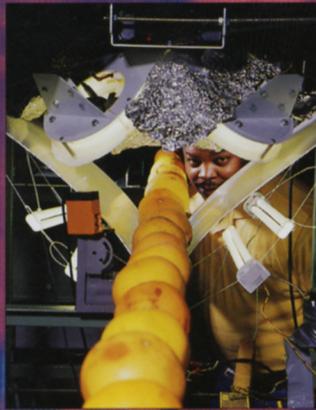


**Georgia  
Tech**



**Research  
Institute**



Solutions for the New Millennium

2000

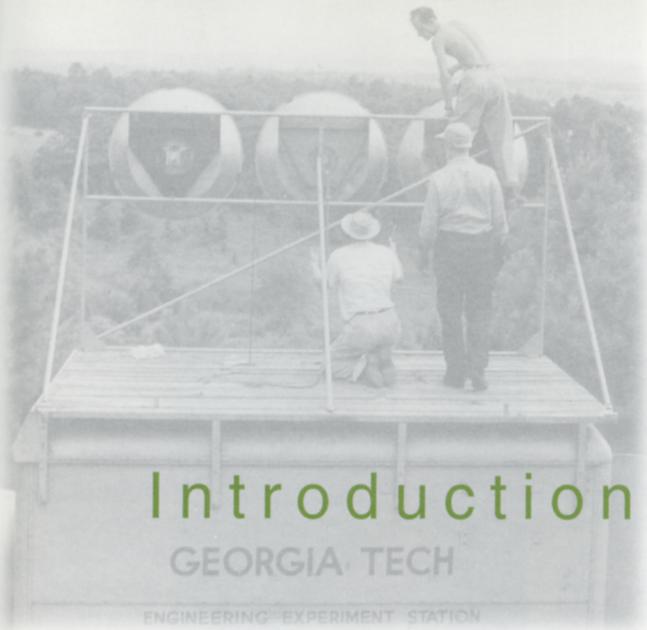
Annual Report

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**Cover captions, top to bottom:**

1. Part of GTRI's work on imaging and grading grapefruit quickly involves uniform illumination and low-cost, digital camera technology.
  2. GTRI engineers test a replacement circuit board for the AN/APG-70 radar, which offers better reliability, a 62 percent reduction in IC part count and greater obsolescence protection than its predecessor.
  3. This three-screen virtual "immersion" environment at Georgia Tech allows researchers and scientists to study gorilla habitat remotely.
- Background shot: The area around an inactive volcano in the Virungas Mountain Range is studied with geographic information systems technology.



# Introduction

GEORGIA TECH

ENGINEERING EXPERIMENT STATION

## Solutions for the New Millennium

Three researchers.

A \$12,000 budget.

An entrepreneurial spirit, engineering know-how, and a desire to serve.

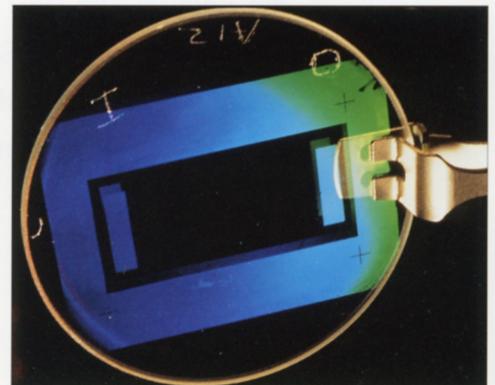
**Those were the 1934 beginnings of the Georgia Tech Research Institute (GTRI)**, chartered to support Georgia industry with high-caliber engineering research and assist with national programs of science, technology, and preparedness.

**Today, on the cusp of a new millennium** — 66 years and more than 1,000 employees later — GTRI continues to meet those needs and more for sponsors in industry, government, and academia around the state, nation, and world. We've done so by moving into a broad spectrum of engineering, scientific, economic, and other technical research and services.

Turn the page to learn more about our research milestones during the previous millennium — and the solutions we're creating for the new one.



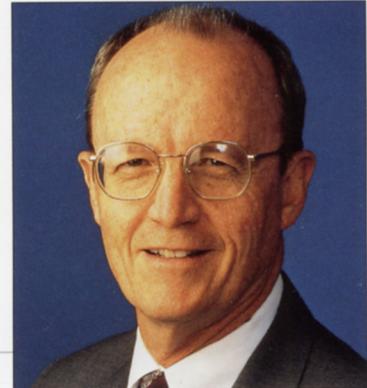
*Creating Solutions through Innovation*



# The Year in Review

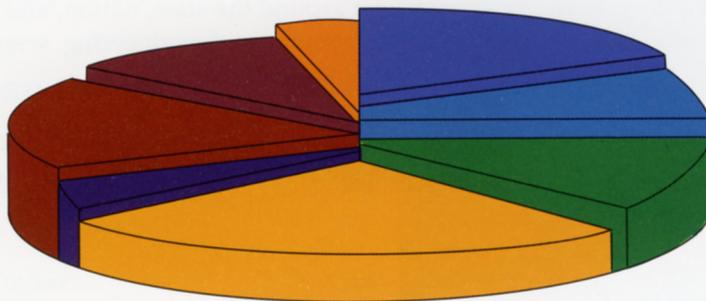
2000

Solutions for the New Millennium



Exceeding previous standards and setting higher ones for the future — that's how GTRI will begin the new millennium.

GTRI FY 2000 MAJOR CUSTOMERS  
(% of research expenditures)



Customer	% of Expenditures
Air Force	23.2%
Federal Non-DoD	3.0%
Industry — Fed. Subcontracts	12.9%
Other Dept. of Defense	11.2%
Industry — Commercial	10.5%
State of Georgia	12.1%
Navy	11.7%
Army	15.4%

Research awards for FY 00, GTRI's last fiscal year of the old millennium, were the largest in GTRI's history: \$107 million. That figure exceeded our previous record of \$103 million in FY 97, and also marked the second consecutive year of significant growth in research awards for GTRI. My deepest thanks and congratulations to all GTRI researchers and support staff for helping us bypass our old record and for setting an exciting new challenge for us as we enter 2001.

Organizationally, we completed our second year under a new cost recovery system based on Federal Acquisition Regulation Part 31.2, Contract Cost Principles and Procedures — Commercial Organizations.

We also made a few changes that will allow us to better serve our customers as we enter the new millennium. In August 1999 we merged the Systems Development (SDL) and Aerospace/Transportation (AERO) laboratories to form the Aerospace, Transportation, and Advanced Systems Laboratory (ATAS). The new lab is led by former AERO Director

David Parekh; former SDL Director Jeffrey Sitterle was named GTRI's chief scientist this year.

Our Arlington Research Laboratory, led by Ed Eagar, opened a Quantico Office in December 1999 to better support Marine Corps activities at that base. Ron Smith is heading work out of that office. And Evan Chastain, director of institute services, was named interim director of our Compliance Assurance Program following Barbara Walsh's move to PricewaterhouseCoopers. Thanks to all of these leaders for stepping up to the challenges I set for them this year.

We welcomed five new and valuable members to GTRI's External Advisory Council, as well. You'll find their names denoted with an asterisk on p. 22.

Sadly, GTRI lost a valuable researcher and mentor with the untimely death of Guy Morris. We have renamed our mentoring course the Guy Morris Memorial Mentor-Mentee Program to honor his mentoring and teaching legacy.

As we stand on the cusp of a new millennium, it's appropriate to take stock of previous research accomplishments. We do that throughout this annual report, highlighting nine important GTRI research projects from the 1960s to today.

The bulk of the report, as usual, looks to the future through the lens of current projects that will generate creative solutions to the new millennium's research challenges. Among the latest projects you'll read about are:

- development of a statewide Malodor Control and Assessment Program, the first of its kind in the United States.
- creation of a Receiver Analysis Modeling System that is helping the U.S. Air Force prepare for what could be the key military concerns of the twenty-first century.
- participation in Georgia Tech's new, multidisciplinary Center for Innovative Fuel Cell and Battery Technologies.

