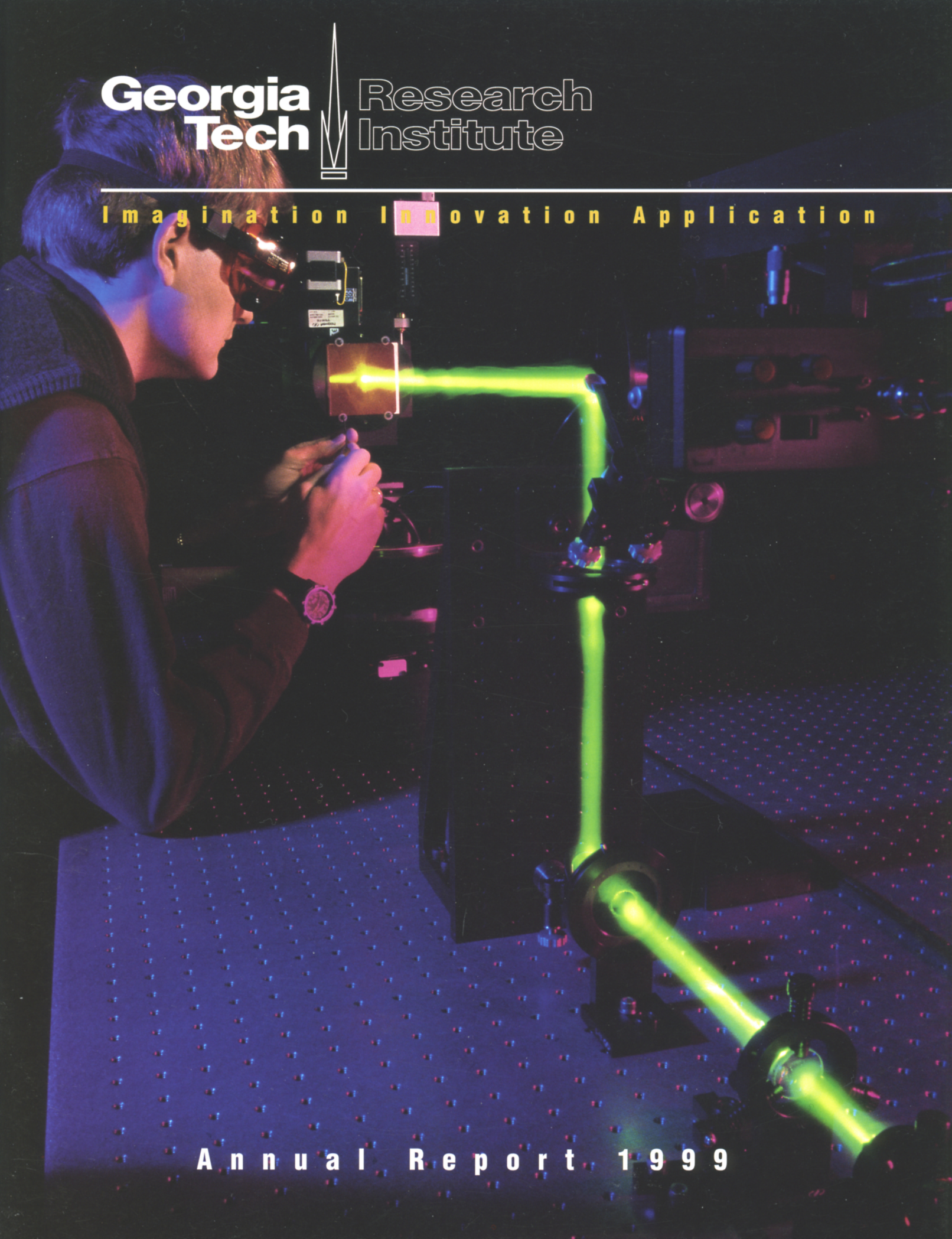
Georgia Tech Research Institute

Imagination Innovation Application



Annual Report 1999

Table of Contents

Imagination
Innovation
Application

. . . the above commitments are the foundation for all research and development conducted here at the Georgia Tech Research Institute (GTRI).

We're resourceful. We're dedicated to introducing new and better ideas, devices, and processes for a better world. And the results of our work are ready to use.

Now.

Our commitment to imagination, innovation, and application yields solutions for the state, the nation, and the world, as well as the industrial and educational communities. We're proud of what we accomplished during 1999, and the credo from which our imagination, innovation, and application spring: Creating Solutions through Innovation.

Georgia Tech Research Institute

Creating Solutions through Innovation.

The Year in Review

Imagination Innovation

GTRI's spirit of imagination, innovation, and application rewarded our customers and our organization with much success during FY 99.

On the fiscal front, we brought in $102.2 million in new research contracts this year — the second-highest amount of awards in GTRI's 65-year history. That figure is up 13 percent from $88.7 million in FY 98. Hard work on the part of our research staff and aggressive efforts over the past few years to diversify our programs have been the primary drivers behind this large increase in awards. FY 99 also saw us complete our first year under a new cost recovery system based on Federal Acquisition Regulation Part 31.2, Contract Cost Principles and Procedures – Commercial Organizations. One benefit of this change is a cost structure that is more familiar to our customers. My special thanks and appreciation to everyone who helped us make this enormous and important shift.

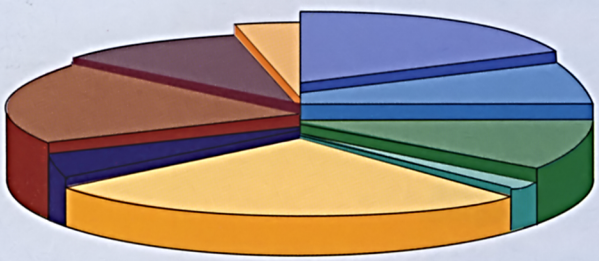
A dedicated committee of GTRI employees also drafted our first Code of Ethics. The code is based on GTRI's core values, as stated in our strategic plan, and documents the principles that guide GTRI's business conduct.

Organizationally, we called on several employees to assume new responsibilities. Charles Brown was appointed GTRI's chief business officer; Janice Rogers, director of administration, added supervision of personnel and research property to her previous duties; Evan Chastain, director of institute services, added supervision of GTRI's machine shop, research security, and facilities to his previous responsibilities; and Tom Horton added management of state programs to his work recruiting federal and industry customers.

On a sad note, we mourned the loss of a valued colleague this year. Brigadier Gen. James S. Allen (USAF, retired), our director of Washington Operations, died in August 1998. Jim represented Georgia Tech's interests in the Washington, D.C., community and was instrumental in helping GTRI build international defense work. His enthusiasm and dedication will be missed.

Our labs were home to exciting

GTRI 1999 Major Customers
(% of research expenditures)



- Air Force 22.3%
- Federal Non-DoD 3.3%
- Industry, Fed. Subcontracts 16.4%
- Other Dept. of Defense 11.4%
- Industry Commercial 9.9%
- State of Georgia 11.2%
- Navy 9.2%
- Army 14.2%
- Other 2.1%

and diverse developments for the state, nation, world, industry, and education this year:

- The Severe Storms Research Center (SSRC) was established at GTRI with funding from the Georgia Emergency Management Agency (GEMA), the Federal Emergency Management Agency (FEMA), and the state. SSRC will be a focal point for severe storm research in Georgia.
- We have developed a unique mobile testing system that evaluates airborne radar systems for potential vulnerabilities. Called EPMTV (Electronic Protection Mobile Test Van), it is easily assembled into different configurations; protected from the elements; and useable in the most remote of locations.
- GTRI's Space Technology Advanced Research (STAR) Center is helping develop critical national resources and helping ensure the survivability of space systems — while stimulating the development of new, innovative approaches to space systems and technologies development.
- As our cover photo illustrates, our researchers are developing unique paint color-matching algorithms that may revolutionize the way paints are color-matched, turning a low-tech process into a high-tech approach.
- Foundations for the Future (F3), a partnership between higher education and industry, promotes K-12 telecommunications access in Georgia. With our collaborators, we completed wireless installations in Oglethorpe and Jasper counties, and installation of a wireless, multi-county infrastructure in four counties in southwest Georgia.
- As a key member of the EPA-funded Hazardous Substance Research Centers (HSRC) Program, GTRI anchors the technology transfer activities of the five regional centers, which are dedicated to hazardous substance management research and training.
- Our researchers have developed an innovative, noise-reducing material with many potential applications. The proprietary material, which decreases sound intensity by a factor of up to 100, could also be fashioned into "quiet curtains," office partitions, or large outdoor sound barriers.

We're particularly proud of having delivered to the U.S. Air Force the Bistatic Coherent Measurement System (BICOMS). BICOMS, a unique test facility, is believed to be the only one of its kind in the world able to conduct wide bandwidth bistatic imaging and radar cross section measurements of full-sized aircraft.

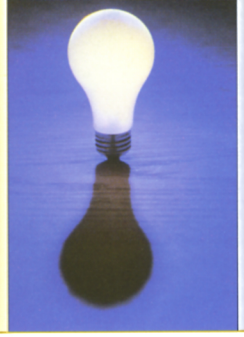
And the FalconView laptop flight-mapping software GTRI helped develop gained additional recognition as a result of being featured in a chapter of Bill Gates' book *Business at the Speed of Thought.*

Our employees also brought GTRI positive recognition as a result of their individual accomplishments. A sample follows:

- **Dr. Krishan Ahuja** – one of *Aerospace Engineering Magazine*'s Top 50 Innovators for 1998.
- **Dr. Marvin Cohen** – Fellow, Institute of Electrical and Electronics Engineers.
- **Mr. Jim Coleman** – Meritorious Service Award, Armed Forces Communications and Electronics Association Intl.
- **Mr. Nile Hartman** – Fellow, Optical Society of America.

Thanks to all GTRI employees for their dedication and the excellent work they perform for our customers. We couldn't meet the standards we aspire to as an organization without talented engineers, scientists, technicians, students, and support staff. Without question, our employees are the source of the imagination, innovation, and application that GTRI customers benefit from every day.

Dr. Edward K. Reedy
Vice President,
Georgia Institute of Technology
Director,
Georgia Tech Research Institute



How We Do Research

I m a g i n a t i o n I n n o v a t i o n

Imagination — we're resourceful. GTRI researchers are applying their know-how to improving the aerodynamics of American tractor-trailers and other boxy trucks, which will save fuel. We're also using lasers and other technology to automate the paint-matching process, saving time and money.

PHOTODISC

By directing pressurized airflow across various surfaces of large trucks, our engineers hope to increase lift, reduce drag, and cut truck fuel use and costs.

