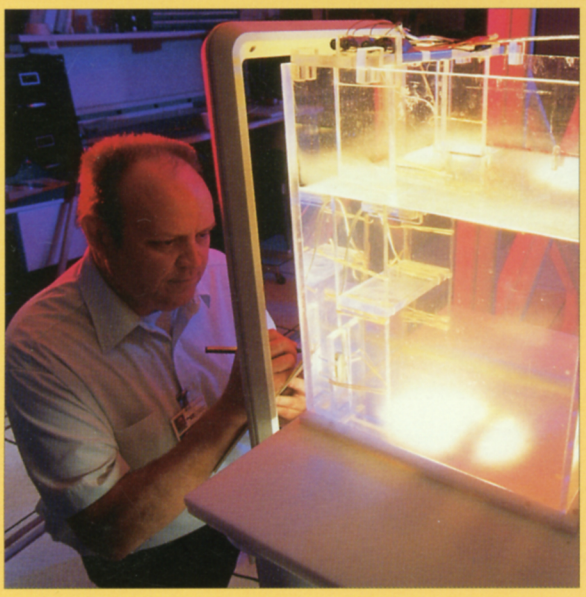
Creating Solutions Through Innovation



Georgia Tech Research Institute

Annual Report 1998

Table of Contents

Cover photos, clockwise from top left:

A two-foot-long antenna, right, developed at GTRI will be placed inside the crew lock of the International Space station, allowing communication with wearers of Russian-designed space suits.

GTRI completed final design and development of the Bistatic Coherent Measurement System (BICOMS), a state-of-the-art instrumentation radar system for the U.S. Air Force.

The FAST wearable computer system provides hands-free mobile access to electronic maintenance and repair manuals.

Through the EAS/Medical Device E3 Test Center, GTRI is helping manufacturers prevent potentially harmful interactions between implantable medical devices and electronic article surveillance systems.

BICOMS PHOTO COURTESY DAVID ASBELL; ALL OTHER COVER PHOTOS BY STANLEY LEARY.

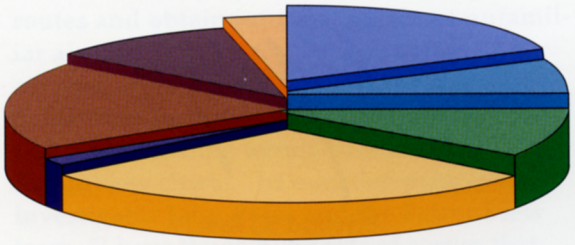
The Year in Review

GTRI made new strides during FY 98 to enhance the way we do business while continuing to develop new and innovative solutions for our customers.

Our researchers brought in $88.7 million in research awards. Among these awards were wins for GTRI's largest proposal effort and for our first videotaped proposal submission. We also completed negotiations resulting in the single largest industrial contract in GTRI's history.

GTRI's awards were down somewhat from FY 97, continuing the cyclical nature of research awards we've experienced over the last several years. Expenditures, however, were up 6.5 percent to more than $106 million, the highest in our history. Our colleagues in Georgia Tech's schools and colleges also performed well, garnering $98.3 million in research grants and contracts during FY 98.

GTRI's first endowed chair — the Glen P. Robinson Chair in Electro-Optics — was established this year with a generous $1.5 million gift from Mr. Robinson, a former GTRI employee. Mr. Robinson, who is a Georgia Tech alumnus, also was a satellite/cable communications technology pioneer.



GTRI 1998 Major Customers
(% of research expenditures)

- Air Force 28.0%
- Army 19.3%
- Industry, Fed. Subcontract 20.3%
- State of Georgia 10.9%
- Other Dept. of Defense 10.6%
- Federal Non-DoD 2.9%
- Industry Commercial 4.9%
- Navy 3.1%

FY 98 was GTRI's last year operating under OMB Circular A-21 Cost Principles for Educational Institutions. As of July 1, we adopted a new cost accounting system: the Federal Acquisition Regulation Part 31.2 Contract Cost Principles and Procedures - Commercial Organizations. As a commercial cost structure, FAR 31.2 is more familiar to our customers and is better suited to GTRI's contract research environment.

Organizationally, we made several changes that will enhance competitiveness. As a result of our move to FAR 31.2, we established GTRI's first Office of Compliance Assurance. This office is developing and administering a program, similar to those in the defense and health care industries, that will support GTRI's compliance with good business ethics and all applicable regulations. We formed a Business Development Office to perform market research and target new business opportunities. The Office of Institute Services was created to lead special internal projects and programs, such as identifying ways to enhance cost management, as well as establishing metrics for tracking our performance.

Our people were recognized by many outside organizations for their outstanding performance — so many, in fact, that we've devoted the next three pages to their service and achievements on and off the job this year.

We appreciate those who took on new directorship responsibilities: George Harrison, Research Operations; Jim Cofer, Business Development; Evan Chastain, Office of Institute Services; and Barbara Walsh, Compliance Assurance. With the advent of FY 99, we welcomed new laboratory directors Bill Rogers, Electronic Systems; David Parekh, Aerospace Sciences; Barry Bullard, Huntsville Research Operations; and Gary Caille, Electro-Optics, Environment and Materials. We thanked

retiring lab directors Bob Cassanova, Trent Farrill and Richard Stanley for their years of service.