- design of an innovative Voice Over Internet Protocol appliance that results in lower long distance charges and simultaneous transmission of voice, fax, and data — without costly network upgrades.
- development of software to extract, generalize, categorize, and index electronic records.
- work toward demonstrating cost-efficient, high-bandwidth Internet access via satellite for K-12 schools and libraries.

We were extremely proud of special recognition bestowed on two GTRI research projects. The Georgia GIS Data Clearinghouse, a joint project with Georgia Tech's College of Architecture, won a 2000 Exemplary Systems in Government Award. Presented by the Urban and Regional Information Systems Association, the prize recognizes the clearinghouse for filling data needs and providing better access to government records. In addition, Traverser v1.1 was one of two finalists for the SUPERQuest Most Promising New Enterprise Network Technology/Network Infrastructure Systems and Services Award. Announced at SUPERCOMM 2000, Traverser was selected from more than 150 applicants for its extraordinary telecommunications achievements. Traverser is part of research that will deliver digital video, data, and voice signals simultaneously to residential customers via existing copper telephone lines.

GTRI also hosted a Georgia Tech visit by U.S. Rep. Johnny Isakson, U.S. Sen. Bob Kerrey, and the Web-based Education Commission.

Our employees brought GTRI positive recognition through their accomplishments:

- Krishan Ahuja — American Institute of Aeronautics and Astronautics Engineer of the Year for 2000.
- Don Clark, David Millard, Mark Richards, Bob Trebits, and Jim Wiltse — Third Millennium Medals, Institute of Electrical and Electronics Engineers (IEEE).

- Bob Trebits and Josh Nessmith — Military Sensing Symposium Fellows, 46th Annual Tri-Service Radar Symposium.
- Jim Scheer — Fellow, IEEE.
- Jim Wiltse — 2000 Microwave Career Award, IEEE Microwave Theory and Techniques Society.
- Jennie Lincoln — recognized by C.E. Wilhelm, commander-in-chief, U.S. Southern Command, for her valuable work on the United Counterdrug projects.

I was pleased to be among the employees representing GTRI as Third Millennium Medal recipients and Military Sensing Symposium Fellows.

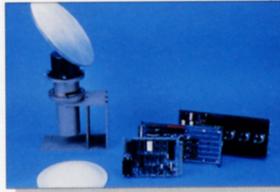
All the positive achievements with which we're closing one millennium and opening another would not be possible without the dedication and hard work of GTRI's employees. They are the heart, soul, and intellect behind every solution we create for our customers.



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

Since 1934, GTRI has:

- become nationally/internationally recognized for radar research.
- made important national defense contributions in electronic and electromagnetic theory and hardware design.
- become what many consider the foremost university research center in electronic warfare.
- become a national leader in millimeter wave technology because of research in the higher-frequency portion of the spectrum.
- received international recognition for high-temperature materials research.
- grown a defense electronics program that continues to be recognized as one of the nation's leading university-based programs in that area.



Late 1950s

First military-designation millimeter wave radar built. *p. 18*

Slip-cast fused silica technique for forming large refractories developed, thus beginning internationally recognized, high-temperature materials research.

1956

EES pioneers economic development methodologies.

1960

Charter broadened to encompass economic development and add industrial extension service for Georgia.

EES develops unique, innovative, and experimental systems in atomic collisions. *p. 6*



## Where We've Been

### Milestones in GTRI Research

1919

Georgia Legislature creates State Engineering Experiment Station (EES), GTRI's predecessor organization.

1934

EES begins research, principally in textiles, ceramics, and helicopter engineering.

1930s,  
1940s

EES becomes first to successfully demonstrate the feasibility of producing viscose rayon from southern pine pulp.

Cotton roving and spinning processes developed that are two to three times faster than those used by industry at the time.

1946

Georgia Tech Research Institute (now the Georgia Tech Research Corporation) begins as EES contract organization. First major funding from federal agencies.

Late 1940s

Pioneering investigation looks at atmospheric conditions' effects on propagation characteristics of electromagnetic waves in the microwave region. Identifies optimum frequencies for transmission in rough terrain.

1948

First radar project starts; grows rapidly into major program. Electron microscope studies of kaolin launched (longest continuing EES project).

1947

EES acquires first electron microscope in the Southeast.

1950s, 1960s

EES grows significantly, particularly in R&D projects for defense and space exploration.

1961

First of statewide system of field offices opens in Rome, GA.

1962

EES erects the first large-scale nuclear research reactor at a southern university.

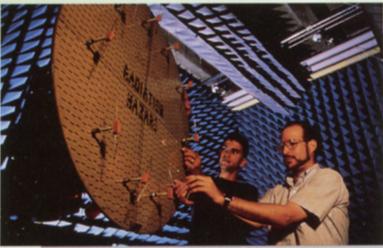
1964

EES international development program starts, eventually assisting more than 49 developing countries.

# 2000

In the new millennium, GTRI will create solutions in:

- biomedical engineering
- broadband infrastructure systems, devices, and chips
- chemical/biological sensors
- commercial product realization
- fuel cell and battery technologies
- information security
- information warfare in space
- law enforcement technologies
- logistics
- training
- unmanned autonomous vehicles.



Near-field sampling techniques developed. p. 20

## Early 1970s

1977

EES solar thermal test facility opens as second largest of its kind in the nation.

## Where We're Going

### Solutions for the New Millennium

Advanced Technology Development Center begins work with major assistance from EES.

1980

1980s

World's highest-frequency microwave radar built, operating at 225 GHz.

1970s

EES performs pioneering work in solar energy, biomass, and other alternative energy sources, including conservation. Becomes nationally recognized leader in near-field antenna research, threat radar systems, millimeter wave technology, and defense electronics.

1983

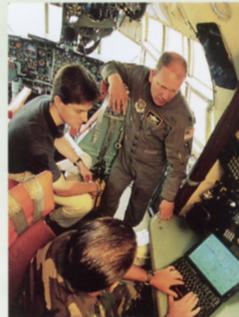


Three-D vision technique patented that today is used in a successful and popular commercial optical film product for certain 3-D glasses. p. 16

1989



Technique developed for detecting the OH radical. p. 12



GTRI wins the Cogswell Award, given yearly to Department of Defense contracting organizations with the best records for upholding security standards.

1992

GTRI begins developing FalconView laptop flight planning system. p. 14

1996

The Centennial Olympic Games held in Atlanta bring special research opportunities to GTRI.

1984

EES changes its name to Georgia Tech Research Institute (GTRI) on Oct. 1.

1986

A major antenna and radar measurement facility becomes operational at GTRI's Cobb County facility. Its capacity for radar and antenna measurements was unmatched at any other single southeastern location.



1997



Integrated optic interferometric sensor patented. p. 8

Late 1960

Compact radar range invented. p. 10



1999

GTRI delivers an upgraded test facility believed to be the only one of its kind in the world. The Bistatic Coherent Measurement System (BICOMS) installed at Holloman Air Force Base, NM, was designed by GTRI researchers.



2000

GTRI develops a statewide Malodor Control and Assessment Program, the first of its kind in the United States.

# Interdisciplinary 2000

Solutions for the New Millennium

## Research Milestones

### Investigating Atomic-Level Collisions

During the 1960s, GTRI scientists steadily conducted breakthrough atomic collision research. Work ranged from research on the safe heating, fueling, cooling, and diagnostics of thermonuclear reactors to studies furthering understanding of ozone creation and destruction. Recent related Georgia Tech research has helped model planetary and stellar atmospheres. See also [www.physics.gatech.edu/people/faculty/flannery/afosrl.htm](http://www.physics.gatech.edu/people/faculty/flannery/afosrl.htm).

**A**s technological challenges become more complex, their solutions are less likely to evolve from only one discipline. At GTRI, we're combining disciplines to develop a computer network for the Marines; an "intelligent" automated deboning device for the poultry industry; and an electronic-record processing software that could have numerous applications.