Improving Aerodynamics to Increase Fuel Efficiency and Safety

Based on wind tunnel measurements made by GTRI on its FutureCar model, it may be possible to save nearly 1.2 billion gallons of fuel per year by applying newly developed aerodynamic technology to American tractor-trailers and other boxy trucks.

The FutureCar project adapted aerodynamic technology to automobiles in order to reduce drag. By applying these same principles to large trucks, our engineers believe they can create fuel savings and increase safety of operation.

Directing pressurized air flow across different surfaces of the vehicle results in a change in lift, the weight the wheels perceive they are carrying; and also reduces drag, which accounts for half the power a truck engine expends to overcome resistive forces at 60 mph.

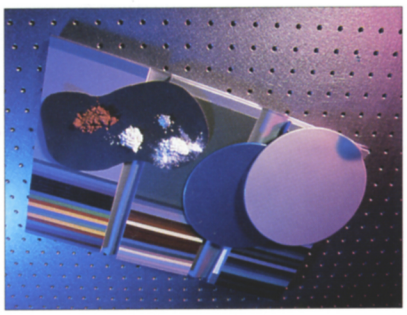
Reducing drag and increasing lift would result in significant fuel savings. Our engineers believe that safety, too, could be enhanced. Lift could be adjusted to enhance the truck's braking ability, increase traction in rain and ice, or provide better control during a jack-knife. *See also www.gtri.gatech.edu/aero-gtri/.*

Matching Paint the High-Tech Way

Anyone who has ever painted a room knows that paint color can vary greatly from batch to batch. On an industrial level, this is more than a cosmetic issue; it translates into time and money lost. Researchers at GTRI are developing unique paint color-matching algorithms that may revolutionize the way paints are color-matched, turning a low-tech process into a high-tech approach.

Presently workers paint a sample and visually match it to the existing paint. The process our researchers are developing uses lasers, monochrometers, and computers to measure the scattering of light off the painted surface *(see cover photo)*. The measurements are used with the algorithms to identify the pigments in the paint and the volume fraction of each pigment.

To test and implement this novel color-matching approach, our researchers have designed and built an instrument that can precisely measure a paint sample. The information generated is used to automate the paint mixing process, saving time and money for the manufacturer.



STANLEY LEARY

Duplicating paint colors like those shown here will be easier with our novel color matching approach – it identifies the amount of each pigment in a paint.

Innovation — we introduce creative, new, and better ideas. GTRI has developed novel phosphor materials and coating techniques. Our researchers are also creating a tool that generates software for parsing and interfacing with specific kinds of data.

Phosphor Center Program Glows Brightly

Whether driving down a dark highway at night or flying an airplane during a storm, people rely on the brightness of the dials and meters on their dashboards to get them safely to their destinations. The same phosphor technology that makes those dials glow is also at work in high-definition television, medical instrument monitors, computer screens, virtual environment displays, and other high-tech applications, making it indispensable to our health and welfare, and of growing importance to our economy.

Because they glow without any increase in temperature, phosphors are an important and highly researched area for a number of emerging flat-panel display technologies. Georgia Tech is headquarters for the Phosphor Technology Center of Excellence (PTCOE) sponsored by the Advanced Research Projects Agency. PTCOE is active in research in this area, including improving low-voltage thin-film electroluminescence displays, field emissions display films, and thin-film cathode ray tube films.

Our researchers are working to develop novel phosphor materials and structures. They already have made significant progress toward developing a new phosphor material for use as a blue emitter, and also for electro-luminescent displays in developing low temperature processing techniques that will enable low-cost manufacturing on glass substrates.

New phosphor coating techniques have also shown promise for improving the performance of low-voltage phosphors for field emission displays, an important first step in reducing the power consumption of these displays. *See also http://ptcoe.marc.gatech.edu/.*

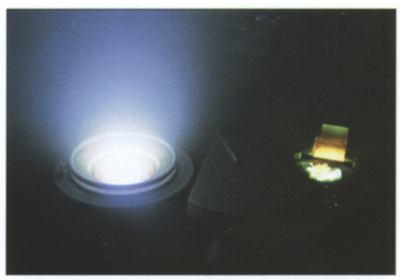
'Super-Translator' Saves Programming Time

Creating what could be called a "super-translator," researchers at GTRI have developed a powerful software generation toolset. It enables software developers to more effectively deal with text data described by a data interchange format (DIF).

The toolset automatically generates software necessary to parse and interface with data. The functions developed under this task may result in tremendous savings of programming effort. Rather than having to develop new parser and interface software for each DIF, users can simply regenerate code to accommodate the changing format. The tools feature multiple interface generation, allowing direct, in-memory, or database access to the data. *See also dss.gtri.gatech.edu.*

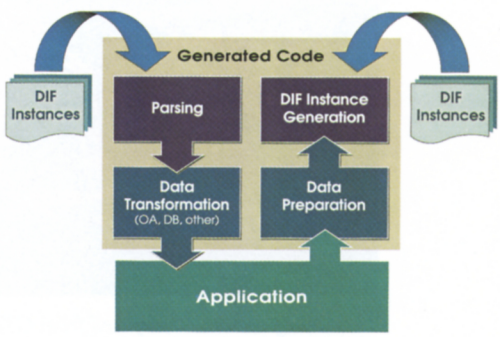
STANLEY LEARY

A researcher loads substrate for deposition of thin film-phosphor materials into an ion-assisted deposition system.



STANLEY LEARY

A view inside the ion-assisted deposition system. Electron beam evaporation of a phosphor material is proceeding on the right.



THOM MCLEAN, KAY LINDSEY

Data Interchange Format Usage Model

Application — we apply our skills and brainpower to work that is ready to use. Now. GTRI has helped ensure that the embedded systems of various State of Georgia entities become compliant with all necessary Y2K safeguards as deadlines approach. But tomorrow's applications are never far from our minds. Our researchers are developing those applications today for the state, nation, world, industry, and education.

GTRI Helps Georgia Prepare for Y2K

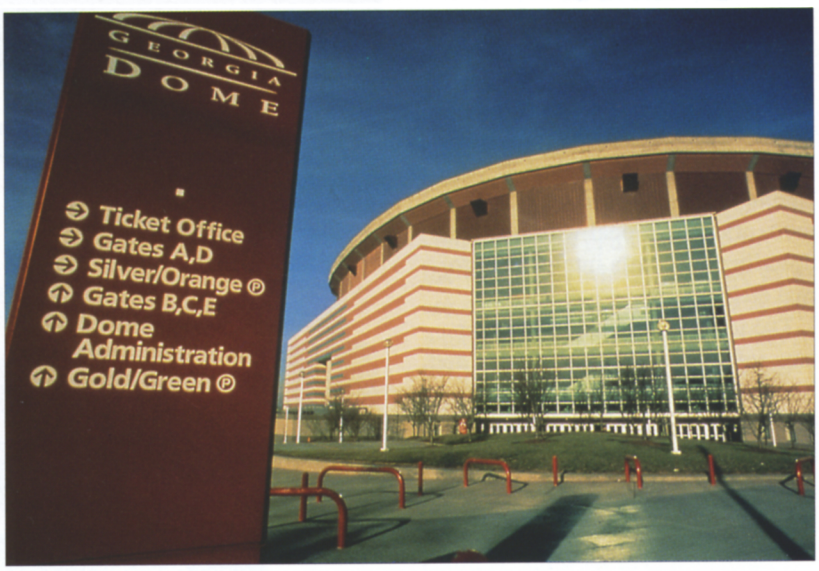
In a few short months, the world's computing infrastructure will enter the year 2000. The millennium changeover has the possibility of causing widespread disruption of computing activities, resulting in unknown, but potentially severe, consequences. Various State of Georgia agencies have contracted with GTRI experts to help ensure their embedded systems become compliant with all the necessary safeguards as this deadline approaches.

For example, our researchers visited the Georgia Public Safety Training Center (GPSTC) and found that the organization had made good progress in planning for Y2K issues. Our researchers used their expertise in embedded computer systems to augment GPSTC's current efforts, including helping to prioritize mission critical systems for in-depth compliance assessments and testing. They also worked with GPSTC personnel to formulate remediation strategies, including developing fallback and emergency response plans.

Another example of our work in this area is with the Department of Transportation. GTRI experts will travel to more than 100 facilities used by the DOT to inventory and assess the Y2K compliance status of their embedded computer systems. Items range from laboratory equipment to heavy equipment and aircraft.

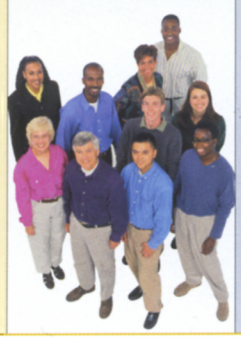
We are conducting similar programs for the Department of Natural Resources, the Georgia Bureau of Investigation, the Georgia World Congress Center and Georgia Dome, and several other entities. All told, our researchers will travel to more than 200 sites throughout Georgia conducting inventory, assessment, and testing activities in support of state agencies. GTRI also has given presentations at nine state workshops on Y2K contingency planning conducted by the Georgia Emergency Management Agency.

KAY LINDSEY



COURTESY GEORGIA DOME

The Georgia Dome benefitted from GTRI's Y2K compliance review of its embedded computer systems.



. . . For Our Communities

Application

Our more than 1,000 employees are the source of GTRI's imagination, innovation, and application. They share their resourcefulness, creative ideas, and skills not only with their customers, but also with their communities. Whether they're offering computing support to non-profits or showing children the wonders of light, our employees enhance the world around them.

Improving the Air We Breathe

When she's not performing indoor air quality research, Environmental Sciences Branch Chief Charlene Bayer is helping set standards in that arena.

Bayer is chairperson of the general workgroup and a member of the technical committee writing the American National Standards Institute standard for indoor emissions of equipment, furnishings, products, and floor, wall, and ceiling treatments.

STANLEY LEARY

Charlene Bayer

This work will result in "a standardized method of testing and comparing products, and will provide a label to tested products," Bayer said. "It is the first standard of this type in the United States."

Bringing Computing to Non-Profits

Research Engineer Jay Harrell is one of many GTRI researchers who has used computer, Internet, or World Wide Web know-how after working hours to help non-profit organizations around Georgia.

Harrell has written database applications for the Georgia Council on Child Abuse (GCCA). He also created database applications and performed computer maintenance for the Healthy Mothers, Healthy Babies Coalition (HMHBC) of Georgia and for a St. Bede's Episcopal Church mailing list.

The GCCA database is used to collect and analyze data for "First Steps," an infant health project. At HMHBC, Harrell's work supports, among other projects, "Powerline," a statewide 1-800 help line for people who experience problems accessing healthcare.

