgia that can be used in future digital media efforts with assistance from the Digital Media Research Program in Georgia Tech's School of Literature, Communication and Culture. Cisco, through Scientific Atlanta, will be donating the equipment.

The second area of research being examined at GTI deals with RFID and wireless technologies. The focus here is logistics and supply chains, automated manufacturing techniques and authentication and identification technologies. RFID and wireless technologies can be used to track factory parts in assembly plants, ensuring that correct parts are used in the right sequence and assembled as efficiently as possible.

"GTI is building a unique test bed that will have the full capabilities of fundamental device and sensors testing, benchmarking of commercial products as well as the ability to conduct scale testing in live test environments. The fact that the solutions development and associated testing is done with a factory-wide scale model in mind distinguishes this test facility from all other

academic facilities," said Joe Dalton, GTI research leader in RFID and wireless technologies. "A fundamental key differentiator for the Ireland test bed is the provision of co-location facilities for commercial vendors involved in the wireless technologies area to work with GTI to develop solutions on behalf of either their own product portfolio or on behalf of a client company. The goal is to get the optimum solution to market as quickly as possible for the customer."

There are also many health care applications around wireless technologies that are being investigated at GTI, relating mainly to workflow optimization, error reduction and inventory management. Since Ireland is already home to manufacturing sites for a number of large drug companies, some of this research targets pill-tracking accuracy, ensuring authenticity, quality and dosage.

"There are a lot of worries about counterfeit drugs, so there is a real need for this kind of research. We'd like to have some kind of authentification built into every drug – maybe even down to the tablet level – so we know there's quality behind it and that it was manufactured where they say it was," noted Cross. "We're already creating a test bed that, like the IPTV test bed, is going to be the authoritative place in the world to test out these technologies."

GTI's third research area – health care technologies – is focusing on medical devices for preventive and predictive medicine, and on medical device manufacturing. The team in Ireland is leveraging work being done in Atlanta, both through medical device companies at the Advanced Technology Development Center, Georgia Tech's nationally-recognized science and technology incubator, as well as collaborations between Georgia Tech biomedical engineering professors and their Irish colleagues.

The final area of research deals with sustainable energy alternatives, an area of importance to both the United States and Ireland. It includes research in efficient wind turbines, ocean wave energy, biofuels, fuel cells and innovative solar cells. Cross said GTI will primarily be investigating systems approaches to integrating alternate forms of energy.

"After our first year of operation, we have initiated work in each of these areas. These involve some Georgia-based companies that decided to team with us in Ireland," Cross said. "We're also going to be working with some Irish-based companies to provide them with an opportunity to locate part of their operations in Georgia or to have access to Georgia Tech resources back in Atlanta."

One such company is IntelliOne Technologies, the premier traffic information company that measures roadway speed by instantly analyzing mobile phone network usage. In October 2007, the company announced a research and development project with GTI to create an IPTV interface for the company's personal traffic guidance system. IntelliOne Europe is now based in Athlone.

"Georgia Tech Ireland welcomes IntelliOne Europe as a partner in our digital media research initiative," Ahuja said. "We believe live and interactive traffic information delivered to consumers through IPTV is most compelling and we look forward to collaborating with IntelliOne as we deploy our national test bed."

According to Cross, collaborations of this sort are essential to GTI's future. While he expects the five-person staff in Athlone to grow to 50 researchers backed by more than 1,000 multi-disciplinary researchers at Georgia Tech, he says the number of jobs created will not define GTI's success.

"One of our success metrics is not how many people we employ, but how many jobs are created in these research markets. I call it the amplifier effect. We're creating markets and opportunities for other companies to be successful," Cross said. "I am often asked by legislators why we are taking Georgia Tech to Ireland. It's not about taking Georgia Tech to Ireland, it's about bringing Ireland to Georgia Tech and, by extension, Georgia."

GTI will not just involve industrial exchanges, but also academic ones. Two Irish universities have signed memorandums of understanding with GTI for collaborative research and an exchange of faculty and students. In addition, Ahuja has agreed to serve on the governing board of the Athlone Institute of Technology to enhance collaboration with Irish universities and understand more fully how they operate.

"In five years, we expect a cumulative investment of €25 million and 50 researchers employed in Athlone collaborating with corporations," said Connolly. "We are looking forward to working with Georgia Tech during the months and years ahead."

GTI LEADERSHIP

Stephen E. Cross
Executive Director

Krishan Ahuja
Director and General Manager

Directors

Thomas J. Malone (Chair)
Sr Exec. Vice Chairman, Milliken and Co. (retired)

Declan Drislan
Solicitor and Partner, Arthur Cox

Eamonn Ryan
Former Executive Director Overseas, IDA Ireland

John McGowan
Managing Director, McNamara Construction

Board Members

John C. Bacon
President, IP2Biz

Howard J. Morrison, Jr.
Owner, Lebanon Plantation (Savannah, GA)

Robert K. Thompson
Senior Vice President for Administration and Finance, Georgia Tech

William J. Todd
President and CEO, Georgia Cancer Coalition

Gary B. Schuster
Provost & Executive Vice President for Academic Affairs, Georgia Tech

David Frost
Director, Georgia Tech Savannah

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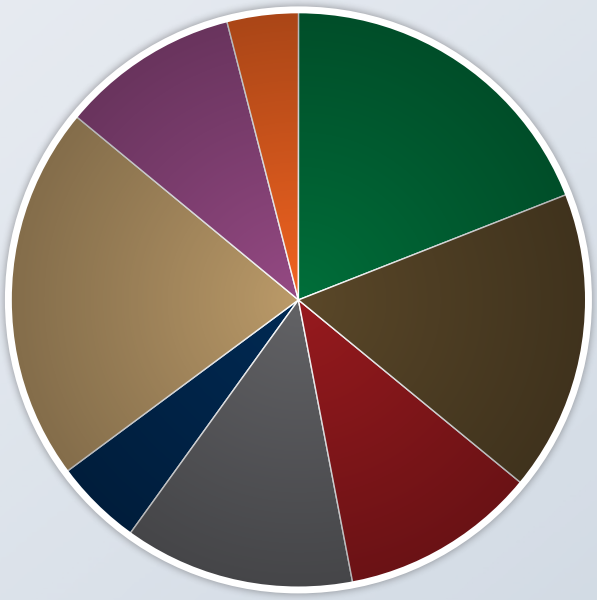
Fiscal Year 2007