*GTRI is helping the U.S. Marine Corps develop a computer network that will help evaluate new command and control tactical data networks and ultimately provide insight into performance in demanding field environments.*

### ROCS Helps Marines Evaluate Tactical Data Network

This year an interdisciplinary team of GTRI researchers assisted the U.S. Marine Corps in developing a

computer network known as the Realistic Operational Communications Scenario (ROCS) program.

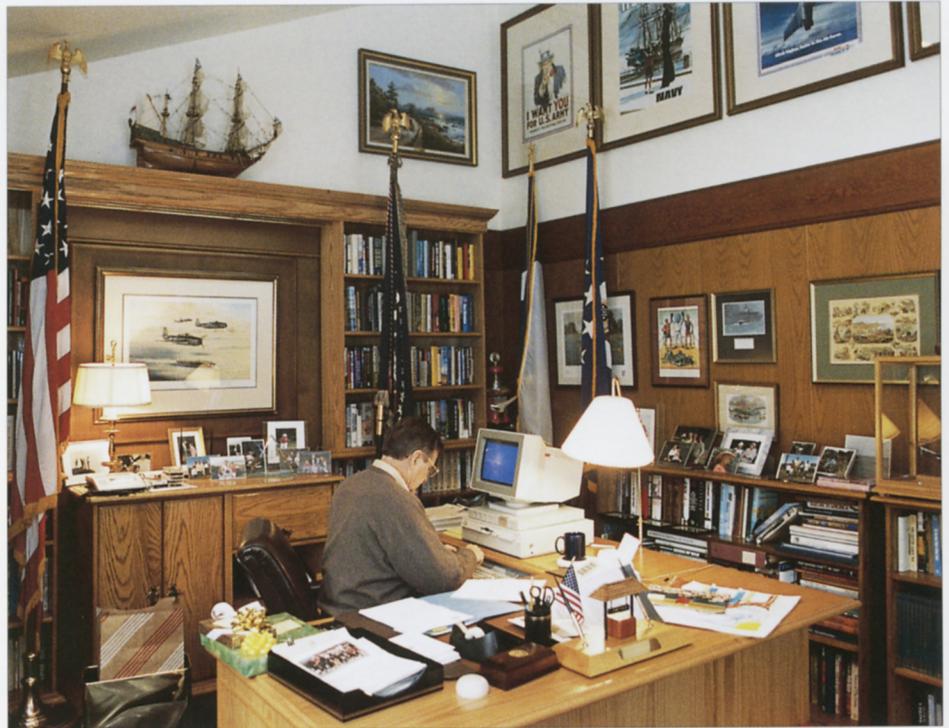
The network helps the Marines evaluate new command and control

tactical data networks, and ultimately provides insight into how the system will perform in a demanding field environment. This unique and powerful capability will help the Marines rigorously evaluate tactical data technologies as the Corps evolves in the twenty-first century.

### Meeting the Poultry Industry's Automation Needs

With colleagues in Georgia Tech's George W. Woodruff School of Mechanical Engineering, GTRI researchers are developing an "intelligent" automated poultry deboning device. One of the fastest growing poultry processing areas, deboning operations have recently returned to manual processing because of poor processing yields and growing food safety concerns relating to available automation systems.

Using computer-vision technology, force-feedback control, and computer modeling, the researchers are developing adaptive control cutting techniques that promise to match cutting performance of the industry's best manual deboners. The team ultimately



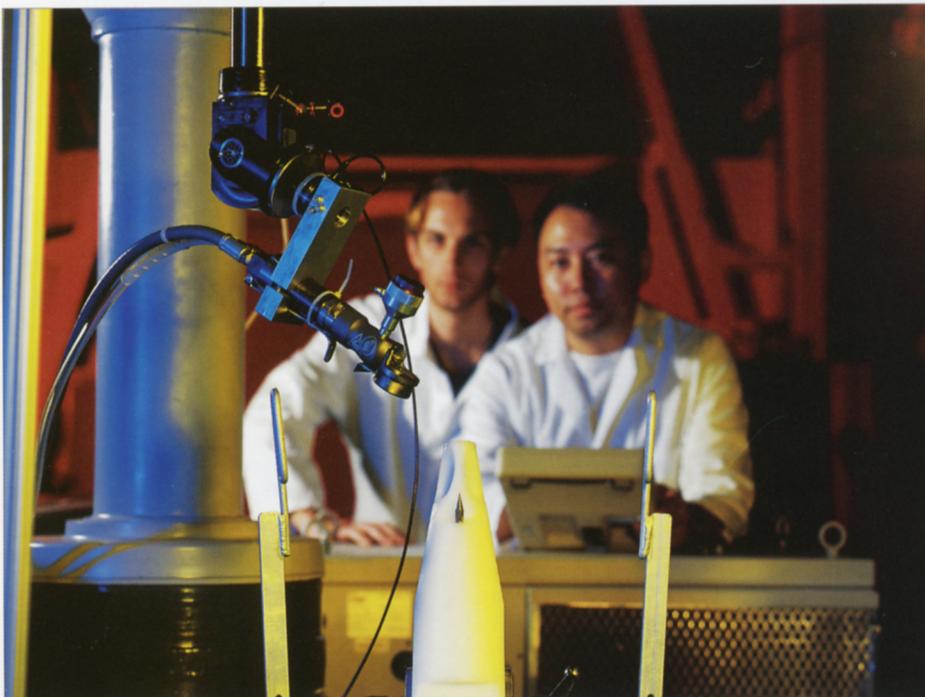
*This year GTRI helped develop software to extract, generalize, categorize, and index presidential electronic records. Shown: George Bush using a computer during his presidential tenure.*

hopes to incorporate this work into a commercial deboning system.

### Analyzing and Preserving Presidential Electronic Records

GTRI lent a hand to the National Archives this year to solve a major challenge associated with the processing and preservation of electronic records.

Our researchers worked with archivists to analyze the processes and information used to gain archival control of presidential electronic records. Software was developed to extract, generalize, categorize, and index the records. The software also helps archivists identify material that is exempt from release under the Presidential Records and Freedom of Information acts. *See also [www.ces.btc.gatech.edu/research.htm](http://www.ces.btc.gatech.edu/research.htm).*



*An "intelligent" automated poultry deboning device in development will combine computer vision, force-feedback control, and computer modeling.*

# State

2000

Solutions for the New Millennium

## Research Milestones Sensing Tiny Contaminants

In the early 1990s, GTRI scientists developed and patented an integrated optic interferometric sensor capable of quickly detecting even the smallest amounts of various contaminants in air, soil, groundwater, and food. These sensors have since been developed into an environmental monitoring system called E-Smart, which scientists believe will reduce health and safety risks.

**S**erving Georgia with innovative research has been paramount for GTRI since our 1919 chartering. Right now we're making temporary protective orders electronically accessible to law enforcement officials; modernizing a Georgia Department of Transportation accident database; developing early tornado detection technologies; and creating the first statewide malodor control and assessment program in the United States.



## They Can't Hide from the Web

A woman is physically abused every nine seconds in the United States. For many, their most important protection is a piece of paper — a Temporary Protective Order (TPO) — which, until recently, had to be in their physical possession at all times.

Now, thanks to researchers at GTRI who just completed the pilot for the statewide, web-based Georgia Protective Order Registry for the Georgia Commission on Family Violence, dispatchers and law enforcement officers can immediately access all TPOs by using a computer and the Internet.

*The Protective Order Registry provides a statewide index of active protective orders accessible by law enforcement officers and the judiciary.*

### More Information May Mean Safer Roads

Making Georgia roads safer means knowing more about each traffic accident — the vehicles, the people, the location, and the conditions — such as road surfaces, traffic, and volume — that may have contributed.

GTRI researchers are modernizing a database for the Georgia Department of Transportation (GDOT) to provide a more complete “picture” of accidents. The database includes an Internet browser interface that allows GDOT to study the most common accident locations and develop plans to reduce the 300,000 Georgia accidents — and 1,500 fatalities — that occur each year.

### Predicting Nature's Fury

March 20, 1998, 6:30 a.m.: A deadly tornado chews through five north Georgia counties, killing 13 people. They had no warning.