"By doing this type of work, I'm able to make a real difference for agencies that often can't otherwise afford high-quality information technology services," Harrell says.

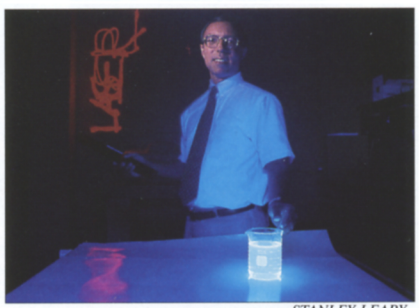
STANLEY LEARY

Jay Harrell

Sharing the Wonder of Light with Youngsters

Light and its properties are fascinating, even to researchers who've been working with it for years.

Principal Research Scientist Bob Schwerzel takes that wonder and knowledge to the elementary and middle school set via his demonstration, "The Wonders of Light." He illustrates light bending in light pipes; fluorescence; the colors of white light; and the purity of lasers. He also demonstrates how laser light shows are created. In his spare time, Schwerzel has taught the "Chemistry" Merit Badge for several boys in his son's Boy Scout Troop, for which he's assistant scoutmaster.



STANLEY LEARY

Bob Schwerzel

"It's fun to see how excited kids get when you show them something they've always taken for granted — in this case, light — in a new and different way," Schwerzel says. "I hope this helps them gain a better appreciation for science, and maybe even decide to follow a career path in science themselves."

. . . Among Disciplines

I m a g i n a t i o n I n n o v a t i o n

At GTRI, we often innovate by combining our expertise in different research specialties to create new, imaginative products, devices, and applications. Our researchers are integrating disciplines to help fight the war on drugs, improve radar warning systems, address power pole maintenance, and create noise-reducing materials.

STANLEY LEARY

Our researchers combine tools including LANDSAT images, mapping, and advanced GIS visualization to help the National Guard on the CD-GRASS project.

Enhancing Technological Efficiency for Counterdrug Law Enforcement

In the government's ongoing war on drugs, GTRI is playing a major role through an innovative blend of geographic information systems, digital mapping, enhanced visualization, virtual reality, electro-optics, sensor fusion, modeling and simulation, and other operational assessment technologies.

The Counterdrug Regional Assessment Sensor System (CD-GRASS), under development here for the National Guard Bureau's Counterdrug Directorate (NGB-CD), directly supports NGB-CD in its aid to drug law enforcement agencies. The mission of CD-GRASS is information integration, assessment, and decision support to counterdrug operations through state-of-the-art technology transfer and insertion. CD-GRASS also incorporates NGB-CD assets including its Digital Mapping Initiative; aerial reconnaissance and sensor deployment; law enforcement training centers; and 54 state and territory counterdrug task forces. *See also http://eoeml-www.gtri.gatech.edu/home/mindy/cdgrass/ and www-cddmi.forscom.army.mil.*

GTRI Improves a Bright Idea for Military Aircraft

GTRI has redesigned a vital component of a radar warning system widely used in U.S. military aircraft, making the system easier to maintain and far more dependable.

The ALR-69 Radar Warning Receiver (RWR) notifies pilots when enemy radar is trained on them, so they can take evasive action. Our researchers have revamped the RWR display, replacing its old cathode-ray tube with a flat panel electro-luminescent display and upgrading its internal circuitry.

The new display unit features higher brightness, night vision capability, and sunlight readability, and it is fully compatible with other system functions. Yet it is precisely the same size as the older version, for easy retrofitting into existing aircraft. The new model also boasts a predicted reliability of 14,000

STANLEY LEARY

To the right is the GTRI-revamped ALR-69 Radar Warning Receiver azimuth indicator. It improves upon its predecessor (left) by adding night-vision compatibility to its list of pilot-friendly features.

hours, versus 2,500 actual hours for its predecessor.

Remote Inspection for Power-Line Crossarms

GTRI scientists are developing an innovative approach to an expensive maintenance problem for power companies.

Thousands of miles of high-voltage electric lines crisscross the country, supported by hundreds of thousands of wood crossarms bolted to power poles. Like all outdoor wooden structures, crossarms are subject to rot and infestation. Current inspection practice involves climbing each pole to check for crossarm deterioration.

We are working with Entergy Services Corp. to find a better inspection method, and are testing two possibilities. One involves mechanical vibration response, in which an airplane-mounted Doppler laser vibrometer would determine the wood's condition as revealed in the crossarm vibration caused by the sound of the aircraft as it flew along the power lines.

Measuring light spectral response, another proven wood-rot indicator, may be another alternative if the necessary monitoring equipment can be mounted on an aircraft.

Fighting Crime the High-Tech Way

The information technology, sensors, and database expertise honed at GTRI are finding new applications in the war against crime.

Our researchers are harnessing sensor technologies to detect drugs, selected chemical compounds, and explosives, as well as harmful agents in water. These devices have applications in chemical and biological warfare.

GTRI also developed a management information system for criminal and civil case data for Georgia's state and superior court systems. We've fine-tuned technology that helps law enforcement officials combat drug traffic at certain national borders, and applied a blend of technologies to meet the mapping needs of law enforcement officials addressing illegal drug production. Our law enforcement group includes retired military officials and a former policeman.

New Material Concept Offers Substantial Noise Reduction

A good night's sleep is an important part of maintaining health. That's why researchers from GTRI, the Atlanta Veterans' Affairs Medical Center, and Emory University have teamed up to examine one of the factors influencing sleep — noise — and how to mitigate its effect on sleep quality.

Using the Veterans' Affairs Nursing Home Care Unit and a local long-term care unit that is part of Emory University as laboratories, our researchers have studied the particular acoustical properties of those environments and developed an innovative, noise-reducing material with many potential applications.

The proprietary material, which decreases sound intensity by a factor of up to 100, may be manufactured into curtains drawn between beds, even with a see-through window if desired. The "quiet curtain" could also be fashioned into office partitions or large outdoor sound barriers and may find numerous applications in classrooms, nurseries, hospitals, restaurants, and industrial or military settings.

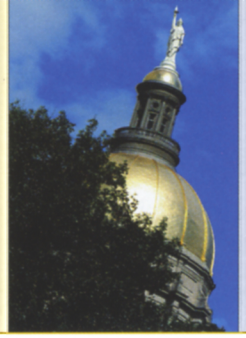
COURTESY JAMES MAHAFFEY

The motion of helicopter rotors (center) causes vibrations in a wooden crossarm (upper left); sophisticated equipment measures those vibrations.

STANLEY LEARY

A GTRI researcher tests potential "quiet curtain" materials for their noise-reducing properties.

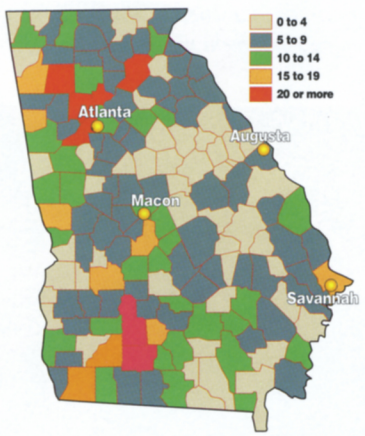
Support for this work also was provided by the Atlanta Veterans' Affairs Rehabilitation R&D Center of Excellence on Geriatric Rehabilitation.



. . . For Georgia

Imagination Innovation

GTRI is dedicated to providing high-quality engineering research to our home state of Georgia that helps develop natural resources, industries, and commerce. To this end, our researchers are creating innovative and improved severe storm forecasting, imaginatively addressing transportation and environmental needs, and applying technology to enhance poultry processing and information management in certain Georgia courts.



EVERETT HULLUM

Number of Tornadoes by County in Georgia, 1950-1998

GTRI Experts to Lead Severe Storms Research

Each year severe weather — including tornadoes, hurricanes, and floods — threatens Georgia citizens and often results in casualties.

Emergency management officials believe that better warning systems could reduce the number of deaths associated with severe weather. The establishment of a Severe Storms Research Center (SSRC) was recommended in 1998 by the Governor's Task Force on Warning and Communication. Organized immediately following severe weather in March of that year, the task force is charged with assessing Georgia's capability to forecast such conditions and inform citizens; it also issues recommendations to improve or enhance those capabilities.

The SSRC is located at GTRI and funded by the Georgia Emergency Management Agency (GEMA), the Federal Emergency Management Agency (FEMA), and the state. The new center will be a focal point for severe storm research in Georgia.

SSRC will also serve Georgia by providing quick response information to weather and emergency agencies, as well as educating residents about severe weather. GEMA officials want the SSRC to become a beta test site for improved forecasting methodology and technology that will later be implemented throughout the United States. *See also www.gtri.gatech.edu/res-news/ssrc.html.*

Applying Computer Imaging in the Poultry Industry

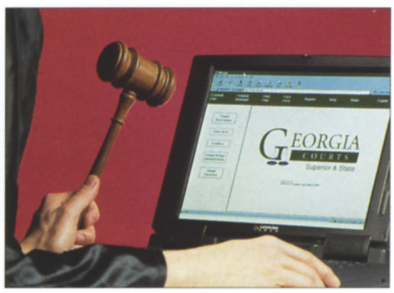
Georgia's poultry industry is benefiting from research conducted at GTRI on machine vision for product process and quality control. This technology harnesses the power of computers to analyze images and make decisions about what they "see." The technology has been used in numerous manufacturing settings; however, due to natural variations in poultry that make identifying defects difficult, the poultry industry has been unable to fully utilize this innovative approach.

Our researchers are developing and testing prototype systems using digital imaging and computer programs that match the unique needs of the poultry industry. Ultimately we hope to develop affordable computer programs that will use color and texture information to identify defects automatically at line speeds. We also hope to improve the speed of the system.

Progress made in 1999 included the design and installation of a prototype system in a commercial poultry processing operation. Assessments included evaluation of the physical system operation, plant operational performance, user interface, and user issues, as well as integration into the plan production process. *See also http://atrp.gatech.edu.*

Georgia's Courtrooms and Attorneys Well Served by GTRI

GTRI researchers are helping Georgia's courts extend their capabilities via information technology. Our courts automation project is providing state, superior, and juvenile courts with a new Internet-



STANLEY LEARY

With critical data available at their fingertips via a TCP/IP network, Georgia state, superior, and juvenile court officials can access data anywhere they have Internet access.

based data system that is user friendly, integrated, and secure.

Previously, the Georgia courts did not have access to criminal activity information from other counties. As a result, officials could not get a complete picture of a suspect's history. GTRI's work makes it possible for the courts to acquire this information via the Internet. With critical data available at their fingertips via a TCP/IP network, account holders — primarily judges and clerks — can access the data anywhere they have Internet access. This allows court officials to make informed decisions more easily.