Among the many innovative research solutions you'll read about in this report are:

■ The Initiative for Community Outreach, Research and Education (ICORE) helps neighborhoods throughout Georgia address issues related to rehabilitating environmentally impaired properties — many of them former industrial sites. GTRI and other campus units offer communities a comprehensive program of technical assistance and education.

■ For the U.S. Air Force, GTRI completed final design and development of the Bistatic Coherent Measurement System (BICOMS), a state-of-the-art broadband, monostatic and bistatic radar cross-section measurement system.

■ Internationally, GTRI human factors experts worked with Litton Corporation and Kaman Aerospace to update the Royal Australian Navy's SeaSprite helicopters. The researchers addressed the design of controls and displays at the heart of the new system.

■ For industry, GTRI researchers are designing and prototyping the next generation of all-optical switching equipment using Wavelength Division Multiplexing. This technology will help bridge the gap between the maximum possible speed of electronics and the virtually unlimited bandwidth available optically.

■ In education, GTRI collaborated with the Center for Integrating Science, Mathematics and Computing, Georgia Tech's K-12 outreach unit, to become a franchise of GLOBE — Global Learning and Observations to Benefit the Environment. The program trains students to collect environmental data, and teaches math and science skills.

■ GTRI is a prime player in Georgia Tech's new Information Security Center. The center will address research needs identified in the national Information Security Forum, which was led by former U.S. Sen. Sam Nunn during FY 98.

■ And GTRI continued developing tomorrow's solutions, as well. We funded internal research projects ranging from locomotion in robotic insects to tracking weather using phased-array radar.

This report and the work it highlights would not exist without GTRI employees. I thank them for providing the very best solutions to the customers we serve. As we approach the year 2000, it's truer than ever that our people, their skills, intelligence and hard work are the key to creating the innovative solutions we offer our customers.

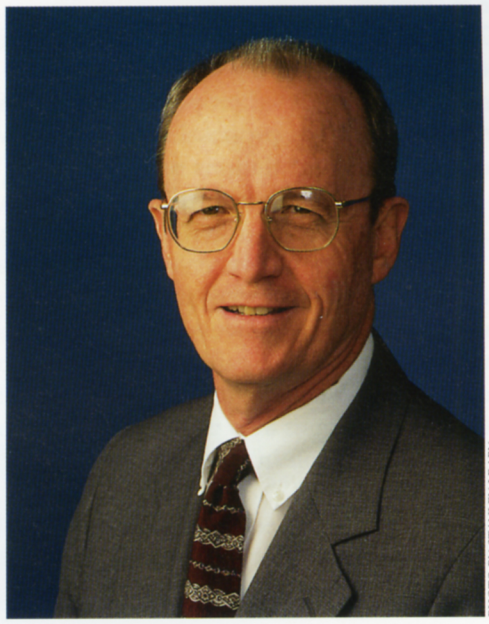


PHOTO BY STANLEY LEARY

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

Our Solutions Are Our People

GTRI's ability to meet complex research challenges depends on its innovative and resourceful people. From research scientists and engineers to computer technicians, secretaries and co-op students, each employee's contributions are vital to GTRI's success. Read on to learn about our employees' contributions to their professional and home communities, and to GTRI.

...Enhancing GTRI's World-Class Standing

■ When President Bill Clinton made his historic 1998 visit to Africa, a GTRI-developed mapping program for pilots, known as FalconView, went with him. Maj. Joel Carlson of the 89th Airlift Wing, based at Andrews Air Force Base near Washington, DC, used the program during a support flight carrying a high-level White House delegation to a meeting during the trip. A navigator and GPS project officer, Carlson **employed FalconView to plan routes and obtain information about unfamiliar airports in Africa,** a difficult continent for aviators. "Our approaches into unfamiliar airfields were easy, thanks to the big-picture view of the surrounding terrain provided by FalconView charts," he e-mailed **principal investigator John Pyles and the FalconView team**. "I have flown hundreds of sorties that were made safer by the program's unique ability to enhance aircrew situational awareness, especially around unfamiliar terrain. I would like to congratulate you and your staff on the fine program you produce."

■ Research scientist **Eliesh Lane** and senior research scientist **Robert Schmitter** were **recognized by U.S. Sen. Max Cleland** in a letter to Georgia Tech President G. Wayne Clough. Cleland commended them for their vision and commitment to revitalizing Georgia's communities. Lane and Schmitter are addressing issues such as brownfields through the Initiative for Community Outreach, Research and Education.

■ Senior research scientist **Steve Hays** and research engineer **Kirk Mahan** led the **first international training** offered by GTRI's OSHA Training Institute Education Center. They led two construction safety training programs in Jubail, Saudia Arabia. Attendees were from the United States, Great Britain, India, the Philippines, Pakistan, Saudi Arabia, Jordan, Norway and Australia.