Today, the Severe Storms Research Center (SSRC) at GTRI is studying ways to better forecast severe storms in Georgia, and is developing new technologies for early tornado detection. With funding from the Georgia and Federal Emergency Management Agencies and Georgia’s legislature, SSRC’s state-of-the-art Warning Decision Support System is helping the National Weather Service provide better — and earlier — notice that Mother Nature is about to make a violent call. *See also [www.gtri.gatech.edu/res-news/SSRC2.html](http://www.gtri.gatech.edu/res-news/SSRC2.html).*

### Sniffing Out — and Managing — A Problem

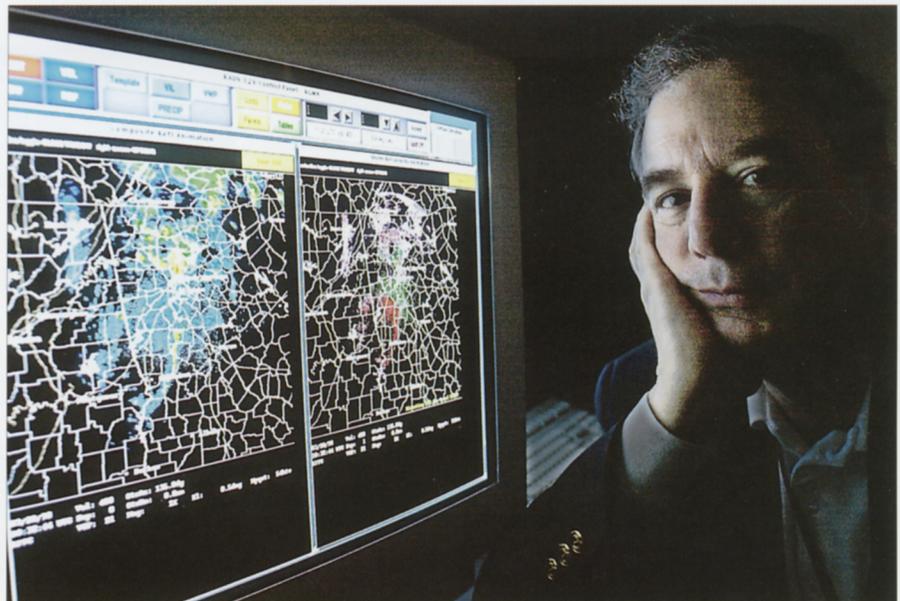
About 43 billion pounds of meat and poultry processing waste is converted yearly into usable byproducts such as pet and animal feeds. The operations that produce these byproducts must also control related odors — often a serious environmental problem for nearby communities.

With the Georgia Department of

Agriculture, GTRI researchers developed a statewide Malodor Control and Assessment Program, the first of its kind in the United States. While rendering plants can’t eliminate odors, they can better identify and control them, thanks to new GTRI-developed protocol.



*Using a vacuum and smoke, GTRI researchers can create visible twisters for study.*



*GTRI researchers and colleagues are studying ways to improve tornado forecasting. Shown are images of the March 1998 tornado that ripped through parts of northern Georgia.*

# Nation

2000

Solutions for the New Millennium

## Research Milestones

### Making Big Measurements in Small Spaces

To determine antenna pattern characteristics or target radar cross section (RCS) under realistic — yet convenient — conditions, GTRI researchers invented the compact range in the late 1960s. The technique simulates a plane wave over an antenna or RCS target. Although most compact ranges are small and operate indoors, they measure radiation patterns as they would occur over long distances. *See also [seal.gatech.edu/EAD/emtef.htm](http://seal.gatech.edu/EAD/emtef.htm).*

**U**.S. national security benefits from many of GTRI's research solutions. We are helping the Marines plan for Light Armored Vehicle viability through 2015; preparing the Air Force for key twenty-first century military concerns; and extending the lives of radars aboard F-15 aircraft. On the civilian side, we're helping create more efficient traffic management centers.



*Improved survivability, readiness, and combat effectiveness of Light Armored Vehicles were addressed by GTRI researchers in work for the U.S. Marine Corps.*

### Optimizing LAV Life Cycle

Improved survivability, readiness, and combat effectiveness of Light Armored Vehicles (LAV) were objectives tackled by GTRI in a project for the U.S. Marine Corps.

Our researchers provided independent business case analysis, systems engineering, and test-planning expertise to support acquisition and maintenance strategies for the LAV program. The work also supported several operational-system upgrades intended to preserve the vehicles' viability through the year 2015. *See also [www.gtri.gatech.edu/arl/index.htm](http://www.gtri.gatech.edu/arl/index.htm).*

### Simulating the Battleground of the Future

A Receiver Analysis Modeling System (RAMS) under development at GTRI is helping the U.S. Air Force prepare for what could be the key military concerns of the twenty-first century.

RAMS dynamically models electronic warfare emitters and

receivers including radar warning receivers, electronic support measure receivers, and electronic intelligence receivers. In addition, RAMS also allows strategists to analyze the effectiveness of information warfare techniques for the interception, exploitation, and attack of hostile information assets and the defense of friendly assets.

### Avoiding Obsolescence in the Twenty-first Century

VHSIC Hardware Description Language (VHDL) software is helping GTRI researchers devise components that reduce the costly impact of integrated circuit obsolescence.

One example of this work involves board redesign in the AN/APG-70 radar deployed aboard F-15 aircraft. As an "executable specification," the VHDL code captures inherent electrical/timing requirements in software, allowing manufacturers to replace older designs with current technology,

thereby extending the radar's life. VHDL code allows a higher level of integration, reducing parts count and increasing reliability. *See also seal.gatech.edu/.*

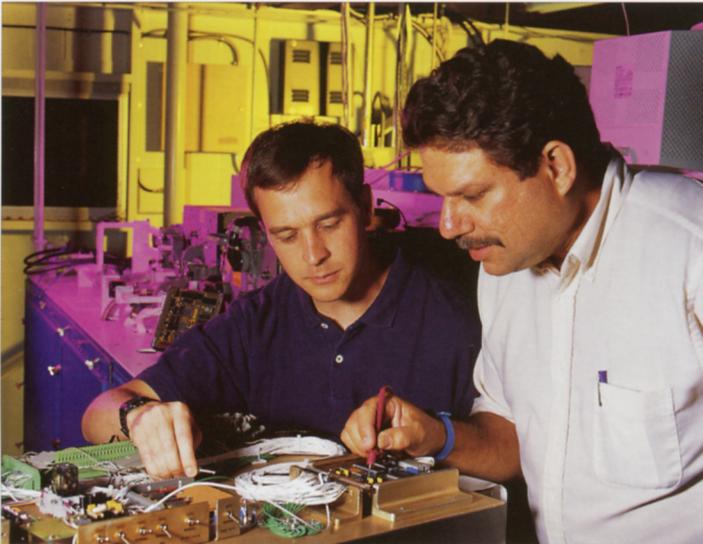
### Designing User-Friendly Traffic Centers

GTRI engineers have developed an Internet-based software system called ErgoTMC to assist the growing number of cities establishing or upgrading traffic management centers (TMCs) as a less expensive alternative to new highway construction.