Total Research Volume	$130,522,291
Total Research Labor	$53,162,906
Independent Research and Development Investment	$3,491,302
Square Footage Occupied in GTRI Facilities	470,587
Workers Trained by Graduates of GTRI's OSHA Training Institute	39,427
Number of GTRI Employees	1,161
New Research Programs Awarded in FY07	364
Percentage of Georgia Tech Faculty Working at GTRI	25%
GTRI Research Labs	7

GTRI Customers



- Air Force – 19%
- Army – 17%
- Navy – 11%
- DoD Other – 13%
- Federal Other – 5%
- Industry/Federal Subcontract – 21%
- State and Local Governments – 10%
- Private – 4%

GTRI and Georgia Tech: a Great Complement, a Greater Synergy

When customers work with GTRI, they are getting much more than the world-class expertise and experience of a leading research institution. They are also opening the door to the vast intellectual resources of one of America's leading research universities, the Georgia Institute of Technology (Georgia Tech). GTRI and Georgia Tech are complementary world-class institutions that collaborate to solve the innovation equation on behalf of clients. This combination provides unmatched expertise, capabilities, and know-how in solving some of the toughest problems facing government and industry.

- Georgia Tech has the largest voluntary cooperative education program of any university in the nation. GTRI is the largest employer of Georgia Tech students, hiring more than 200 each year.
- GTRI operates a number of multi-disciplinary research centers that facilitate research collaboration with Georgia Tech's academic colleges (see page 45).
- Nearly 40 GTRI researchers hold joint appointments with Georgia Tech's academic colleges.
- GTRI researchers hold top-level leadership positions on the Georgia Tech Faculty Council.
- GTRI teaches more than half of the courses offered by Georgia Tech's Distance Learning and Professional Education (DLPE).
- A GTRI researcher serves as the national security liaison for the Strategic Partners Office in Georgia Tech's Enterprise Innovation Institute.
- Georgia Tech is consistently the only technological university ranked in *U.S. News & World Report's* listing of America's top 10 public universities. In addition, the magazine ranked Georgia Tech's College of Engineering in the nation's top five.
- For producing African-American engineering graduates, *Diverse Issues in Higher Education* ranks Georgia Tech first among U.S. universities at the bachelor's level, second at the master's level, and first at the doctoral level.
- Georgia Tech is home to or partner in 19 federal centers of excellence, up from six in 1997. They range from photonics to the engineering of living tissues.
- Georgia Tech is second in the nation in engineering research expenditures, both overall and in federal funding.
- The number of patents awarded to Georgia Tech researchers increased 193 percent during the past 10 years, and today Tech ranks among the top 10 universities in the nation. A total of 365 invention disclosures were filed in 2006, up more than 200 percent over the past decade.
- Georgia Tech launched 75 new companies during the past decade. In 2006 alone, 10 startup companies were launched and another 18 were in formation.
- Global analysis of university biotechnology commercialization by the Milken Institute ranked Georgia Tech fourth in the number of biotechnology startup companies and eighth in patents awarded.

Young and Fearless: The Next Generation of Scientists and Engineers

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

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

GTRI also has relationships with other prominent universities, providing opportunities for their students to work with Georgia Tech experts to gain practical engineering experience.

Graduate Research Assistants and Graduate Students (in GT's Cooperative Education (Co-Op) program)	33
Undergraduate Co-Op Students	106
Student Assistants/Interns	91
Total	**230**

Supporting Breakthrough Research and Student Opportunities

As GTRI prepares to celebrate 75 years of solving tough problems, employees and customers from around the world have shared stories of people who were not afraid to push the limits of accepted science and persevere on difficult problems when others might have given up. Creativity, innovation and hard work are mentioned time and time again. GTRI is committed to capturing the success of the past, nurturing the next generation of talent and encouraging breakthrough ideas. That's why we must ensure that brilliant minds have the intellectual freedom and financial backing to explore promising technologies, prove their viability, and change the world.

Establishing an Alumni Lab

GTRI alumni (retired and former employees) and customers have shown significant interest in providing opportunities to mentor and support young researchers and in serving as catalysts in transforming great ideas into real-world results. In response, GTRI is creating an alumni laboratory to foster intergenerational learning and collaboration. Additional plans call for creating opportunities for promising young researchers to spend extended time on-site with industry and government partners learning firsthand the problems they are teaming to solve.

Enabling the Next Breakthrough

GTRI researchers have no shortage of new and creative ideas that could become revolutionary as long as there is funding in place to support their early-stage research. There is great internal demand for seed funding to explore dual-use technologies. GTRI experts who are intimately familiar with specific technologies used for defense applications often see possibilities for using the same technologies to solve problems for industry, simplify everyday life and make the world a better place. From making it easier to open jars, to developing wireless captioning devices for the hearing impaired, to reducing water consumption in the food processing industry, our researchers see opportunities to transfer technology and make a difference.

Empowering the Next Generation of Scientists and Engineers

Students are the future. GTRI is already the largest employer of Georgia Tech students, involving more than 200 of these hard-working young people in research projects each year. To expand student research opportunities, GTRI plans to create applied research internships in our field locations around the nation and in our first international research institute in Athlone, Ireland. (See pages 48-49) GTRI's stakeholders have shown significant interest in real-world applied research experiences for students – a concept wholeheartedly supported by GTRI. Students bring energy, different perspectives and a fearlessness that helps to make us successful.