Our researchers' work for the courts led to a similar effort for the Prosecuting Attorneys' Council. GTRI experts have provided technical assistance to district attorneys throughout Georgia to improve their information system infrastructure. The ultimate goal? Streamlining the case management process, thus enhancing the handling and tracking of cases.

Innovative Solutions to the State's Transportation Challenges

The creative application of advanced technology — or Intelligent Transportation Systems (ITS) — to key transportation issues in Georgia is another growing focus at GTRI. During FY 99 we worked to optimize commercial vehicle operations, as well as enhance railroad crossing safety management, with sponsorship from the Georgia Department of Transportation (GDOT).

One project involves development of an electronic permit system for oversized and overweight commercial vehicles. The transponder-based system allows such vehicles to be automatically identified while traveling. Based on the availability of accurate information, an officer at roadside can then decide whether to stop a particular vehicle at the next weigh station. This arrangement saves time and money by minimizing the amount of time that trucks must be stopped, weighed, and inspected.

The railroad crossing safety management system our researchers are developing is a database for inventory, and subsequent hazard analysis, of all railroad crossings in Georgia. The system, developed for the GDOT Office of Traffic Operations, Railroad Section, allows the state to systematically assess safety conditions at each crossing and then make changes in the safety warning devices — which may involve the addition of bells, flashing lights, and gates — that may be necessary to improve safety.

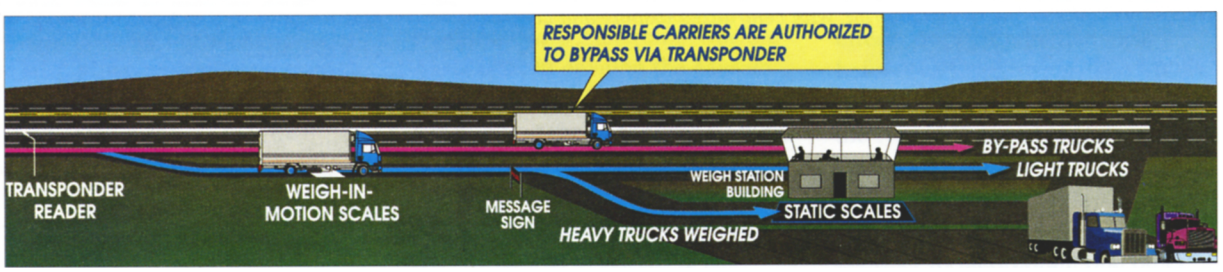
Also during the year, our researchers played a leading role in establishing ITS Georgia, a society of organizations dedicated to encouraging the use of advanced technology for improving the state's transportation system.

ICORE: Rebuilding Georgia's Neighborhoods

Like every industrialized corner of the world, many communities in Georgia deal with pollution, poverty, and health-related issues. Furthermore, few of the affected areas have the resources to solve such complex problems. GTRI's Initiative for Community Outreach, Research, and Education, or ICORE, was established in 1996 in response to such needs.

ICORE draws from a variety of Georgia Tech departments and experts, integrating the strengths of those programs to provide solutions for local community revitalization needs. These groups work side by side with community residents to solve infrastructure problems that can inhibit the growth of an area — and the people who inhabit it.

During FY 99 this community-integrated program worked with residents to revitalize three historic neighborhoods in Atlanta by identifying abandoned areas, conducting site assessments, identifying contaminated sites, and training residents about pollution prevention. Funded by the U.S. Environmental Protection Agency, our ICORE initiative is rebuilding neighborhoods, while building relationships in the community. *See also http://eoeml-www.gtri.gatech.edu/lab/ICORE/.*



Weigh Station of the Future

BILL YOUNGBLOOD, KAY LINDSEY

. . . For the Nation

Imagination Innovation

About 80 percent of GTRI's research benefits the U.S. Armed Forces or national defense programs. We're proud of our innovative missile, countermeasures, and electronic warning systems research and development. In addition, we employ our imaginations to develop non-defense applications that could be useful around the nation — such as a camera that collects vehicle occupancy data, and liners that could change hall acoustics with a button press.

COURTESY JOE BROOKS, KAY LINDSEY

The C-130 Electronic Warfare (EW) Bus System is an integrated electronic countermeasures suite for the C-130 aircraft, with centralized display and control.

The Crew's the Key: Electronic Warning Systems Training

Calm, rapid, and razor-sharp responses to the electronic warning systems in aircraft cockpits are essential for performance and survivability among Air Force flight crew members. Training can enhance those skills. To that end, GTRI researchers continued developing an electronic warfare embedded training function in FY 99, with sponsorship from the Warner Robins Air Logistics Center.

Our approach relies on existing flight planning tools currently used by Air Force crews. These tools are used as a framework for creating training profiles. When integrated within the main system design, the training function becomes a low-cost investment in enhanced crew performance. No extra hardware for training is needed because the training program is integrated with other systems functions. Digital replays of missions are provided for assessment and scoring of each crew's performance. *See also http://elsys.gtri.gatech.edu/elsys/elsys.html.*

On the Road with Radar Testing

Evaluating airborne radar systems for potential vulnerabilities requires specialized equipment, as well as mobility and flexibility. The equipment must be portable; easily assembled into different configurations; protected from the elements; and useable in the most remote of locations.

To meet the needs of the Air Force Research Laboratory and the Defense Advanced Research Projects Agency, GTRI has developed a unique mobile testing system called EPMTV (Electronic

Protection Mobile Test Van) that meets those requirements. EPMTV includes special jamming emulators and computer-controlled signal generation equipment mounted in a van. The jamming emulators can be quickly reconfigured to operate at different frequencies, or to generate special modulations required for testing. The van's shelter and a generator's power allow evaluation to continue uninterrupted, despite challenging field conditions.

The data our researchers gather in their field tests provide vital information for developing electronic protection techniques that can enhance airborne radar systems. As a result, the EPMTV is in demand. It was on the road constantly during FY 99, testing radars around the country. *See also http://seal.gatech.edu/ep_tim/.*

GARY MEEK

Our Electronic Protection Mobile Test Van allows researchers to test air and ground radars despite challenging field conditions. Here, they adjust equipment that creates false targets.

Making an Electronic Countermeasures Model User-Friendly

When the Air Force's Air-to-Air Electronic Countermeasures (AECM) model was built in the early 1980s to provide a testbed for analyzing new electronic counter-countermeasure (ECCM) techniques, softwares weren't always user-friendly. Why? Because easy-to-operate graphical user interfaces were not available for model developers to use.

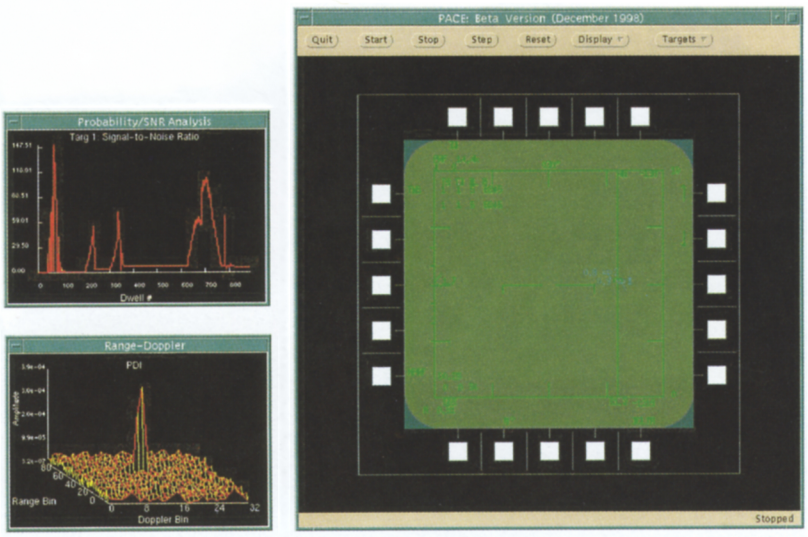
Today, our researchers are teaming with MTL Systems Inc. of Dayton, Ohio, to provide such tools, enhancing the capabilities of the AECM for research and training. Users will benefit from buttons and pull-down menus that facilitate data entry; graphical user interfaces with built-in help functions; and graphical display of major performance indicators such as tracking error, probability of detection, and operational radar B-scan displays.

GTRI has assisted the Air Force on this project as needed over the last decade. Most recently, our researchers provided software engineering services to rehost the simulation onto a SUN Unix computer and update the graphical user interface.

Developing Missile-on-a-Mountain Simulation Capability

Our researchers have been instrumental in working with the U.S. Navy and with Electronic Warfare Associates to develop the Missile-on-a-Mountain (MOM) simulation capability at the Electronic Combat Range in China Lake, California. Initial operating capability for this semi-active missile simulation facility, which was designed to test active electronic countermeasures (ECM), was demonstrated in May 1999.

The Hardware-in-the-Loop simulation incorporates an actual semi-active missile seeker onto a three-axis flight table controlled by a validated missile flyout model. An aircraft hosting a system under test can fly within 200 feet of the missile seeker while being illuminated by the corresponding instrumented target tracking radar; this allows system users to determine the "end game" missile-to-target effects occurring immediately before warhead fusing. The MOM system was developed to support the Navy's Integrated Defensive Electronic Countermeasures testing and is designed to incorporate other semi-active seekers. GTRI is under contract to incorporate one other



COURTESY LINDA LAUGHLIN, KAY LINDSEY

Enhanced Capabilities -- U.S. Air Force's Air-to-Air Electronic Countermeasures Model. *See page 13.*

seeker, and the Navy is considering adding a third seeker to the facility.

More and More Pilots Planning on FalconView

The FalconView laptop flight-mapping software developed for the U.S. Air Force, U.S. Special Operations Command, and U.S. Navy continues to grow in popularity and in the capabilities it offers.

FalconView, which offers aeronautical charts, satellite images, elevation maps, and overlays of data such as transmission towers and detailed threat information, was first used in mission planning by Air Force F-16 pilots. Today it's a vital tool for pilots of every U.S. fighter plane, as well as the airlift, bomber, tanker, and rotary aircraft communities in the Air Force, U.S. Special Operations Command, and the U.S. Navy. Pilots for European nations can access their own version of the software, as well; and several U.S. non-defense agencies also are considering FalconView's applicability to their mission planning needs. New features added in FY 99 include advanced chart printing capabilities, moving map integration onboard several aircraft, and new high-resolution imagery display.