ErgoTMC provides an integrated suite of software tools that emphasizes operator-friendly factors in TMC design. ErgoTMC addresses every aspect of design — from floor layout to computer specifications — effecting a more efficient TMC while reducing the potential for human error. This work supports the U.S. Department of Transportation's Federal Highway Administration. *See also [ergotmc.gtri.gatech.edu/welcome.htm](http://ergotmc.gtri.gatech.edu/welcome.htm).*



*At the direction of the Federal Highway Administration, GTRI has created interactive tools for planning traffic management centers. The tools address design issues, documentation, case studies, and basic human factors planning.*



*GTRI engineers test a replacement circuit board for the AN/APG-70 radar, which offers better reliability, a 62 percent reduction in IC part count, and greater obsolescence protection than its predecessor.*

# World

2000

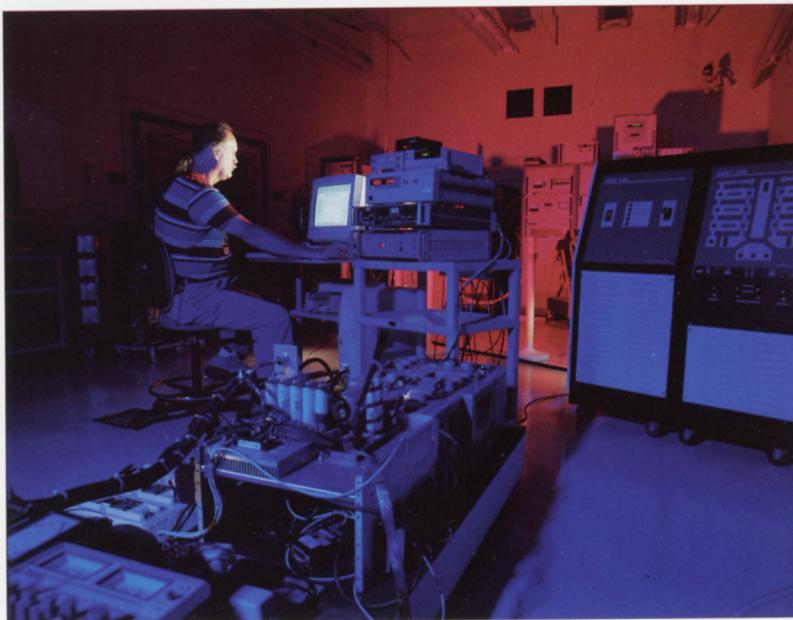
Solutions for the New Millennium

## Research Milestones

### Measuring the Elusive OH Radical

The fight against air pollution took a giant step forward when a GTRI researcher developed a more sensitive measurement technique for the elusive hydroxyl (OH) radical in the early 1980s. Considered the most important atmospheric cleansing agent, OH eradicates many greenhouse gases and pollutants. Photochemical discoveries from the Arctic to the South Pole can be attributed to this technique.

The impact of GTRI research is often felt around the world. Work with global potential includes helping lead Georgia Tech's new Center for Innovative Fuel Cell and Battery Technologies; coordinating real-time communication for international Counterdrug2000 participants; providing Y2K and related assistance; and helping conserve wildlife for the twenty-first century.



The Georgia Tech Center for Innovative Fuel Cell and Battery Technologies includes a new power cell testing laboratory unveiled in March.

## The Future of Fuel: Batteries and Fuel Cells

The energy source that has powered some spacecraft might one day operate your portable phone and neighborhood electric plant.

This power source — the fuel cell — is one focus of the new Georgia Tech Center for Innovative Fuel Cell and Battery Technologies. GTRI leads this multidisciplinary center, which specializes in research on fuel cell and battery technology for wireless telecommunications, ultra-low emission vehicles, and distributed stationary power supplies. See also [www.fcbt.gatech.edu](http://www.fcbt.gatech.edu).

## International Cooperation Fights Narcotics

Success in the war on illegal drugs requires international cooperation and breaking down communication barriers. GTRI is leading an effort to coordinate military and civilian

representatives from 12 nations of the Western hemisphere through United Counterdrug2000.

The program is an initiative of the U.S. Southern Command in cooperation with the Organization of American States. Our researchers are providing technical support for conferences and working groups that rely on Internet-based information technology to allow real-time communication in the fight against illegal drugs.

### Benefits Beyond Y2K for the U.S. Air Force

Additional, unexpected benefits resulted from a GTRI Y2K remediation effort for the U.S. Air Force.

Along with helping mitigate potential computer problems, the work helped bring about numerous improvements that enhanced the problem-solving effectiveness of existing business processes, organization structures, and doctrine.

Our researchers' comprehensive assistance included technical reviews of Y2K management and test plans and support for evaluation processes, as well as the development of management information systems for the Air Force's Y2K office.



*This three-screen virtual "immersion" environment at Georgia Tech allows researchers and scientists to study gorilla habitat remotely.*

### Conserving Wildlife for the Twenty-first Century

An innovative application of technology for the Dian Fossey Gorilla Fund International, via the Georgia Research Alliance, may help ensure survival of endangered Rwandan gorillas into the next century.

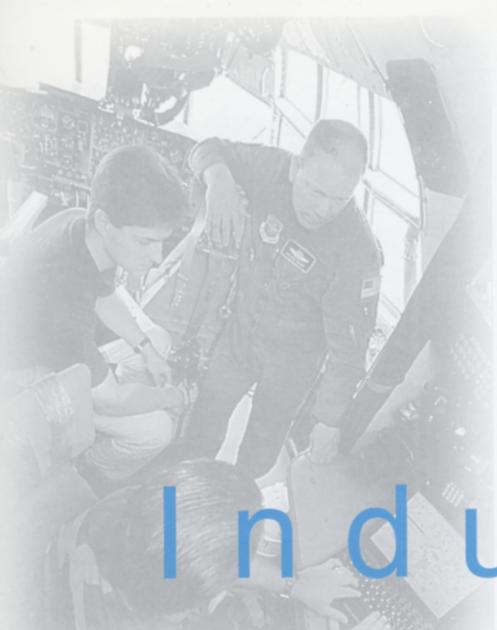
GTRI researchers are helping combine geographic information system data from satellites with hyperspectral data gathered by a special aerial camera and demographic information recorded on the ground to assess habitat — the chief variable affecting the dwindling gorilla population. The combined information will provide conservationists with a measure of how many gorillas an area can support, and also will establish a baseline for documenting future habitat loss.

*See also*

*[gtresearchnews.gatech.edu/reshor/rh-spr00/gorilla.html](http://gtresearchnews.gatech.edu/reshor/rh-spr00/gorilla.html)*



*GTRI's assistance in combining geographic information systems and hyperspectral and demographic data and technologies will help address habitat loss, the single greatest threat to the survival of mountain gorillas such as these in Rwanda.*



# Industry 2000

Solutions for the New Millennium

## Research Milestones Spearheading Laptop Flight Planning

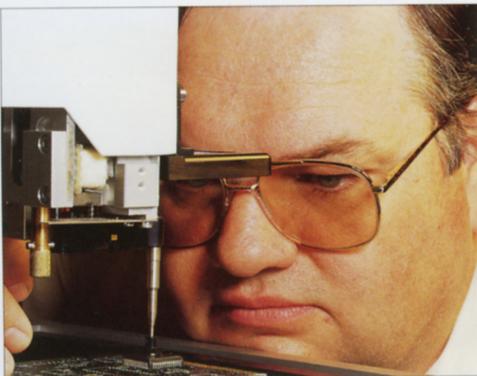
In 1992, GTRI researchers created FalconView, a laptop computer-based military flight planning system that replaces hand-drawn mission maps with interactive graphics. FalconView can display data such as the locations of no-fly zones, buildings, friendly aircraft, and ships. It also receives and displays information on troop movements, weather, and potential threats. See also [www.FalconView.org](http://www.FalconView.org).