Philanthropy will help GTRI approach the future aggressively and successfully. For information about how to make a gift to support the alumni lab, seed funding for great ideas, or to support students, please contact:

Betsy Plattenburg
Director of Development and Corporate Relations
betsy.plattenburg@gtri.gatech.edu
404. 407. 7889

Dr. H. Allen Ecker, Executive Vice President, Scientific Atlanta, a Cisco Company:

"As a former GTRI researcher (Engineering Experiment Station from 1966-1976), I experienced firsthand the challenges of transforming ideas into workable solutions. I have many fond memories of my time at EES. I currently serve on the external advisory board of GTRI, so I stay abreast of current research capabilities and their potential impact. The developing research in IPTV at Georgia Tech Ireland is an area of special interest to me and thus I was pleased to make a personal gift to support IPTV research. I would like to urge others with current and past affiliations to GTRI who see the value of groundbreaking research and remember how hard it can be to get new ideas off the ground to consider giving back to support the next generation of students and young researchers."

Loraine Williams, community volunteer:

"I made a gift to support students in Ireland because I realize that not all students have the ability to finance work or study abroad and I feel strongly that Ireland provides a unique learning laboratory. Ireland is without question the most dramatic economic development success story in the world".

GTRI Professional Education

In 2007, approximately 5,100 students took one or more of the 100 GTRI-related professional education courses in areas that included defense technology, dental technology, and occupational safety and health. The courses are offered through Georgia Tech's Department of Distance Learning and Professional Education (DLPE), and can also be taught at customer locations and GTRI field offices.

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

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

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

The remaining five GTRI defense technology certificates are sensor-related: antennas, electronic warfare, radar systems and infrared and electro-optical technology. All are in high demand.

In addition to course offerings in defense technology, GTRI offers continuing education courses in dental technology and occupational safety and health standards. Such academic offerings are an outgrowth of the kind of work being done at GTRI.

Through DenTeC – Georgia Tech's Dental Technology Center – doctors, clinicians, technicians and industry researchers are introduced to innovative dental technologies that will increase efficiency and proficiency, minimize discomfort for patients, reduce the amount of time required for procedures and lower overall health costs. Courses and workshops are available in management areas such as financials and insurance, marketing, scheduling and administration, and clinical areas such as ceramic restorations and restorative dentistry. In 2008, a certificate in dental practice management will be available to professionals via the Internet.

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

For more information about GTRI's professional education program visit www.gtri.gatech.edu

Georgia Tech Research Institute

Hire the Best, Train the Best, Keep the Best

GTRI's scientists and engineers are among the best problem-solvers in the business. Our team-based approach to supporting customers allows our approximately 1,200 dedicated employees the flexibility to be creative and truly innovative. During the 2007 fiscal year, 171 new engineers and scientists joined GTRI's corps of problem solvers.

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

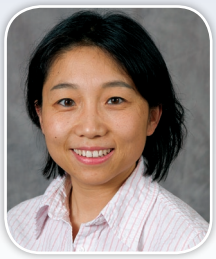
It's no wonder GTRI has built a stellar team that pairs the vast technical experience of veteran researchers with the best and brightest young minds of today. All of them take pride in the fact they are helping make the world a better place.

Name: Margie Brown
Title: Research Associate
Starting position: Marketing Coordinator
Years with GTRI: 18
What motivates you:

Our sponsors constantly keep us on our toes and keep our skills on the cutting-edge. We don't take anything for granted.

Name: Jie Xu
Title: Research Scientist II
Starting position: Tech Temp
Years with GTRI: 6
What motivates you:

My ultimate goal is to use my knowledge to help society. Developing new technologies to solve problems in real life gives me motivation each day.



Name: Josh Davis
Title: Research Scientist I
Associate Branch Head
Starting position: Co-op Student
Years with GTRI: 10
What motivates you:

We thrive on solving hard problems – we're focused on challenges.

Name: Lee (Sheiner) Montana
Title: Research Engineer I
Associate Branch Head
Starting Position: Co-op Student
Years with GTRI: 7
What makes GTRI special:

I believe that the work we do is important, which gives me a sense of purpose that even my children notice.

Name: Kevin Massey
Title: Senior Research Engineer
Starting position: Student Assistant
Years with GTRI: 17
What motivates you:

My hope is that the work that I'm doing now will help save the lives of soldiers and help keep us safe from the bad guys.

Name: Bryan Smith
Title: Research Scientist I
Starting Position: Research Scientist I
Years with GTRI: 4
What makes GTRI special:

GTRI helps me expand my knowledge and grow my expertise, which benefits every customer I work with.

Name: Jerry Lett
Title: Senior Research Associate
Starting position: Research Associate II
Years with GTRI: 23
What motivates you:

It's great knowing that I can provide a service that is needed and appreciated and realizing that I contribute to a mission that makes the world better.

Name: Jeff Kemp
Title: Senior Research Scientist
Starting Position: Co-op Student
Years with GTRI: 18
What makes GTRI special:

We have the chance to be involved with interesting projects from a wide variety of sources on a regular basis. This gives us the ability to do things that few other organizations have a chance to do.

Title Equivalencies: RS/RE I = Instructor • RS/RE II = Assistant Professor

Name: Jay Sexton
Title: Research Engineer II
Starting Position: Research Engineer I
Years with GTRI: 8
What motivates you:

I'm motivated to do quality work every day on projects that make a difference and have a real impact on people's lives.

Name: Tim Strike
Title: Chief Engineer (ELSYS)
Starting Position: Research Technologist I
Years with GTRI: 29
What makes GTRI special:

A lot of our projects help protect people: defense projects to warn and train soldiers, medical projects for diagnostic and computer integration for patient care, and accessibility projects for the disabled.

Name: David Roberts
Title: Senior Research Scientist
Starting Position: Graduate Research Assistant
Years with GTRI: 23
What motivates you:

My work is a creative act, and if I'm going to create something, I want it to be the best I can possibly deliver.