Wireless Technology Benefits Army Logistics

A new computerized supply tracking system developed by GTRI has improved the Army's efficiency and saved millions of dollars by applying sophisticated commercial strategies and wireless technology to military needs.

Called Wildcat, the system uses technology never before tried in the military. It tracks supplies with hand-held mobile computers that transmit data using wireless technology similar to cellular telephones, VHF modems, PC dial-up modems, or local area network (LAN) TCP/IP connections.

Our researchers used a Motorola cellular PC card to fit into a slot on Intermec Technologies' hand-held computers the Army was already using. The computers have built-in scanning capabilities to gather data from bar codes on supply documents. Then GTRI researchers developed both interface and data communications software that allows supply personnel to send captured data to a central database via a wireless connection. The communications software also provides connectivity using a local area network, dial up modem, and VHF wireless modem.

As a result, Army installation units on 14 U.S. military bases are using data and metrics that pinpoint where material is within the supply chain, helping them better manage their parts inventory.

Refining Warning Systems: The Multidisciplinary Way

GTRI laboratories are combining expertise areas to help the U.S. Air Force address complex challenges posed by a common Department of Defense missile warning system. Their goal? To help reduce the possibility of false alarms prompted by unrelated urban or industrial events.

Multidisciplinary teams of our researchers are documenting the physical dynamics of the problem. They also are modeling the system and its environment. The researchers will use what they learn to modify the system, thereby enhancing its performance.

GTRI brings to this work its

unique combination of in-house expertise, ranging from atmospheric sciences to embedded software design — as well as years of experience designing, testing, and upgrading missile warning systems.

Enhancing the Testing of Optical Missile Warning Systems

Two dynamic simulators developed by GTRI researchers will heighten the ability of missile warning systems to detect their quarry.

Developed for Warner Robins Air Force Base, each simulator tests either infrared or ultraviolet missile warning systems destined for aircraft use.

In addition to reducing the rate of false alarms, the simulators can be used to improve threat detection algorithms. Various "flyout" scenarios presented by the computer-driven simulators put the warning systems through a rigorous and thorough battery of tests.

The two products developed for Warner Robins are for laboratory use. However, we are scheduled to begin work soon on a similar simulator for the U.S. Navy that will test missile warning systems once they've been installed on aircraft.

Making Sound Test and Evaluation Decisions

When Congress mandated reductions in military infrastructure several years ago, the U.S. Air Force turned to GTRI for assistance meeting these new requirements. GTRI professionals have been instrumental in helping the Air Force's research, development, and test and evaluation communities weigh financial and performance needs. Work performed has included research on activity-based costing, competitive sourcing and privatization, and public-private enterprise arrangements.

In addition, our researchers have helped the Air Force standardize and institutionalize its test and evaluation processes. Currently, researchers are performing feasibility studies, analytical engineering reviews, cost benefit analyses, infrastructure assessments, and long-range planning analyses. Senior Air Force and Department of Defense leaders, as well as congressional decision makers, use the findings of GTRI's studies to aid in future planning and budgeting. *See also www.te.hq.af.mil/.*

STANLEY LEARY

Researchers designed data communications software for this hand-held computer, which tracks U.S. Army supplies and transmits information via a wireless connection or modem to a central database.

Evaluating Networking for the Future

An unbiased opinion is always helpful — especially in planning for a complex and highly secure information network. U.S. Army Headquarters Forces Command (FORSCOM HQ) called on GTRI to offer such feedback in an evaluation of Vision 2000, a plan for addressing FORSCOM's future networking needs.

GTRI researchers put their technical resources, experience, and opinions on all aspects of networking, from desktop to broadband, to work on the project. They are assessing the technology of existing FORSCOM network equipment. In addition, they are advising the command on how to best implement Vision 2000 plans for integrated multimedia applications and end-to-end network management over multi-protocol networks, including Ethernet and ATM.

Along with evaluations of planned deployment, our researchers are providing FORSCOM with recommendations on security issues, vulnerabilities testing, and challenges that the Vision 2000 plan poses. One example is our analysis of the FORSCOM HQ changeover to the Defense Messaging System (DMS) and how message handling is performed there.

STANLEY LEARY

In GTRI's acoustic liner test facility, sound from the black speaker (right) flows through a liner positioned inside a metal box (left).

An Out-of-This-World Antenna

GTRI is making the NASA-led International Space Station a user-friendly place for wearers of Russian-designed space suits.

With researchers from the Boeing Company, we developed a two-foot-long antenna that also serves as a handrail and will be mounted in the station's air lock. The antenna allows wearers of the Russian suits to communicate with station operators as they are entering and leaving the craft during space walks. The addition of an antenna is necessary because the Russian suits operate on a frequency four times lower than that required by U.S. space suits, which have their own antenna in the air lock. *See also http://38.201.67.70/station/assembly/plaid/al.jpg for a drawing of the air lock; http://38.201.67.70/station/assembly/index.html for an overview of the assembly plan of the space station; and http://38.201.67.70/station/eva/outside.html for a discussion of the air lock's use.*

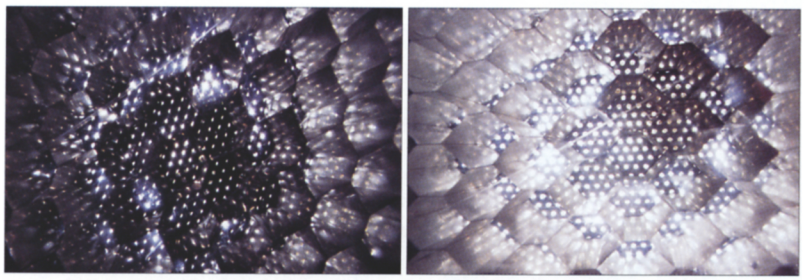
Liners Could Change Concert Hall Acoustics in Seconds

Discriminating listeners know that different theatrical or concert performances benefit from different hall acoustics. With sponsorship from NASA Langley Research Center, GTRI researchers continued developing adjustable acoustic liners during FY 99 that might one day change the acoustics of a hall with the press of a button.

The liners consist of two layers of perforated sheets similar to the silver metallic lining of modern phone booths. Sliding one layer just a fraction in any direction changes the way in which the perforations

overlap — and thus could alter the acoustics of the room fitted with the liners. This adjustable liner concept was developed to keep an aircraft engine acoustic liner performing at its best under all operating conditions, given that noise character changes with operating condition. Our researchers also are developing a bias-flow liner that can be tuned by varying the flow of air through the perforations.

The liners are tested at a unique facility developed at GTRI. It allows researchers to make complex measurements that test theoretical models of a given liner's performance.



STANLEY LEARY

Our bias-flow liner can be tuned by varying the air flow through two layers of perforations from lesser (left) to greater (right).

A Special Camera for Collecting Traffic Data

Knowing the number of occupants per vehicle on a highway can be helpful for transportation planning. But how does one take a snapshot without a flash distracting the driver? And how does one get a good image of a car traveling at highway speeds?

GTRI researchers are developing a solution to these challenges under a sponsored project for the Georgia Department of Transportation. They are creating a prototype system that combines a high-speed, infrared strobe light on a roadside tripod with an infrared camera. The infrared strobe is invisible to human eyes, so it's not distracting — but it still illuminates each passing vehicle's interior and freezes the vehicle's motion. That, in turn, allows an infrared camera to digitally record images indicating the number of occupants for computer analysis.

The resulting data could be used to assess the results of efforts to reduce air pollution by increasing vehicle occupancy.

DAVID ROBERTS

Determining whether vehicle occupancy is increasing – and whether that is related to changes in air pollution — will be easier using data collected by an infrared roadside camera GTRI researchers are developing.

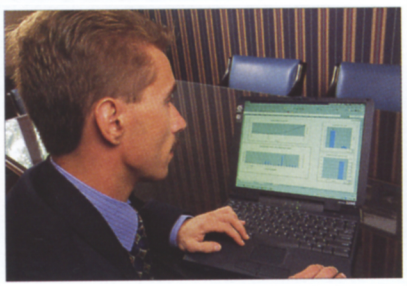
. . . For Industry

I m a g i n a t i o n I n n o v a t i o n

GTRI has a lot to offer industry — innovative research, deadline- and budget-conscious researchers, and streamlined contracting options. Our researchers are assisting industrial customers via imaginative applications in robotics, business process models, creation of electronic manuals, and ensuring food safety via sensor technology.

Developing an 'Eye' for Coordination

Enabling robots to operate in constantly changing or harsh environments is one of the greatest challenges facing robotics researchers and consumers. GTRI is developing



STANLEY LEARY

Georgia Tech graduate Tony Souza, a senior consultant at Lexmark Solution Services, uses a special software tool developed at GTRI for his company.

a potential solution to this problem by writing computer algorithms that control robot activities via real-time use of vision data.

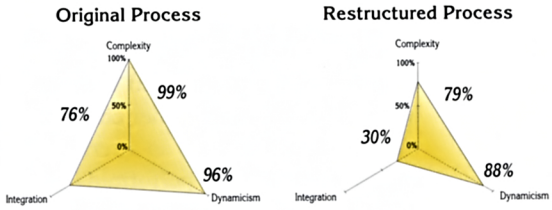
This innovative technology allows robots to dynamically react to real-time changes in their environments without extensive modeling of the environment, the robot, or the camera involved. This approach endows the robot with a close-to-human ability to see and adapt to its environment.

Our researchers have demonstrated the system's capabilities via simulation and constructed a prototype system to show its basic workings. The results of the work are encouraging; further research completing the system's development is planned. *See also http://mime1.marc.gatech.edu/imb/projects/mivs/vs_index.htm.*

New Metrics: Information-Age Models Help Businesses Get Data Just in Time

The "Just in Time" concept for stock or product flow is rapidly becoming standard operating practice for businesses. But the application of this powerful concept throughout an enterprise often suffers because Industrial Age business process models are still in use. Lexmark Solution Services is the first business to benefit from GTRI's pioneering work helping companies get information in the correct form where and when it is needed.

This work is based on a special software tool developed by researcher Gary Tjaden for the business process reengineering class he teaches at the Georgia Institute of Technology. The tool helps students design processes that focus on increasing knowledge resources and effectiveness of operations — as



GARY TJADEN, KAY LINDSEY

Information Age Effectiveness

opposed to the Industrial Age orientation toward production and resource depletion.

A special version of this software tool, which relies on the structural effectiveness models Tjaden developed, is being created for Lexmark Solution Services. The company will use the tool to implement optimized "information delivery business processes" for its clients so that faxes, documents, labels, and other information materials are available exactly when and where they are required. *See also www.ces.btc.gatech.edu.*

STANLEY LEARY

Business and industry representatives learn how they can harness GTRI's applied research capabilities at our annual Industry and Technology Day.