## The Next Great Thing: From Bright Idea to Reality

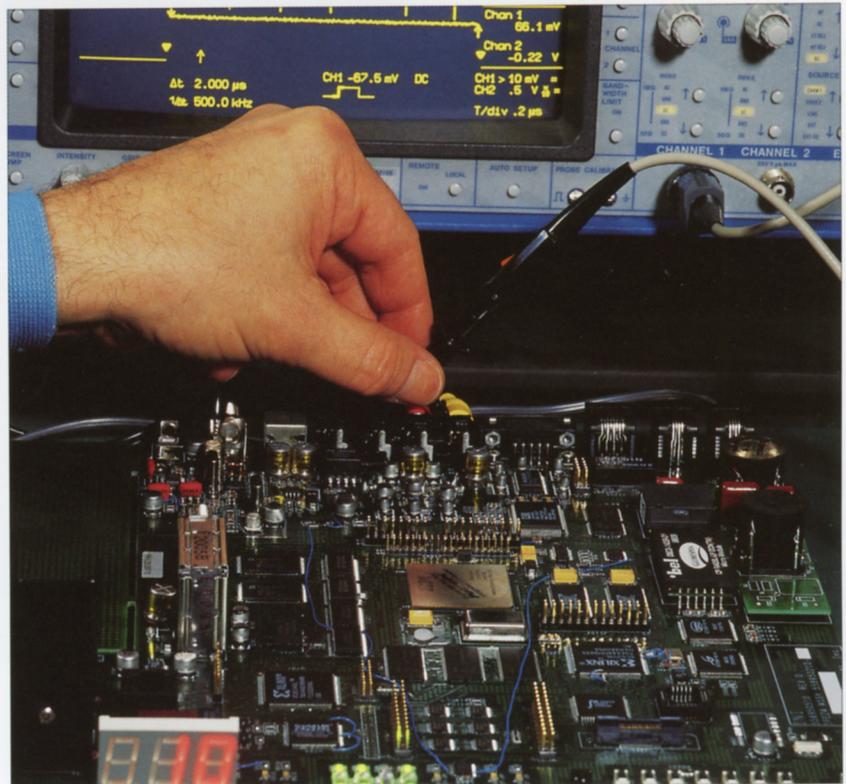
Making great ideas into great products requires concepts, research, design, prototyping, production preparation, and market strategy. GTRI's Commercial Products Realization Office is covering all those bases as it helps mPhase Technologies deliver a new way for residential subscribers to receive digital video, data, and voice signals simultaneously over existing copper telephone lines.

Other results? Seven patents, a new generation of wired consumers, and a track record for taking a big idea into a big marketplace. See also [www.mphasetech.com](http://www.mphasetech.com).

Customer needs are first priority for industry — and for GTRI. Industry solutions we're developing include a new way to send digital information to residences via copper telephone lines; a method of transmitting voice, fax, and data without network upgrades; a device warning motorists of impending road hazards; and a high-speed, low-cost food processing imaging system.



GTRI's Commercial Products Realization Office helped mPhase plan and develop a product that will deliver digital video, data, and voice signals simultaneously over existing copper telephone lines to residential customers. Shown: an mPhase circuit board assembly.



Testing a circuit board for the mPhase project.

## Phoning Home — Via the Internet

Consider this scenario: A corporate headquarters in the Northeast, a key regional office in the Midwest, and hundreds of daily phone calls and faxes in between — over long distance lines.

With a new Voice Over Internet Protocol (VoIP) appliance GTRI is designing for PacketPort.com, calls between the two locations are converted from analog signals and transported over digital networks — giving the calls “local” characteristics. The user benefit? Lower long distance charges and simultaneous transmission of voice, fax, and data without costly network upgrades. *See also [www.packetport.com](http://www.packetport.com).*



*The Safety Warning System developed at GTRI sounds an alarm and displays advisory text messages on an LED screen in vehicles as they enter work zones or other caution areas.*



*A close-up of the microwave-based Safety Warning System.*



*To image and grade 600 grapefruit per minute, GTRI developed computer algorithms that are executed on a 500-MHz Pentium processor in about 10 milliseconds.*

## Traffic Information in Advance

Imagine an “intelligent” traffic system that sounds an alarm and displays one of 64 pre-programmed text messages on an LED screen in your car as you near a highway work zone — or, as a school bus driver approaches a railroad crossing.

This was not only imagined, it was developed — by GTRI researchers, with U.S. Department of Transportation funding. The microwave-based system may save lives, allow better traffic flow, and enhance travel and convenience information. Drivers will know about “police in pursuit” long before seeing blue lights in their rear-view mirrors. *See also [www.svslc.com](http://www.svslc.com).*

camera technology. Plans call for an eight-camera array that affordably provides a 360-degree view of each grapefruit. Commercialization plans are in progress.

## High-Speed Eye on Food Quality Defects

To image and grade 600 grapefruit per minute, our researchers developed computer algorithms that are executed on a 500-MHz Pentium processor in about 10 milliseconds. They used lighting techniques that uniformly illuminate grapefruit racing through imaging cells, and now are incorporating low-cost, digital

# Education 2000

Solutions for the New Millennium

## Research Milestones

### Taking An Elegant Approach to 3-D

A 3-D vision technique developed at GTRI in the early 1980s provides the basis for a successful commercial optical film used in a new kind of 3-D glasses. ChromaDepth<sup>®</sup> 3-D from Chromatek Inc. uses clear micro-optic film to create a stereo image pair by optically manipulating the colors in a single image, thus creating a 3-D effect. *See also [www.chromatek.com](http://www.chromatek.com).*

**P**rogress now and tomorrow depends on well trained, educated workers. GTRI is finding innovative ways to help teachers harness technology; involve students in educational environmental monitoring; provide schools with high-bandwidth Internet access via satellite; and ensure that technical professionals get the training they need.



*K-12 teachers who attend Internet Explorers Club meetings sponsored by Foundations for the Future share experiences, learn from each other, and experiment with tools and technologies they can use in their classrooms.*

## Educational Collaboration Lays Foundation for Learning

Through Foundations for the Future (F3), an education and industry partnership in Georgia, GTRI helps K-12 schools maximize existing technologies and resources for affordable, reliable Internet access and LAN systems, despite geographic or economic limitations.

Current F3 projects include offering Internet training for parents in the nationally recognized Family Technology Resource Centers in DeKalb County; co-sponsorship of the National Educational Computing Conference; and planning and support for numerous multi-school and/or multi-county wireless and hybrid networks providing high-speed Internet access and educational and community networking. *See also [www.f3program.org](http://www.f3program.org).*

## Students and Teachers Study GLOBE

As a Georgia franchise of "GLOBE: Global Learning and Observations to Benefit the Environment," GTRI conducts statewide K-12 teacher training for this worldwide, Internet-based science education program.

Teachers learn how to guide students in hands-on environmental measuring of their region's land cover, water quality, soil types, and atmospheric conditions for entry into GLOBE's online database. Through GLOBE, Georgia students communicate with students in some 8,000 schools in 90 countries as they gather and record valuable environmental data for scientific use. *See also [www.globe.gov](http://www.globe.gov).*

## Deploying Technology School to School

With a grant from the National Science Foundation, GTRI is collaborating with public and private groups on a 16-site deployment initiative to demonstrate cost-efficient, high-bandwidth Internet access by satellite to K-12 schools and libraries.

Using Georgia Public Broadcasting System's Peachnet fiber network for uploading — paired with existing school-based satellite installations for downloading — this innovative demonstration project seeks practical ways to harness schools' existing technology. The goal? Delivering on-demand, real-time, or cached and streaming video transmissions, as well as Internet service, directly to the classroom.



Professionals can earn continuing education certificates in any of several GTRI programs, one of which is Hazardous Materials Management.

## Continuing Education Attracts International Clientele

Each year, some 4,000 professionals from around the world improve their workplace technical skills through continuing education programs offered by GTRI.

In response to workplace demand,

our researchers have developed five certificate programs: Occupational Safety and Health; Hazardous Materials Management; Sustainable Facilities and Infrastructure; and two defense electronics programs, Radar

Systems and Radar Signal Processing. In addition, GTRI designs and delivers customized courses at locations ranging from U.S. Army installations to corporate locations in Korea, Germany, and Saudi Arabia. See also [www.conted.gatech.edu/home/index.html](http://www.conted.gatech.edu/home/index.html).



GTRI researchers train students and teachers to make hands-on environmental measurements in their communities and enter them into GLOBE's online database, which contains data from 8,000 schools in 90 countries.