Name: David Schmieder
Title: Principal Research Scientist
Starting Position: Senior Research Scientist
Years with GTRI: 29
What motivates you:

I learn new things every day in subjects that fascinate me. I take great pride in GTRI's reputation.

Name: Dennis Brown
Title: Machine Shop Manager
Starting Position: Mechanical Tech I
Years with GTRI: 29
What makes GTRI special:

We solve problems to help people and our environment. I would like to think that GTRI helps make the world a little bit better.

Name: Martha Farley
Title: Market Support Manager
Starting Position: Clerk Typist
Years with GTRI: 35
What motivates you:

The work our people do makes a real difference and I've always tried to do whatever I could to help our scientists and engineers be successful.

Name: Craig Wyvill
Title: Principal Research Engineer
Starting Position: Research Engineer II
Years with GTRI: 29
What makes GTRI special:

We have the unique ability to span the systems development cycle, from basic innovations to applied research to prototyping to field testing, all of which lets us truly innovate.

Name: Barry Sharp
Title: Senior Research Engineer
Starting Position: Associate Research Engineer
Years with GTRI: 29
What makes GTRI Special:

GTRI gives its researchers a great deal of freedom to pursue different interests. The learning and growth program also provides the time and resources for researchers to study new areas and broaden their knowledge.

Name: Paul Hawley
Title: Administrative Manager II
Starting Position: Chemical Tech I
Years with GTRI: 30
What motivates you:

I truly enjoy supporting GTRI's researchers and feel good about helping them make a difference for our customers and for society.

Name: Mike Harris
Title: GTRI Fellow
Starting Position: Student Assistant
Years with GTRI: 32
What motivates you:

At GTRI, we experience the excitement that comes from doing something that no one else has ever done before.

- Senior RS/RE = Associate Professor
- Principal RS/RE = Professor

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 issues.

Gary Gimmestad FY08 – 10 *Electro-Optical Systems*	**Ron Bohlander** FY07 – 09, Chair *Information Technology & Telecommunications*	**Larry Corey** FY06 - 08 *Sensors & Electromagnetic Applications*
Neil Lareau FY08 – 10 *Electronic Systems*	**Betty Whitaker** FY07 - 09 *Information Technology & Telecommunications*	**Dennis Folds** FY06 - 08 *Electronic Systems*
Lora Weiss FY08 – 10 *Aerospace Transportation & Advanced Systems*	**Tom Fuller** FY07 - 09 *Aerospace Transportation & Advanced Systems*	**Lon Pringle** FY06 - 08 *Signature Technology*

Exploratory Research at GTRI: New Frontiers, New Possibilities

GTRI's independent research and development program provides early-stage investments for researchers, encouraging them to explore new approaches to difficult challenges. Through this program, GTRI's best and brightest problem solvers truly push the envelope and test new ideas, concepts and technologies. The results can be revolutionary and can accelerate entry into new research areas that may have high payoff for GTRI's current and future customers. During the 2007 fiscal year, GTRI invested more than $3.4 million in this program.

GTRI's independent research and development program helped fund this research on shrinkage in dental polymers.

GTRI Leadership

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Professor, Stewart School of Industrial & Systems Engineering
Professor, College of Computing
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GTRI's seven laboratory directors are also key members of our leadership team. You can find their contact information along with descriptions of the laboratories they lead on pages 46 & 47.

External Advisory Council

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 the latest trends and meet the changing needs of both industry and government customers. Council members include:

The Hon. Kathy Ashe
Georgia State Representative, 56th District

Mr. Ben J. Dyer
Senior Managing Director, Jackson Capital, LLC
President, Innovations Publishing, LLC

The Hon. Chip Rogers
Georgia State Senator, 21st District

Mr. John C. Bacon
EAC Vice Chair (State and Industry)
President & CEO, Intellectual Property Partners, LLC

Dr. H. Allen Ecker
Executive VP, Scientific-Atlanta, Inc.

Mr. George T. Singley, III
President, Engineering, Training and Logistics Group (Retired)
Science Applications International Corporation (SAIC)

VADM Herbert A. Browne, (USN, Ret)
President & CEO (Retired), Armed Forces Communications & Electronics Association (AFCEA) International

Mr. Alan J. McLaughlin
EAC Vice Chair (National Security)
Strategic Planning & Technology Consultant (Director, Lincoln Labs/MIT, Retired)

The Hon. James W. Tysinger
Former Georgia State Senator, 41st District

Dr. John F. Cassidy, Jr.
EAC Chair
Consultant; Senior VP of Sciences & Technology (Retired), United Technologies Corporation

Mr. William R. T. Oakes, Jr.
CEO, Acorn, LLC

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

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

Mr. Glen P. Robinson, Jr.
Retired Founder, President and CEO of Scientific Atlanta, Inc.