Real-World Solutions Through Innovation: GTRI Showcased for Industry

The world-class research and development performed by GTRI touches many aspects of daily life — from helping to manage traffic

flow to ensuring the safety of the food we eat. But without industry partners, those solutions could never reach the world — and research on even more advanced, imaginative solutions could not be conducted. Bringing business and research together to develop new applications for meeting future challenges is the idea behind our Industry and Technology Day. Industry and government leaders who attend learn about and see GTRI's capabilities in a variety of technologies, including transportation, product realization and manufacturing, food and agriculture, information technology and security, bio-medicine/bio-science, education and training, law enforcement and public safety, modeling and simulation, and more. In addition, visitors hear from Georgia Tech President G. Wayne Clough and get to talk with our experts about potential products and solutions. *See also www.gtri.gatech.edu/gtri-ind.*

Flying High Above the Paperwork Sea

Planes are a large and important part of commercial and U.S. military operations — but it can sometimes seem as if the sea of training manuals and paperwork associated with each individual plane is larger than any ocean. It's not simply that there are so many manuals; each time the aircraft or its systems are improved, all of the manuals must be updated, reprinted, and distributed. This is a time-consuming, expensive, and seemingly never-ending task.

GTRI has joined with RJO Enterprises Inc., an MTS3 Company, and together we have developed an imaginative and innovative approach to combat the problem: electronic technical manuals based on the SGML standard. That product can be easily updated; quickly and inexpensively distributed through existing computer networks in a variety of formats, such as CD-ROMs, World Wide Web pages, e-mail, and database publishing; and can also link to training, supply, and maintenance/diagnostic systems. Formatting is automatic, allowing those making the updates to concentrate on content, rather than presentation. The system is robust enough and easily designed to handle incorporating new manuals. In the event a paper printout is needed, it is as close as the nearest laser printer.

In addition, linking manuals with diagnostics provides for a reduced maintenance cycle. This system is allowing access from worldwide sites to centrally hosted maintenance and operations manuals within minutes — and at the same time helping eliminate the paperwork sea of the past.

Advanced Biosensor Will Improve Food Safety

Food poisoning — it seems as though each week brings a new media report on an outbreak or problem. As a result, food safety is of growing concern to the public and the food industry. GTRI researchers have developed an innovative sensor that will help detect potential problems with food quickly and inexpensively.

The biosensor uses laser light to examine meat or food. By combining integrated optics with immunoassay techniques and using surface chemistry information, the sensor can quickly detect harmful food-borne pathogens. The sensor also has potential uses in other fields, such as medical testing and environmental monitoring.

STANLEY LEARY

Updating, reprinting, and distributing huge paper manuals becomes unnecessary with an electronic approach developed by GTRI researchers.

Taking the Jitters out of Information Transfer

What's adding lanes to the information highway these days? The answer is wavelength division multiplexing (WDM): the concurrent transmission of data, using several wavelengths, over a single fiber-optic cable.

WDM poses some challenges, however, and GTRI researchers are addressing some of those. Many promising WDM systems, for example, introduce "delay jitter" — cells of data that should arrive at a user's desktop consecutively don't do so. Jitter can result in poor quality transmission of video or voice signals from the fiber-optic to wireless modes.

Our researchers are testing the impact of a promising WDM architecture on delay jitter as it transmits different amounts of data between photonic and wireless systems. Their work eventually will allow network providers to allocate bandwidth and storage to mitigate – or compensate – for delay jitter variations, providing end users with higher-quality transmissions.

. . . For the World

I m a g i n a t i o n I n n o v a t i o n

The value of GTRI's research and development doesn't stop at national borders. Our researchers are helping international sponsors make innovative use of computer vision simulation software and radar warning receivers. We're applying technology with United Kingdom colleagues to meet the ballistic missile threat. And we're developing imaginative approaches to plasma and space-based technologies that could benefit the globe.

GTRI Takes Computer Vision from the Imagination to Application

In movies, computers quickly and easily "see" and recognize people, places, and things. Yet in real life, computer vision is one of the most daunting tasks facing researchers. GTRI has helped advance this critical research area through its Georgia Tech Vision (GTV) simulation software.

The package can be used for a variety of purposes — from correctly picking out a "target" in a cluttered background to helping design more effective camouflage for aircraft. This year our researchers completed studies of the software with the British Defense and Evaluation Research Agency (DERA), and are now working with the agency on further validation studies. DERA selected GTV after a review of the best vision modeling software packages in the world. Why? Because it is the "best available of its type" and "likely to become the world standard synthetic observer model for a wide variety of tasks," according to DERA. *See also http://eoeml-www.gtri.gatech.edu/home/shane/work.research.viseo.html and http://eoeml-www.gtri.gatech.edu/home/shane/work.research.gtvision.html.*

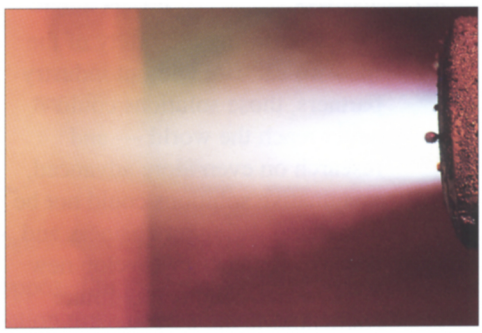
STANLEY LEARY

Plasma Remediation of In Situ Materials (PRISM) relies on plasma arc torches to vitrify or gasify hazardous wastes, contaminated soils, or landfill contents.

Vitrifying Wastes Can Clean Up, Stabilize Ground for the Future

An innovative solution to a variety of pollution problems — and possibly to some construction problems, as well — has been developed at GTRI's Plasma Applications Research Facility.

Plasma Remediation of In Situ Materials (PRISM) relies on plasma arc torches, which are hotter than the surface of the sun, to vitrify or gasify hazardous wastes, contaminated soils, or the contents of landfills. PRISM vitrifies substances via vertical boreholes. Because no material has to be dug up, classified, moved, or otherwise handled, PRISM can vitrify the material with reduced costs and little chance of further contamination; the rock-like substance that results is highly resistant to leaching.



STANLEY LEARY

A plasma, which is essentially "contained lighting," is hotter than the sun. The rock-like substance it produces after exposure to soils or other materials is highly resistant to leaching.

PRISM also offers some additional advantages. If it is used to treat a landfill, it can reduce the volume of the material, allowing up to 90 percent of the space to be recovered. The plasma turns the landfill bottom into a rock-like liner, reducing the chance that contamination will leak out. During operation, the process generates fuel gases that could be collected and sold to help defray operational costs.

Plasma torch technology also can be used to stabilize soil in landslide areas, as well as for structures and foundations in construction projects. *See also http://eoeml-www.gtri.gatech.edu/lab/eeb/plasma-arc.html.*

STAR Center Aids Work in Space

GTRI's Space Technology Advanced Research (STAR) Center brings the experience of Georgia Tech, the imagination of students, and the innovative collaboration of government and industry together to develop tomorrow's space technology today. Working in areas

DEFENSE VISUAL INFORMATION CENTER

Assistance from our researchers ensures timely delivery of AN/ALR-69(v) radar warning receivers for use on F-16s and a variety of other aircraft.

ranging from advanced space transportation systems to information operations, our center is helping develop solutions to a number of challenges.

During late 1998, STAR hosted an Air Force Research Laboratory Workshop on space-based radars. The workshop brought together people working on a variety of systems to share information and ideas in areas from system engineering to computer modeling. That STAR was chosen to organize and host this conference is not surprising, given its experience with radar systems and space technology research.

Workshops, however, are only a small part of our center's work. STAR is involved in a number of other projects that will help develop critical national resources and ensure the survivability of space systems — while stimulating the development of new, innovative approaches to space systems and technologies development. *See also www.star.gatech.edu/.*

Innovative Work Continues to Help 'Ground' Airborne Threats

Radar/threat warning receivers are an integral part of air forces worldwide — but tailoring standard U.S. units to meet the specific needs of friendly foreign governments could be time consuming without help from GTRI.

Our researchers continue providing system engineering support, as well as verification and validation assistance, for the AN/ALR-69(v) radar warning receivers being prepared for allies at the Warner Robins Air Logistics Center.

GTRI's assistance enhances U.S. government laboratory capabilities and speeds up software testing, making timely delivery of these crucial units possible. The process allows for very rapid turnaround of solutions to challenges; our researchers can analyze threat intelligence data to determine how well the software involved detects and identifies friendly and hostile radar systems. We were selected to help with this work because of the unique facilities GTRI makes available for testing and developing electronic warfare systems. *See also http://elsys.gtri.gatech.edu/senworld/sen.html.*

Collaborative Effort Helps Provide Clear Skies for Ballistic Missile Defense

It is a scenario out of a school book: Party A develops an object that does one thing; Party B creates another that does something similar. Both face a common problem — and by combining the two approaches, the problem can be addressed.

Real life is rarely that simple, but in this case, GTRI is helping the United States and the United Kingdom combine technologies to meet the rapidly spreading threat of ballistic missiles through a truly successful international collaboration.

The goal is to develop high-performance radar technology that can be operated in complex missile defense environments, is responsive to a rapidly expanding and evolving threat, and is cost-effective to implement in near-term radar systems. The United States has expertise in wide-band phased adaptive array radar technology, while the United Kingdom offers experience in narrow-band adaptive digital beamforming technologies. By combining the two, a wide-band adaptive beamforming radar architecture and design rules can be produced.

Our researchers have helped this process by providing expertise on both radar systems and their design, and via their use of rapid prototyping simulations. This allowed many areas to be examined so that optimal designs could be identified and studied. As a result, researchers were able to confirm the feasibility of the techniques and recommend a demonstration of such a unit, helping both nations rapidly and efficiently develop a system to face a growing threat to world peace.