# Collaboration

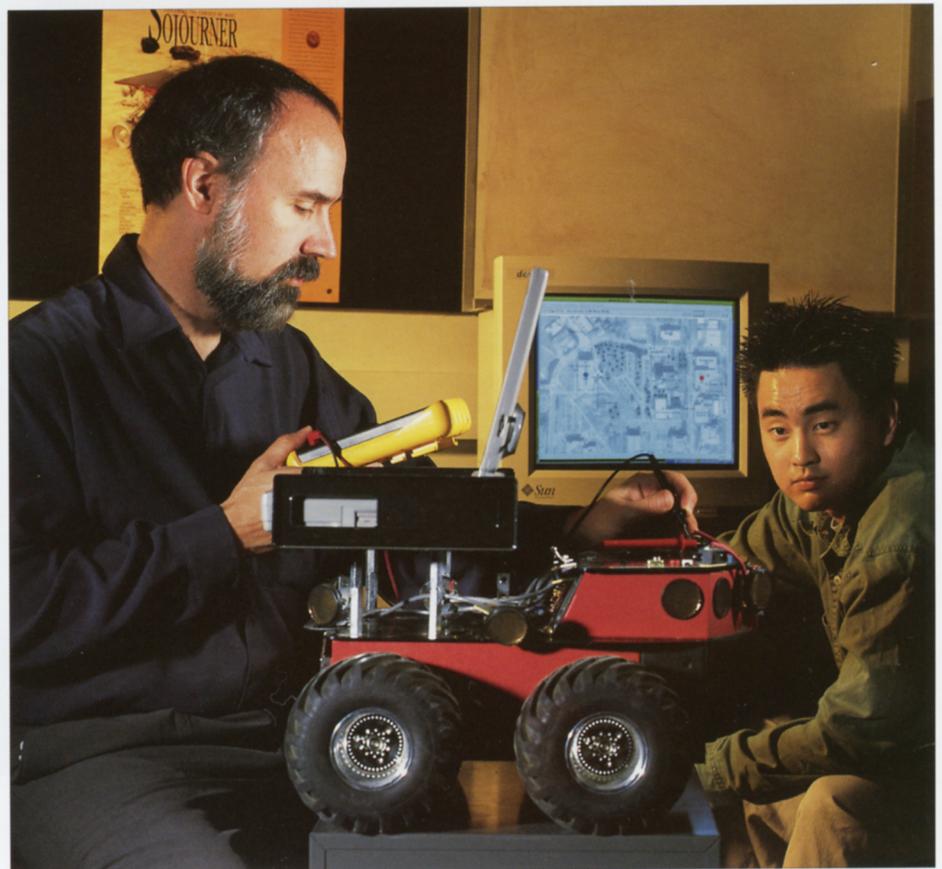
2000

Solutions for the New Millennium

## Research Milestones Building Millimeter Wavelength Radars

Microwave and coherent millimeter wavelength radar technology enables long-distance detection of objects as small as raindrops. Developed at GTRI in the 1980s, the highest-frequency millimeter radar of this type operates at 225 GHz. This device can provide useful imaging with an antenna less than 30 centimeters in diameter and also detects Doppler returns from a moving target.

One special advantage GTRI offers is its relationship with colleagues at Georgia Tech and other universities. We collaborate with them on solutions ranging from learning robots to ways of enhancing information security, as well as creating and testing noise-reduction materials for nursing homes and other environments.



*A researcher programs a route for an autonomous robot to follow.*

## Designing Learning Capabilities in Robots

A collaborative effort between GTRI and Georgia Tech's College of Computing (CoC) is making mobile robots smarter.

The Defense Advanced Research Projects Agency (DARPA) Mobile Autonomous Robot Software (MARS) program is developing software technologies that enable the safe, reliable, and cooperative operation of autonomous, free-ranging robots for the real world. The Georgia Tech MARS effort focuses on robot learning at multiple levels in Tech's MissionLab system. Other collaborative GTRI/CoC research with the DARPA Tactical Mobile Robotics program is making MissionLab easier to use for a variety of military situations. See also [www.cc.gatech.edu/ai/robot-lab/](http://www.cc.gatech.edu/ai/robot-lab/).

## GTRI Information Security Research Develops Innovative New Technologies

Georgia Tech's Information Security Center, a combined effort of GTRI and Tech's College of Computing, is helping businesses and government agencies protect against network-based attacks.

This year our researchers developed new and innovative intrusion-detection systems including NetWarden and a new demonstration project, SENTINEL II. Significant strides were also made in the Public Key Infrastructure Laboratory (PKIL) at GTRI; our researchers helped test the Federal Bridge Certification Authority and demonstrated the secure exchange of digitally signed documents between a diverse group of autonomous organizations. See also [www.gtisc.gatech.edu](http://www.gtisc.gatech.edu).

## Quiet Curtain Technology Bars Unwanted Noise

Researchers from GTRI, Emory University, and the Department of Veterans' Affairs are working on an



*The Mobile Autonomous Robot Software program is developing software technologies for safe, reliable, and cooperative operation of autonomous, free-ranging robots.*

innovative approach to blocking nocturnal noise with the use of high-tech drapes.

The drapes, known as "Quiet Curtains," combine noise-shielding material with fabric, a combination that appears to reduce noise by approximately 12 decibels in initial experiments in a nursing home. Originally designed to help shield nursing home patients from sleep-disrupting noise, the "Quiet Curtains" have other applications in environments such as offices, hotels, libraries, and schools. See also [www.gtri.gatech.edu/rh-win98/acoustic.html](http://www.gtri.gatech.edu/rh-win98/acoustic.html).



# Laboratories and Field Offices

2000

Solutions for the New Millennium

Headquartered in Atlanta, GTRI also has laboratories and field offices at six additional locations in the eastern United States:

Arlington, VA

- Arlington Research Laboratory

Quantico, VA

- Quantico Office

Atlanta, GA

- GTRI Headquarters
- Electronic Systems Laboratory
- Electro-Optics, Environment, & Materials Laboratory
- Information Technology & Telecommunications Laboratory
- Signatures Technology Laboratory

Cobb County, GA

- Aerospace, Transportation, & Advanced Systems Laboratory
- Sensors & Electromagnetic Applications Laboratory

Dayton, OH

- Dayton Field Office

Eglin Air Force Base, FL

- Eglin Field Office

Huntsville, AL

- Huntsville Research Laboratory

Warner Robins, GA

- Warner Robins Field Office

## Research Milestones

### Developing Near-Field Sampling

In the early 1970s, Georgia Tech researchers developed a new antenna testing technique called near-field sampling, which eliminated the need for large outdoor, far-field test ranges. The near fields of an antenna are measured, and the far-field pattern and other performance data are then calculated, while directional effects of the measuring probe are simultaneously corrected.

### GTRI Intergovernmental Personnel Agreements

GTRI researchers make added contributions to national technology and policy development by working in national organizations through the Intergovernmental Personnel Agreement (IPA) Program. This program allows scientists and engineers to collaborate directly with colleagues in federal agencies while retaining their GTRI faculty status. GTRI faculty who served as IPAs during FY 2000 include:

Aberdeen Proving Grounds, MD

- Dana L. Ulery, Army Research Laboratory

Alexandria, VA

- Gary Carter, Office of the Chief of Naval Operations

Arlington, VA

- Benjamin P. Riley, Office of Naval Research
- Thomas J. Singleton, Office of Naval Research