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The 2007 GTRI Team

DAVID AALFS
LINDA ABERCROMBIE
JOSEPH ACCETTA
JAMES ACREE
ALEXANDER ADAMS
ETHAN ADLER
VITO ADRAGNA
DIANE AENCHBACHER
GEORGE AGUILAR
SEAN AHONEN
VICKI AINSLIE
BRANDON ALEXANDER
NEAL ALEXANDER
BRIAN ALEXANDER
JOHN ALFORD
SARAH ALLEN
JAMES ALLISON
JAMES AMS
PATRICIA ANDERSON
DINAL ANDREASEN
HARRY ANDREWS
KATHERINE ANDREWS
DARREN APPLING
ANTHONY ARRINGTON
ODELL ARRINGTON
OSCAR ASBELL
BILLY ATCHESON
THOMAS AUTREY
MICHAEL AVERA
JOHN BADEN
JAMES BAER
ROBERT BAGGERMAN
KUN BAI
JOSHUA BAILEY
CHRISTOPHER BAILEY
CHRISTOPHER BAILEY
MARY BAILEY
GARY BAILEY
BRADFORD BAKER
GAYATHRI BALASUBRAMANIAN
SARA BALLARD
WILLIAM BALLARD
JEANNE BALSAM
SCOTT BANKS
TANAH BARCHICHAT
ANDREW BARDAGJY
NATHANIEL BARISH
BRETT BARNETT
ERIC BARNHART
ELLEN BARRETT
OLIVER BARRETT
ROBERT BARRETT
STEVE BARTON
MARSHA BARTON
ANN BATCHELOR
DAVID BAXTER
CHARLENE BAYER
RODERICK BEARD
ROBERT BEARDSWORTH
ROBERT BEASLEY
CARL BEASLEY
LARRY BEASLEY
JAMES BEISNER
WILLIAM BELL
GISELE BENNETT
BEAU BENNETT
SCOTT BERGER
JUWAN BERNARD
JAMES BERTOGLIO
MICHAEL BIERCUK
LINDA BIGHAM
MURPHY BISHOP
CARLEE BISHOP
SHARON BISHOP
TAMMY BLAIR
WILLIAM BLAIR
STEPHEN BLALOCK
MELISSA BLANCHARD
JULIE BLANKENSHIP
SAMUEL BLANKENSHIP
CARL BLUNT
CATHERINE BODUROW
WILLIAM BOHABOY
RONALD BOHLANDER
NICHOLAS BOLLWEG
WILLIAM BORLAND
JOSEPH BORST
THERESE BOSTON
RICHARD BOYD
KAREN BOYLE
BENJAMIN BRACKETT
THOMAS BRADLEY
MATTHEW BRADLEY
THOMAS BRANCH
LISA BREZEE
JUSTIN BRIDGES
TERRY BRIDGES
DAVID BRINKMANN
MICHAEL BRINKMANN
CHELSEA BRITT
DOUGLAS BRITTON
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RALPH BROOKS
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KATHERINE BROWN
PAUL BROWN
MARGUERITE BROWN
JAMES BROWN
TERRELL BROWN
C. THOMAS BROWN
IDA BROWN
GEORGE BROWN
JOSEPH BRUDER
WILLIAM BRYAN
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XAVIER BRYANT
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KRISTEN BUTLER
WILLIAM BUTLER
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RODNEY CAGLE
GARY CAILLE
FRANK CALDWELL
THOMAS CALLIS
RODOLFO CAMACHO-AGUILERA
KENNETH CAMANN
STEPHEN CAMP
MATTHEW CAMPBELL
DANIEL CAMPBELL
NORMA CAMPBELL
DANIEL CAMPBELL
COREY CAMPBELL
DEREK CAMPBELL
JASON CANDLER
ANGELA CANTOR
KEVIN CARAVATI
REBECCA CARAVATI
GERALD CAREY
TODD CARNAHAN
ANN CARPENTER
STEVEN CARR
LINDA CARROLL
CHARLES CARSTENSEN
JESSICA CARTENSEN
RANDOLPH CASE
JAMES CATHCART
EVAN CAYLOR
JAMES CHALOUPKA
TRAVIS CHAMBERS
GLENN CHAMPION
NICHOLAS CHAN
BRIAN CHANDLER
RAJESWARI CHANDRASEKARAN
KENNETH CHANEY
CYNTHIA CHANNELL
CLARENCE CHARLESWELL
BRENDA CHEEKS
BALAJI CHELLAMIYENGAR
ALBERT CHEN
GARRY CHESHIRE
BRIAN CHILDRESS
ROGER CHIOU
CAROL CHOI
MYUNG CHOI
ALBERT CHRISTIANSON
ADAM CHURNEY
BRIAN CIESZYNSKI
LOUIS CIRCEO
GERALDINE CLARK
DONALD CLARK
EDGAR CLAUSER
CHARLES CLAXTON
DUSTON CLINE
MARK CLUTE
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JOHN COBB
JANET COBB-SULLIVAN
HOMER COCHRAN
CHANDLER COE
JAMES COFER
DOUGLAS COHEN
ADAM COHEN
MARVIN COHEN
BYRON COKER
ANGELA COLAR
MITCHELL COLE
CHARLES COLE
JAMES COLEMAN
SHEREE COLESTOCK
ALEXANDER COLETTI
THOMAS COLLINS
JEANETTE COLLINS
GEORGE COLLINS
ANNETTE COMES
RUSSELL COMPTON
ALBERT CONCORD
MICHAEL CONIGLIARO
STEPHEN CONOVER
MELISSA CONTI
ANTHONY CONTRADA
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KYLE COOGAN
KATHIE COOGLER-PRADO
JIM COOK
AMY COOK
DANIEL COOK
KEVIN COOK
JAMES CORBETT
LARRY COREY
NAKENYA CORKER
JULIAN COTHRAN
HENRY COTTEN
THOMAS COTTON
ERNIE COWMAN
CARL COX
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HAROLD CRAIN
CHARLES CRAWFORD
DEMETRIA CRAWFORD
DAVID CREASY
DON CREYTS
CHRISTINA CREYTS
JOHN CRIBBS
STEPHEN CROSS
JOHN CROSSLAND
DAVID CROWE
SCOTT CROWGEY
CAROL CROY
NICHOLAS CURRIE
WILLIAM CUTTS
STEPHEN CUZZORT
JOHN DAHER
WAYNE DALEY