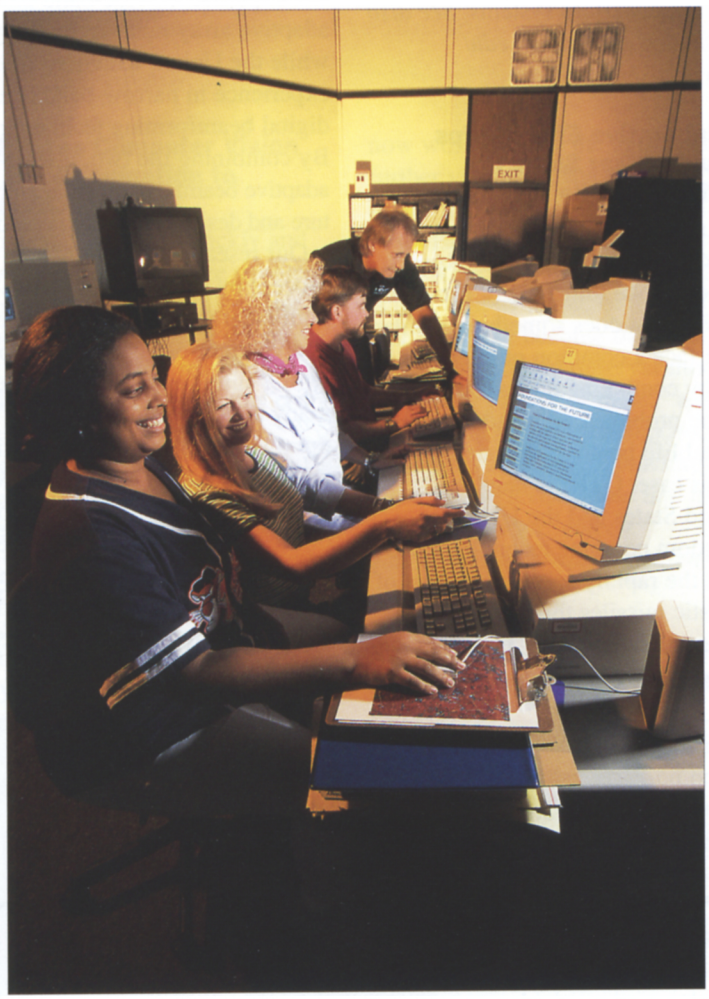
DEFENSE VISUAL INFORMATION CENTER

GTRI was selected to help with AN/ALR-69(v) warning receiver preparation for planes such as the C-130, in part because of our unique facilities for testing and developing electronic warfare systems.

. . . For Education

I m a g i n a t i o n I n n o v a t i o n

An educated, trained work force is essential to the economic success of industry, Georgia, the United States, and the world. GTRI is applying telecommunications, hands-on math and science training, wearable computers, continuing education — and imagination — to innovatively educate current and future workers.



STANLEY LEARY

Foundations for the Future promotes K-12 telecommunications access in Georgia in many ways, including computer training for teachers.

Applying Telecommunications Expertise to K-12 Schools

Foundations for the Future (F3) is the epitome of how GTRI applies high-tech expertise in innovative, imaginative ways.

This partnership between higher education and industry was formed to promote K-12 telecommunications access in Georgia. With the help of other institutes of higher education and with support from the AT&T Foundation and the State of Georgia, we use our understanding of technology to assist K-12 educators; provide a center for information flow between them and industry; and offer unbiased expertise for telecommunications infrastructure planning.

Application of GTRI's know-how will improve educational practices in the state; we already have helped Georgia take some important steps toward this goal. New developments include sponsorship of a two-day conference on funding sources for technology in schools, which attracted more than 400 registrants; completion of wireless installations in Oglethorpe and Jasper counties; and installation of a wireless infrastructure in four counties in southwest Georgia. *See also http://maven.gtri.gatech.edu/foundations.*

Training Georgia's Teachers to 'Go Global'

COURTESY NANCY DAVIS

The Georgia Goes Global! program encourages participation in Global Learning and Observations to Benefit the Environment (GLOBE). A hands-on, minds-on science and education program for

K-12 students, GLOBE enhances the environmental awareness of individuals worldwide to increase scientific understanding of the Earth. It also is designed to improve student achievement in math and science.

As a franchise of the GLOBE program, Georgia Tech is establishing a GLOBE teacher training program in Georgia. By providing comprehensive teaching skills, GTRI hopes to build a cadre of committed, effective GLOBE teachers in grades K-12 throughout the state, allowing Georgia's students to participate in and benefit from this international program. *See also www.globe.gov.*

Wearable Computer Finds Innovative Application in Factory Environment

GTRI's wearable computer technologies provide an exciting, new approach to supporting and potentially training workers in manufacturing or plant settings — while also offering a way to transfer real-time information to and from those individuals.

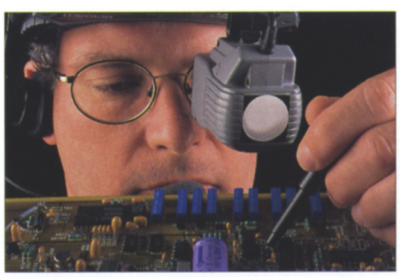
The specialized information system our researchers have developed, known as Factory Automation Support Technology (FAST), is a wearable computer system that provides invaluable hands-free mobile access to electronic maintenance and repair manuals. Because of its live two-way video conferencing capabilities, remote experts are able to support technicians as they repair malfunctioning equipment on the factory floor. Furthermore, the system can employ voice recognition in noisy environments to collect or retrieve data for quality control, inspection, or any kind of monitoring activity.

FAST is being tested in the poultry industry. Our efforts during FY 99 focused on redesigning the hardware to make it smaller — and hence more comfortable — as well as more powerful. *See also http://wearables.gatech.edu/.*

Providing Innovative Education Opportunities

One of the greatest challenges facing today's leading research institutions is the growing mandate to meet the global work force's evolving and varied educational needs. At GTRI, our comprehensive continuing education program provides individuals from industry and government a wide range of courses; each year as many as 1,300 people take advantage of our offerings.

These intensive programs cover a wide range of topics in two general areas: (1) Safety, Health, and Environment, and (2) Defense Electronics. Every course offered is designed to be innovative and tailored to the challenges facing government and business personnel. All courses are taught by GTRI faculty members who are recognized experts in their respective fields. Many of the courses combine lecture and hands-on opportunities to enhance the learning environment and offer the best possible training.



STANLEY LEARY

Our FY 99 work on the Factory Automation Support Technology (FAST) wearable computer system focused on creating smaller, more powerful hardware.

STANLEY LEARY

Teachers are trained for participation in the GLOBE project, which collects environmental data while teaching students valuable math and science skills.

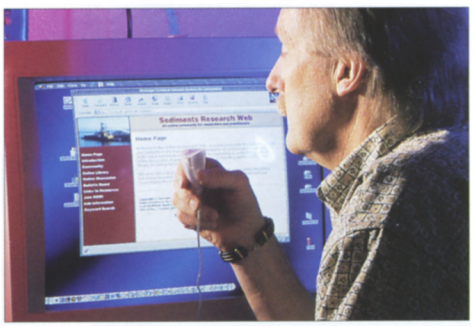
COURTESY GEORGIA TECH CONTINUING EDUCATION

GTRI offers hands-on practice and learning opportunities in its continuing education courses, some of which address the handling of hazardous materials.

. . . With Our Colleagues

I m a g i n a t i o n I n n o v a t i o n

GTRI brings an extra advantage to its innovative work: the skill and imagination of our colleagues from the Georgia Institute of Technology and other organizations. We collaborate with them on many applications, from promoting electronic interaction among the country's Hazardous Substance Research Centers to creating wind sensors, extending automation capabilities, and developing compression for video streams.



STANLEY LEARY

A researcher records an audio Internet presentation for the Hazardous Substance Research Centers web site.

GTRI Promotes Electronic Collaboration for HSRCs

As a key member of the EPA-funded Hazardous Substance Research Centers (HSRC) Program, GTRI anchors the technology transfer activities of the five regional centers, which are dedicated to hazardous substance management research and training. GTRI also leads the technology transfer activities of the South and Southwest Center, which primarily address remediation of contaminated sediments.

Much of our activity has focused on communicating the centers' research in print and electronic media to audiences including communities, government, industry, and academia. Our ongoing uses of the Internet include developing interdisciplinary communities of researchers working on complex problems. Technology transfer professionals also are developing virtual workshops that will capture technical presentations by HSRC researchers and make them continuously available online.

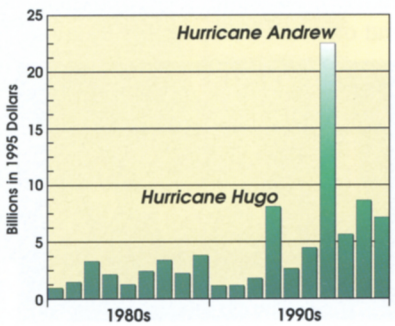
In addition, we host the South and Southwest Technical Outreach Services to Communities program, which guides communities through the environmental cleanup and site reuse process by providing independent technical information. *See also www.hsrc.org.*

Wind Sensor Could Ultimately Help Save Lives

Hurricanes and tornadoes claim hundreds of lives and billions of dollars in property damage annually. As a participant in the University Research Consortium at the Idaho National Engineering and Environmental Laboratory (INEEL), GTRI is helping find ways to mitigate that toll.

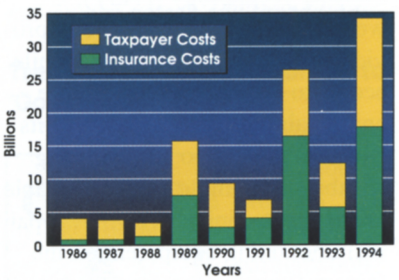
Our researchers are developing a laser wind sensor that supports wind velocity measurement needs identified by INEEL's Partnership for National Disaster Reduction (PNDR) program. PNDR goals include improving characterization of hurricane-force winds and enhancing understanding of the response of large-scale structures, such as single-family homes and non-engineered commercial buildings, to extreme winds. The idea is to develop construction and design improvements, enabling such buildings to better withstand extreme wind, thereby reducing loss of life and property in such events.

Our device, a non-Doppler, single-ended laser-based sensor, will operate in an environment simulating the turbulence, vibration, and



COURTESY PARTNERSHIP FOR NATURAL DISASTER REDUCTION, KAY LINDSEY

Costs of Hurricane Damage in 1995 Dollars



COURTESY PROPERTY CLAIM SERVICE, SENATE TASK FORCE ON NATURAL DISASTERS, PARTNERSHIP FOR NATURAL DISASTER REDUCTION, KAY LINDSEY

Taxpayer and Insurance Costs from Natural Disasters, 1986-1994

noise associated with different windstorms. The sensor accurately measures horizontal and vertical wind speed and turbulence intensity without obstructing the airflow or seeding the airflow with calibrated particles.

Automated Live Poultry-Transfer System Offers Innovative Solutions

GTRI is helping fulfill a decades-old automation goal in the poultry industry.

Working with scientists from the University of Georgia and faculty from Georgia Tech's Woodruff School of Mechanical Engineering, our researchers are developing an automated live chicken transfer system that should reduce labor costs and improve product quality.