Atlanta, GA

- Richard S. Combes, Department of Energy, Atlanta Regional Support Office

Chantilly, VA

- Eric E. Sundberg, National Reconnaissance Office

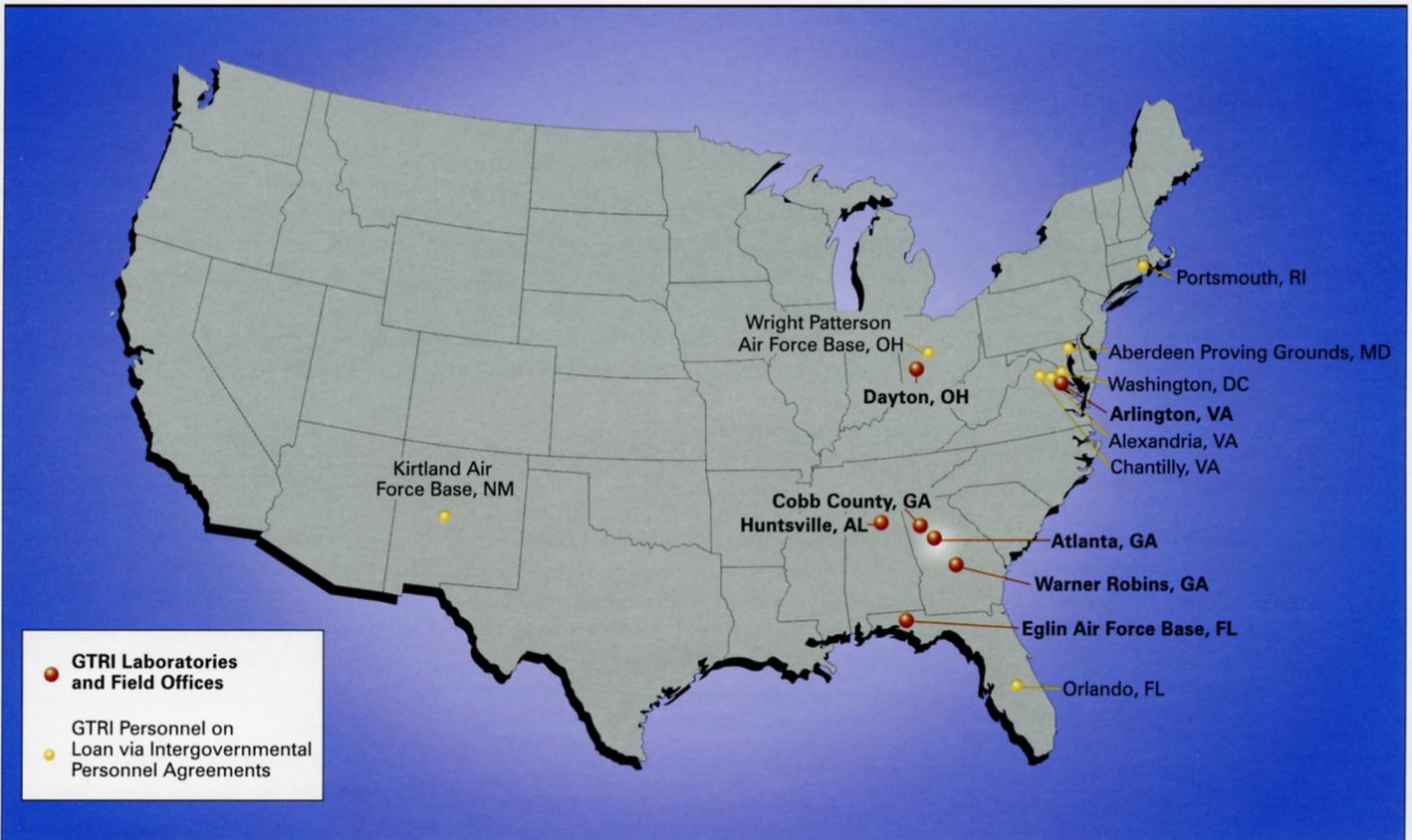
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Portsmouth, RI  
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Washington, DC  
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 • Catherine B. Joseph, U.S. Environmental Protection Agency, Office of Pesticide Programs, Health Effects Division

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*GTRI Laboratories, Field Offices, and IPA Locations*

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*\*new members*

# Glossary

**Coherent Millimeter Wavelength Radar Technology.** Enables small components and antennas to be used to detect and image extremely small objects. *p. 18*

**GTRI's Commercial Products Realization Office.** Coordinates key projects developing commercial products for industrial customers. *p. 14*

**Defense Advanced Research Projects Agency (DARPA).** Central research and development organization for the U.S. Department of Defense. Manages and directs selected basic and applied research and development projects; pursues research and technology where risk and payoff are high, and where success may provide dramatic advances for traditional military roles, missions, and dual-use applications. *p. 19*

**Dian Fossey Gorilla Fund, International.** Dedicated to the conservation and protection of the endangered mountain gorilla and its habitat in East Central Africa. Promotes research and education, and provides assistance to further this mission. *p. 13*

**ErgoTMC.** Internet-based software system for helping cities establish or upgrade traffic management centers (TMC). Contains integrated suite of software tools that emphasizes operator-friendly factors in TMC design. *p. 11*

**Foundations for the Future (F3).** Partnership of higher education, industry, and the State of Georgia to promote K-12 telecommunications access in Georgia. *p. 16*

**Georgia Commission on Family Violence.** Created by the Georgia General Assembly in 1992 to develop a coordinated response and comprehensive plan to end family violence in the state. *p. 8*

**Georgia Research Alliance.** A partnership of Georgia's research universities, the business community, and state government. Fosters Georgia's economic development by growing and leveraging the research capabilities of Georgia research universities and helping develop scientific and technology-based industry, commerce, and business. *p. 13*

**Georgia Tech Center for Innovative Fuel Cell and Battery Technologies.** Multidisciplinary center focusing on fuel cell and battery technology for wireless telecommunications, ultra-low emission vehicles, and distributed stationary power supplies. *p. 12*

**Georgia Tech Information Security Center.** Interdisciplinary center conducting world-class research and development on all aspects of information security. Emphases include developing new technologies and methods for ensuring information security, and developing public and organizational security policies. *p. 19*

**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 part of this program. *p. 16*

**Malodor Control and Assessment Program.** Helps rendering plants identify and control odors using GTRI-developed protocol. *p. 9*

**Mobile Autonomous Robot Software program (MARS).** DARPA program that develops software technologies that enable the safe, reliable, and cooperative operation of autonomous, free-ranging robots for the real world. *p. 19*

**MissionLab.** Multi-agent robotics mission specification and simulation software. *p. 19*

**Realistic Operational Communications Scenarios (ROCS).** Network for helping the Marines evaluate new command and control data networks; provides insight into system performance in a demanding field environment. *p. 6*

**Receiver Analysis Modeling System (RAMS).** Dynamically models electronic warfare emitters and receivers, including radar warning, electronic support measure, and electronic intelligence receivers. *p. 10*

**Safety Warning System.** Microwave-based system that will warn drivers of impending road hazards by sounding an alarm and displaying pre-programmed messages. *p. 15*

**SENTINEL II.** Information security intrusion detection system that uses neural network technology. *p. 19*

**VHSIC Hardware Description Language (VHDL).** Used to devise components that reduce the costly impact of integrated circuit obsolescence. *p. 10*

**Voice Over Internet Protocol (VoIP).** Being applied by GTRI to convert calls between two locations from analog to digital signals, transport them over digital networks, and give the calls "local" characteristics. *p. 15*

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# Our Mission + Values

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Solutions for the New Millennium

## Our Mission

GTRI will plan and conduct 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.

Editor, Lea McLees; designer, Adele Llop; writers, Gary Goettling, Faye Goolrick, Shelley Lee, Lea McLees, Laura Smith, Patricia West; GTRI map/p. 21, Dana Hrabovsky; copy editor, Daniel Treadaway; printer, Harris Specialty Lithography, Stone Mountain, GA; information, feedback and review, GTRI researchers. Additional assistance from Janice Rogers, Kenya Ervin, Leslee Littleton, Robert Simpkins, Olene Sparks, Katharine Russell, Julie Rhame, Linda Brooks, GTRI Business Development Office, Georgia Tech Research News and Publications Office, Georgia Tech Office of Sponsored Programs.

Photography, Stanley Leary unless noted otherwise. Atlanta Journal-Constitution/Andy Sharp, p. 9/bottom; Atlanta Journal-Constitution/Rich Addicks, p. 9/top; David Asbell, p. 5/BICOMS; Defense Visual Information Center, p. 10/bottom; Gary Meek, cover/bottom, p. 1/bottom, p. 6/bottom, p. 13/bottom, p. 15/middle; George Bush Presidential Library and Museum/Susan Biddle, p. 7/top; Georgia Tech File Photography, p. 1/top, p. 2/top, p. 4/top, p. 5 except BICOMS and FalconView, p. 8/top, p. 10/top, p. 12/top; Joann Vitelli, p. 15/bottom; Nick Faust, p. 13/middle; Oak Ridge National Laboratory, p. 4/middle, p. 6/top; Research Horizons Magazine, p. 11/top.



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