GWYNETH DALTON
JIMMIE DALTON
CARLOS DAVILA
RODGER DAVIS
KYLE DAVIS
SHELTON DAVIS
BRADLEY DAVIS
WALTER DAVIS
DONALD DAVIS
JAMES DAVIS
ALYSSA DAYA
THOMAS DEAN
BARTHOLOMEW DEBACKER
SAMI DEEN
VICTOR DEJESUS
LEE DELLENBAUGH
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DENNIS DENNEY
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JOHN DOSS
PATRICK DOWDY
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ANGELA DUBOSE
RACHEL DUKE
ANN DUNEHEW
MICHELLE DUNHAM
THOMAS DUNN
ANDREW DYKES
WILLIAM EAGAR
CLIFFORD ECKERT
SANDRA EDGE
LISA EHRMAN
JARED EISNER
NORMAN ELLINGSON
JAMES ELLINGTON
JAMES ELLIS
RUSSELL EMBRY
ROBERT ENGLAR
KIRK ENGLEHARDT
MARK ENTREKIN
JAYDON ENTREKIN
DAVID ERICKSON
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JEFFREY EVANS
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ELLEN FIELD
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ASHLEY FLICK
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MIKHAIL FOGELSON
DENNIS FOLDS
RENITA FOLDS
SHAOHUI FOONG
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TINA FOUNTAIN
CHRISTOPHER FOWLER
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CURTIS FREE
ALAN FREELAND
PETER FREEMAN
PAUL FRIEDERICH
DAVID FRIEDMAN
MARTIN FRIERSON
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MARK FROST
XIAOJUAN FU
THOMAS FULLER
RICHARD FULLER
OMAR FUNG
ROBERT FUNK
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RICHARD GAETA
ENOCH GAMBLE
DAYNE GARDNER
ANDREW GARDNER
JEFF GARMON
JEFFREY GARNETT
ALLEN GARRISON
SEAN GARRISON
MOLLY GARY
STEPHEN GAW
DEMETRIS GEDDIS
JENNIFER GEIST
MARK GEORGES
JEFFREY GERTH
ERIC GETER
VINCENT GIBSON
CHARLES GIBSON

KATHRYN GILBREATH
EDWARD GILMORE
MICHAEL GILSDORF
GARY GIMMESTAD
AKLILU GIORGES
GARTH GIRMAN
BRUCE GLASGOW
SAMUEL GLIDEWELL
ROY GLOVER
KELLY GOAD
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ROBERT GOLDEN
ALEXANDER GOLDIN
ALAN GOLIVESKY
JAN GOOCH
ROBERT GOODMAN
STEVEN GORDON
JILL GOSTIN
LAMAR GOSTIN
GARY GRAY
JANICE GREEN
JONATHAN GREER
WILLIAM GREGORY
EUGENE GRENEKER
AYANA GRESHAM
BRIAN GREVE
SERGIO GRULLON
HENRY GUILLEN
THOMAS GUINN
JIAJIE GUO
JAMES GURTNER
WALLACE GUSTAD
KEVIN GUTHRIE
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GARY GUYTON
WILLIAM GUZAK
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HAL HAGEMEIER
STEPHEN HAGUE
WALTER HAINES
JOHNNY HALL
LOUIS HALLER
MILTON HALLEY
JEFFREY HALLMAN
STANTON HALPERN
AZIM HAMID
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HERSCHEL HANELINE
ZACHARY HANIF
GREGORY HANLON
AARON HANSEN
DAVID HANSON
TERENCE HARAN
SIMEON HARBERT
CHARLES HARDIN
SCOTT HARLAN
JUAN HARRELL
KYLE HARRIGAN
ADRIENNE HARRINGTON
ANIKA HARRIS
HERBERT HARRIS
DAVID HARRIS
MARGARET HARRISON
GEORGE HARRISON
JUDY HARRISON
JACK HART
EDWARD HART
ALEXA HARTER
PAUL HAWLEY
COMAS HAYNES
MARLIT HAYSLETT
TED HEATH
MICHAEL HEIGES
KARL HEINRICH
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ANNE HELTON
ROBERT HEMPHILL
CHRISTOPHER HENDERSON
ANDREW HENDERSON
MARY HENDERSON
ROBERT HENDRY
JOHN HENNINGS
ANDREW HENSHAW
RALPH HERKERT
CHRISTOPHER HERNDERSON
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RYAN HERSEY
MORRIS HETZLER
RICHARD HICKS
WALTER HICKS
JAMES HIGGINS
MELINDA HIGGINS
TANA HIGGINS
ALICE HIGHTOWER
STEPHEN HILBER
TERRY HILDERBRAND
MELANIE HILL
JASON HILL
BRENDA HILL
KENDAL HINTON
ROBERT HOCHMAN
DAVID HODGES
PATRICK HODGES
MARK HODGES
WILEY HOLCOMBE
ERNEST HOLDER
SIMON HOLLEY
WILLIAM HOLM
RYAN HOLMAN
JOHNATHAN HOLMES
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EDWARD HOPKINS
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CLAUDIA HUFF
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STANLEY HUGHES
CLARENCE HUGHES
WALTER HUGHEY
GARY HULSEY
WAYMAN HUMPHREY
NATHANIEL HUNTER
KELLIE HUNTER
CHARLES HUNTER
HELEN HUNTON
JOSEPH HURST
STEVEN HURST
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RICKY IVEY
STEVEN JACKSON
AARON JACKSON
VINEET JAIN
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JONATHAN JAMES
ELISA JAMES
CALVIN JAMESON
ANN JAUDON
AARON JAYNES
GREGORY JENKINS
JEFFERY JENKINS
BURT JENNINGS
JEFFREY JO
LUCY JOHNSON
ERMA JOHNSON
KENNETH JOHNSON
ALLAN JOHNSON
VALERIE JOHNSON
RITA JOHNSON
BOBBY JONES
ROGER JONES
CHAD JONES
MICHAEL JONES
JARED JULIAN
BERND KAHN
JOHN KALTER
KEVIN KAMPERMAN
AARON KANE
RAYMOND KANGAS
DANIEL KARNIK
JASON KAU
JOSHUA KAYSE
ROBERT KEARNEY
BYRON KEEL
BRADLEY KELLER
TIFFANY KELLY
RASHARD KELLY
OLGA KEMENOVA
JEFF KEMP
PAUL KEMPER
WILLIAM KENYON
ELEAZAR KENYON
KIRSTEN KEPPLE
JAMES KERCE
ANDREW KERR
ROBERT KERR
MORRIS KESLER
ASHLEE KIDD
GREGORY KIESEL
KIMBERLY KIMMEL
MARK KINDL
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SANDRA KIRCHOFFER
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DONALD KITCHEN
RANDY KNIGHT
DIANE KNOBLOCH
MICHAEL KNOTTS
KATHRYN KNOX
SHARON KOBERG
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BRIAN KOCHER
STAN KOMSKY
SHAYNE KONDOR
MICHAEL KOPP
JASON KRAMER
DARRYL KREITZER
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KRISTINA KUHLKEN
VICTOR KUMSOMBOONE
ERIC KUSTER
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BRETT LABRECQUE
PHILIPPE LACASSE
VALERIE LAFOND-FAVIERES
CYNTHIA LAGESSE
JEFFREY LAHR
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SANDRA LAIB
QUIMIN LAM
DARRELL LAMM
JACK LAND
JOHN LANDGREN
DAVID LANDGREN
SARAH LANE
TEDDY LANE
NEIL LAREAU
MEGAN LAROCCA
DANIAL LAUBLER
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VICTOR LAWSON
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ANTHONY LEBLUE
WARREN LEE
JAMES LEE
STEVEN LEE
MORRIS LEESANG
VINCENT LEONE