The flexible, intelligent system design begins with live birds loaded onto a moving conveyor. The chickens move between a pair of rotating drums with soft rubber fingers that space the birds along the conveyor and prompt them to stand. A beam switch then checks for cadavers, which are removed. Next in the process, a vision system determines the orientation of each bird; a controller then uses a second set of rubber fingers to properly orient the fowl. Finally, another control device guides the legs of each bird into a grasping mechanism, which lifts the birds by their legs and loads them onto a moving shackle.

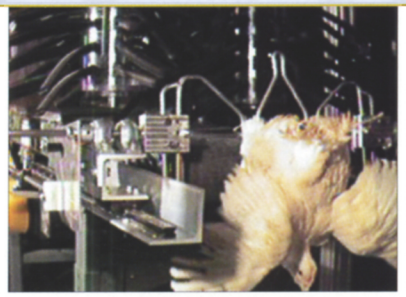
The automated system is expected to pay for itself in less than one year.

Enhancing Compression for Video Streams

Perhaps the greatest barrier to more widespread end-user application of digital communication technology is the nation's aging copper wire network. Particularly for the content-rich signals of video, it's often simply a matter of too much data for too little bandwidth.

Researchers at GTRI are looking at new ways to get the most out of the communication infrastructure, including telephone lines, fiber optic cable, digital coaxial cable, and satellite transmission.

Funded by a Watson Grant from IBM, our goal is to mathematically characterize MPEG-2 compressed video traffic — a data-compression approach that's basically a video version of the file-compression programs used by many desktop computers. Eventually, our researchers expect to address bandwidth allocation issues, which would help companies design reliable video-capable networks.

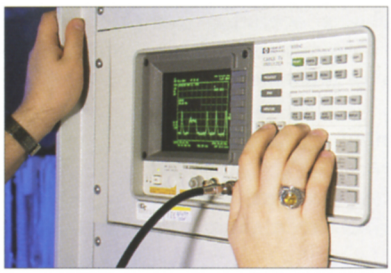


COURTESY STEVEN THOMAS

An automated, live-chicken transfer system being developed by GTRI researchers could reduce labor costs and improve product quality.

STANLEY LEARY

Our mathematical characterization of MPEG-2 compressed video traffic could eventually help companies design reliable video-capable networks.



STANLEY LEARY

The tall, thin spikes on this spectrum analyzer show regular television channels. The shorter, wider peak is a digital signal; its shape demonstrates its more efficient bandwidth use.

GTRI Management

Edward K. Reedy, Vice President, Georgia Institute of Technology; Director, GTRI
(404) 894-3400; ed.reedy@gtri.gatech.edu

Charles E. Brown, Business Support and Finance
(404) 894-3516; charles.brown@gtri.gatech.edu

W. Evan Chastain, Institute Services
(404) 894-6975; evan.chastain@gtri.gatech.edu

James W. Cofer, Business Development
(404) 894-3346; jim.cofer@gtri.gatech.edu

George B. Harrison, Research Operations
(404) 894-7136; george.harrison@gtri.gatech.edu

Janice P. Rogers, Administration
(404) 894-5834; janice.rogers@gtri.gatech.edu

Research Laboratories

David E. Parekh, Aerospace, Transportation, & Advanced Systems
(770) 528-7826; david.parekh@gtri.gatech.edu

W. Edward Eagar, Arlington Research
(703) 528-0883; ed.eagar@gtri.gatech.edu

William S. Rogers, Electronic Systems
(404) 894-7303; bill.rogers@gtri.gatech.edu

Gary W. Caille, Electro-Optics, Environment, & Materials
(404) 894-8790; gary.caille@gtri.gatech.edu

Barry D. Bullard, Huntsville Research Operations
(256) 876-1301; barry.bullard@gtri.gatech.edu

Randolph M. Case, Information Technology & Telecommunications
(404) 894-3456; randolph.case@gtri.gatech.edu

Robert N. Trebits, Sensors & Electromagnetic Applications
(770) 528-7915; bob.trebits@gtri.gatech.edu

John G. Meadors, Signatures Technology
(404) 894-2539; john.meadors@gtri.gatech.edu

GTRI External Advisory Council

Gerald Carey, retired USAF general
Robert Cooper, president and CEO, and chairman/board of directors, Atlantic Aerospace Corporation
Gerald Dinneen, U.S. National Academy of Engineering (retired)
Ben Dyer, president, Intellimedia Commerce Inc.
Allan Ecker, senior vice president of technical operations and chief technical officer, Scientific-Atlanta
John Fabian, president and CEO, Anser Corporation
Tom Marsh, retired USAF general, director and chairman of the board, CAE Electronics Inc. and Converse Government Systems Corporation
Richard Royal, Georgia state representative
Joseph Saloom, consultant in technology
William Todd, founding president, Georgia Research Alliance
Jerry Tuttle, senior vice president, ManTech International; president, ManTech Systems Engineering Corporation
James Tysinger, Georgia state senator
John Welch, executive vice president, Burdeshaw Associates Ltd.

Glossary

Air-to-Air Electronic Countermeasures Model (AECM). Software that provides a testbed for analyzing new electronic counter-countermeasure techniques (ECCM). *p. 13*

ALR-69 Radar Warning Receiver (RWR). Notifies pilots when enemy radar is trained on them, so they can take evasive action. *p. 8*

Asynchronous Transfer Mode (ATM). Dedicated-connection switching technology that organizes digital data into cells or packets of a certain size and transmits them over a medium using digital signal technology. Each cell is processed asynchronously relative to other related cells and is queued before being multiplexed over the line. *p. 16*

Bistatic Coherent Measurement System (BICOMS). Upgraded test facility believed to be the only one of its kind in the world able to conduct wide bandwidth bistatic imaging and radar cross section measurements of full-sized aircraft. *p. 3*

Counterdrug Regional Assessment Sensor System (CD-GRASS). Research program using information integration, assessment, and decision support to counterdrug operations via state-of-the-art technology transfer and insertion. *p. 8*

Data Interchange Format (DIF). Formal description of a document of data stream. It describes the content, structure, and frequently the semantics of the data to be exchanged in an unambiguous way. Provides interface mechanism for applications or systems that may not have been originally designed to work with each other. *p. 5*

Electronic Protection Mobile Test Van (EPMTV). Mobile system for testing potential vulnerabilities of airborne radar systems. *p. 13*

Factory Automation Support Technology (FAST). Wearable computer system that provides hands-free mobile access to electronic maintenance and repair manuals. Being tested in poultry industry. *p. 23*

FalconView. Laptop flight-mapping software – offers aeronautical charts, satellite images, elevation maps, and overlays of data such as transmission towers and detailed threat information. *p.14*

Foundations for the Future (F3). Partnership of higher education, industry, and the State of Georgia to promote K-12 telecommunications access in Georgia. *p. 22*

FutureCar. Research project that adapted aerodynamic technology to automobiles to reduce drag. *p. 4*

Georgia Tech Vision (GTV). Software that is a simulation of human pattern perception, visual search, and detection. The model's algorithms are based on basic vision research and are consistent with the neurophysiology of the visual system. *p. 20*

Global Learning and Observations to Benefit the Environment (GLOBE). A hands-on, minds-on science and education program for K-12 students. Goals are enhancing environmental awareness, improving student achievement in math and science, and increasing scientific understanding of the Earth. Georgia Goes Global is a part of this program. *p. 22*

Hazardous Substance Research Centers (HSRCs). Five regional centers dedicated to hazardous substance management research and training. EPA-funded. *p. 24*

Initiative for Community Outreach, Research, and Education (ICORE). Program applying Georgia Tech expertise to help community residents solve infrastructure problems that can inhibit the growth of an area, and the people who inhabit it. *p. 11*

Intelligent Transportation Systems (ITS). A broad range of diverse technologies, including information processing, communications, control, and electronics, applied to transportation issues. *p. 11*

Missile-on-A-Mountain (MOM). Semi-active missile simulation facility. Hardware-in-the-Loop simulation incorporates an actual semi-active missile seeker onto a three-axis flight table controlled by a validated missile flyout model. *p. 13*

MPEG-2. An approach to compressing video traffic. Basically a video version of the file compression programs used by many desktop computers. *p. 25*

Phosphor Technology Center of Excellence (PTCOE). A consortium formed with funding from the Advanced Research Projects Agency to develop a world-class research and educational program in phosphor technology, and to support the high-definition display industry with state-of-the-art enabling technologies. *p. 5*

Plasma Remediation of In Situ Materials (PRISM). Using plasma arc torches to vitrify or gasify hazardous wastes, contaminated soils, or landfill contents. *p. 20*

Severe Storms Research Center (SSRC). Focal point for severe storm research in Georgia. *p. 10*

Space Technology Advanced Research Center (STAR). Group of GTRI and Georgia Tech researchers developing solutions to challenges of space transportation, radar use, information operations, and more. *p. 20*

Standardized Generalized Markup Language (SGML). An international standard for defining device-independent, system-independent ways to electronically represent text. *p. 19*

Transmission Control Protocol/Internet Protocol (TCP/IP). The basic communication language, or protocol, of the Internet. It also can be used as a communications protocol in private intranets and in extranets. *p. 11*

Wavelength Division Multiplexing (WDM). Concurrent transmission of data, using several wavelengths, over a fiber-optic cable. *p. 19*

Wildcat. Computerized tracking system that uses handheld mobile computers and transmits data using wireless technology, modems, or local area network connections. *p. 14*

Index

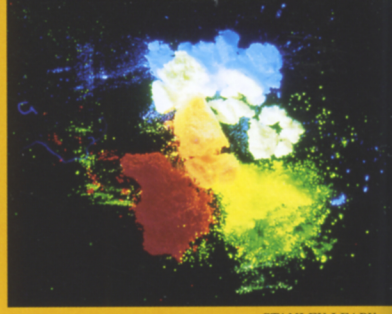
Our Mission

As stated in our strategic plan, GTRI plans and conducts focused programs of innovative research and development, education, and economic development that advance the global competitiveness and security of Georgia, the region, and the nation.

Our Values

GTRI's business philosophy includes the following core values:

- **Personal and organizational integrity underlie all that we do.**
- **A commitment to quality, value, and customer satisfaction defines our future.**
- **Competence and creativity are the foundations of our success.**
- **An open, supportive environment fosters efficiency and teamwork.**
- **Continuous development of our people enhances individual achievement.**



STANLEY LEARY

Because they glow without any increase in temperature, phosphors are important to emerging flat-panel display technologies.

Georgia Tech Research Institute

Georgia Tech Research Institute
Georgia Institute of Technology
Atlanta, Georgia 30332-0801

Nonprofit Org.
U.S. Postage
PAID
Permit No. 587
Atlanta, GA

Mailed by
Research News and
Publications Office