JERRY LETT
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RICHARD LEVIN
ZDZISLAW LEWANTOWICZ
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ANDREW LICAUSI
SUSAN LIEBESKIND
DEBORAH LIGHT
DOUGLAS LILLEY
CHERYL LILLY
JUNG-YOUL LIM
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STEPHANIE LIN
AMY LIN
JENNIE LINCOLN
KATHRYN LINDSEY
AARON LIPIN
MARIE LITTLE
NEIL LOBRACCO
DAVID LOCKLEAR
ROBERT LOEBACH
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MARGARET LOPER
MICHAEL LORENZANA
ANDRE LOVAS
BENJAMIN LOWERS
JOHN LOWREY
SCOTT LOYD
CHEN-CHANG LU
KRISTIN LUM-YOUNG
SHARON LYONS
LIAM MAC DERMED
PAUL MACKIE
REID MACTAVISH
JOHN MAGUIRE
MOHAMMAD MAHMUD
RICHARD MAIER
SHAWN MALONE
LORANN MALONE
JAMES MALONEY
FREDERICK MANN
RAYMOND MARCEAU
MIROSLAV MAREK
JAMES MARKS
JAMES MARONEY
PHILIP MARQUARDT
MATTHEW MARSHALL
HAROLD MARSHALL
WILLIAM MARSHALL
DOUGLAS MARTIN
JONATHAN MARTIN
LINDA MARTIN
MICHAEL MARTIN
CHRISTOPHER MARTIN
ARMAND MASSE
KEVIN MASSEY
DOUGLAS MASSEY
DEREK MASSEY
DAWN MASSEY
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CHRIS MATTHEWS
JOHN MATTHEWS
JENNY MATTHEWS
SCOTT MAURER
DORESA MAY
BRIAN MAYHEW
COREY MAYO
BETTIE MCADDOO
KYLE MCCAFFREY
MARK MCCANS
TARA MCCART
CHRIS MCCLANAHAN
TIM MCCLUNE
LEIGH MCCOOK
ROY MCCORD
ADAM MCCORKLE
WILLIAM MCCORMICK
JULIE MCCOY
RUSSELL MCCRORY
CHARLES MCCULLOUGH
ADAM MCDANIEL
THOMAS MCDERMOTT
JENNIFER MCDONALD
LISA MCDONALD
MARIA MCGAHA
ROBERT MCGAHEE
BRANDON MCGOVERN
AKILAH MCINTYRE
MARY MCKENNA
ANGUS MCLEAN
BRANDON MCMAHAN
JAMES MCMICHAEL
GARY MCMURRAY
SHAWN MCNUTT
JOHN MEADORS
PHYLLIS MEANS
BRIAN MEDLIN
BENJAMIN MEDLIN
CHRISTINA MEDLIN
NANETTE MEEKS
LEE MEINECKE
ANTONETTE MELVIN
WILLIAM MELVIN
H MENHORN
HICHAM MENKARA
JASON MERKEL
PAUL MICELI
ROBERT MICHELSON
STUART MICHELSON
ROBERT MICHELSON
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DAVID MILLARD
THOMAS MILLER
WILLIAM MILLER
MATTHEW MILLER
SARAH MILWAY
ANDREW MISHOE
BARRY MITCHELL
MARK MITCHELL
NATALIE MITCHELL

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GREGORY MOHLER
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LELAND MONTANA
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THOMAS MOORE
RICKY MOORE
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ANDREW MORRIS
RICHARD MORRISON
DAVID MORTON
RICHARD MOSER
SHANTRELL MOSS
RICHARD MOSS
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MATTHEW MOYER
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SUWANA MURCHISON
PRESTON MURRAY
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ANDREW MUZIO
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RICHARD NAKASATO
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ARUN NAYYAR
FRANK NEELEY
ROMON NEELY
PATRICK NEELY
JENNIFER NELSON
JOSH NESSMITH
ASHLEY NEWTON
DONTEL NEWTON
NICHOLAS NICHOLSON
CHARLES NICKEY
KENNE NINGAHI
DAMON NIX
DONALD NOBLE
DELORES NOGRADI
MATTHEW NOURY
MAURICE NOVEMBRE
RICHARD ODOM
DAVID ODOM
JOEL ODOM
SETH OGRAM
BENJAMIN OLIVE
DOUGLAS OLSEN
MICHAEL O'NEILL
DANIEL ORTIZ
AMANDA OUDI
BRIAN OUELLETTE
MICHAEL OWENS
CHRISTOPHER OWENS
ARTHUR OYSGELT
ARKADAS OZAKIN
EDDIE PAIGE
TIMOTHY PALMER
RAELLE PANCHOO
VASILIOS PANTAZOPOULOS
CHRYSANTHOS PAPANICOLOPOULOS
BRIAN PARISE
DEBORAH PARK
GLENN PARKER
JUDY PARKS
JONATHAN PARKS
JOE PARKS
ARAM PARTIZIAN
SHRAYESH PATEL
GAUTAM PATEL
JESSICA PATER
DUANE PATTERSON
ROBERT PATTERSON
EDWARD PATTERSON
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MARK PELLEGRINI
KIRK PENNYWITT
MARTHA PERDUE
VIJAYALAKSHMI PERIAPOILAN
BRANDON PERRY
RAYMOND PERRY
THOMAS PERRY
SAMUEL PETERS
ANDREW PETRY
HEATHER PHILLIPS
GORDON PHILLIPS
MICHAEL PHILLIPS
DWIGHT PHILPOTTS
MICHAEL PIEPER
MIRIAM PIERCE
JOHN PIERSON
LAWRENCE PIHERA
ERIC PING
SAMUEL PIPER
CHARLES PIPPIN
JEFFREY PITCHER
BETSY PLATTENBURG
PAUL PLUNKETT
GINA POLIMENI
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DAVID POORE
DAVID POSKEVICH
JASON POWER
RONALD PRADO
THOMAS PRATT
RICHARD PRESLEY
DAVID PRICE
JULIAN PRICE
LON PRINGLE
PAUL PRITCHETT
ERIN PROWETT
KEITH PRUSSING
KENNETH PULLEN

KERRY PULLEN
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GERALD RADOVICH
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PETER RALSTON
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SUSAN RAMOS
ANDREW RAMSEY
DON RANLY
KIMBERLY RANSOM
JUSTIN RATNER
MOHAMMED RAUF
EKKEHART RAUSCH
JERRY RAY
RICHARD RAY
WILLIAM RAY
WILLIAM READY
GABRIEL REBEIZ
ERIN REDDICK
EDWARD REEDY
DEEANN REESE
ANDREW REGISTER
DAVID REID
ZACHARY REINHARDT
GEORGE REINHARDT
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JACOB RHODES
ROBERT RICE
DORIS RICH
GROVER RICHARDSON
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DAVID RIMMER
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RUSSELL ROBERTS
STEVEN ROBERTSON
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DON ROGERS
WILLIAM ROGERS
GREGORY ROHLING
PATRICIA ROSE
DAVID ROSELIUS
JAMES ROSS
ROBERT ROSSON
ROBERT ROSSON
STEFAN ROTH
FRANCIS ROTOLONI
RICHARD ROWLAND
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GEOFFREY RUSSELL
ALAN RUSSELL
BARBARA RUSSELL
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DARRYL SALE
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ROBERT SANDFORD
CRAIG SANDS
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JESSICA SCHULTZ
KYLE SCHWING
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RANDY SCOTT
GAYNELL SCOTT
JOHN SCOVILLE
MELANIE SCOVILLE
SHEMERRA SEARCY
MICHAEL SEELHORST
EVAN SEGUIN
ANTONIO SERNA
JERRY SEXTON
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CHRISTOPHER SHAPPERT
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STEVEN SHARPE
CHARLES SHEETS
ALBERT SHEFFER
LUTHER SHEFFIELD
MICHAEL SHELDON
WILBURN SHELL
DONALD SHERMAN
JAMES SHERRILL
JOHN SHIELDS
ALLISON SHIFLETT
FRANCES SHIFLETT
JOE SHIRLEY
BRIAN SHIRLEY
KEISHA SHIVERS
GREGORY SHOWMAN
BETH SHOWMAN
BRIAN SHRADER
YEVGENIY SHROM

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ERWIN SIMMONS
LOUIS SIMONETTA
CHRISTOPHER SIMPKINS
ROBERT SIMPSON
DEAN SINGLEY
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VALERIE SITTERLE
PAIGE SKIDMORE
GREGORY SLAGLE
CHRISTOPHER SLATER
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RICHART SLUSHER
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LESLIE SMEE
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COURTNEY SMITH
LARRY SMITH
CHRISTOPHER SMITH
MICHAEL SMITH
RONALD SMITH
WILLIAM SMITH
JAMES SMITH
STEVEN SMITH
BRYAN SMITH
GERALD SMITH
BRIAN SMITH
RONNIE SMITH
PALLA SMITH
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STEPHANIE SODIPO
ERIC SOTO
THOMAS SPANGLER
NORMAN SPEAKMAN
LILLIAN SPEARMAN
JONATHAN SPENCER
KRISTI SPIVEY
CHRIS SPIVEY
CARL SPRINGER
RAMYA SRINIVASAN
CARRIE STALLINGS
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CHARLES STANCIL
RICHARD STANLEY
WILLIAM STARK
JEFFREY STARKER
STANCIL STARNES
MONTI STATON
PATRICK STATON
MARQUIS STEPHENS
BRIAN STEVENS
DONALD STEVENS
KELLY STEVENS
JOHN STEWART
RYAN STEWART
WILBERT STEWART
DANA STOCKS-DOUGLAS
HERBERT STOKES
TIMOTHY STRIKE
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VIKKI SUTTON
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DONALD SWANK
JONATHAN SWARNER
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MICHAEL SWIFT
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VINCENT SYLVESTER
DANIEL TABOR
ALAN TALLEY
SEAN TANKO
DUANE TATE
JENNIFER TATE
DREW TAYLOR
JAMES TEAGUE
KYLE TEAGUE
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STEVEN THOMAS
ALAN THOMAS
DAVETTA THOMAS
WILLIAM THOMPSON
STEPHEN THOMPSON
JOE THOMPSON
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GEORGE THURMOND
TERRY TIBBITTS
ROLAND TISDALE
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KIMBERLY TOATLEY
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WUSHENG TONG
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MARCHELLE TOWNS
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DUC TRAN
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