■ GTRI employees have been tapped for Intergovernmental Personnel Agreement service with a number of agencies, including:

- Wright Patterson Air Force Base, Dayton, OH: **Don Bodnar**
- The Army Research Laboratory, Washington, DC: **Harold Breaux, Dana Ulery, Don Wilmot**
- Rome Laboratory, Rome, NY: **Joe Bruder, John Cotton, Robert McMillan**
- The Army Research Laboratory, Atlanta, GA: **Vernessia Callahan, Les Pickering**
- Phillips Laboratory, Albuquerque, NM: **Thomas Davis**
- The Department of Defense, Washington, DC: **Joseph Eash**
- The National Center for Atmospheric Research, Boulder, CO: **Fred Eisele**
- The Office of Naval Research, Washington, DC: **Ben Riley**
- The National Reconnaissance Office, Washington, DC: **Eric Sundberg**

■ Senior research associate **Mark Hodges** authored the August-September **cover story** for the Massachusetts Institute of Technology's *Technology Review*. The article, "Is Web Business

PHOTO BY STANLEY LEARY

Gene Greneker demonstrates the "RADAR flashlight" for four Missouri fifth-graders.

Good Business?" addressed prospects for Web-based commerce.

...Serving Our Professions

■ **Tom Horton**, a senior research associate, was re-elected a **director of AFCEA International**, the premier government information technology association.

■ **Charlene W. Bayer**, a principal research scientist, is **helping develop standards for indoor emissions**. She is chairman of the general workgroup; member of the technical committee; and a member of the air cleaners workgroup developing UL/ANSI Standard 2117 for Indoor Emissions of Equipment, Furnishings, Products, and Floor, Wall and Ceiling Treatments. Bayer also serves on the ASHRAE Environmental Health Committee and the Environmental Health Committee Research Subcommittee.

PHOTO BY STANLEY LEARY

Debbie Winn won a 1998 Outstanding Research Support Personnel Performance Award.

■ The director of GTRI's Business Development Office, **Jim Cofer**, recently completed six years on the **ITEA board of directors**, during which he directed the association's educational program.

■ **Ronald A. Bohlander**, a principal research scientist, was elected to a second term as an **international director** of the Society of Manufacturing Engineers. Based on expertise he developed at Georgia Tech, Bohlander is taking a leading role on SME's Grassroots Committee in providing new-member services via electronic media.

...Growing Future Scientists

■ Senior research associate **Claudia Huff** and research associate **Dara O'Neil** were special awards judges at the International Science and Engineering Fair for high school students during May in Fort Worth, TX. They represented the **Society for Technical Communication**.

■ Four fifth-graders at Claymont Elementary School in Ballwin, MO, who entered an "X-ray flashlight" idea in an inventor competition tried out a similar invention at GTRI. After they raised money to get here, principal research scientist **Gene Greneker** showed them the "RADAR flashlight" he developed. The future scientists also met **Gen. George Harrison** (USAF, retired), director of Research Operations, and learned from research scientist **Jeff Gerth** about development of a modern cockpit for Australian navy helicopters.

...Among the Best

■ **Robert Michelson**, a principal research engineer, won the **1998 Pioneer Award** presented by the Association for Unmanned Vehicle Systems International. This is the highest recognition in the unmanned systems industry for technical contributions that advance the state-of-the-art while moving the community toward the new millennium. The 1997 winner was former U.S. Secretary of Defense Dr. William J. Perry.

■ **Joseph Bruder**, a principal research engineer, was elected a **Fellow of the Institute of Electrical and Electronics Engineers (IEEE)**. Only about 1 percent of IEEE's 300,000 members have earned the Fellow designation.

■ **Annie Pearce** is the newest of **GTRI's Faculty Research Leaders**. Pearce's specialty is investigating sustainable facilities and infrastructure.

■ **Debbie Winn**, a project support analyst, won a **1998 Outstanding Research Support Personnel Performance Award**. Winn was recognized for capability, talent and perseverance in producing and maintaining fiscal data for research projects and proposals, especially during critical deadlines.

...In Our Communities and Around the World

■ Six GTRI employees helped develop a series of recommendations that will substantially **improve the accuracy and lead time of severe weather warnings in Georgia** when implemented. The group was tapped for service on the Governor's Task Force on Warning and Communication during the spring. The task force, led by the Georgia Emergency Management Agency, was chartered by Georgia Gov. Zell Miller in the wake of a devastating March 20 tornado in Hall County. Representing GTRI were principal research scientist **Gene Greneker**, principal research engineer **Mark Richards**, research engineer **Byron Keel,** principal research engineer **Eric Barnhart** and principal research scientist **Nicholas Faust**. Greneker served as chairman of the task force's Forecast Subcommittee.

■ As a member of the Greater Zion Hill Inspirational Choir in Smyrna, GA, senior secretary **Carolyn Gray sang for the homeless** at the 14th Street Presbyterian Church during a springtime breakfast. She also performed with the choir in Washington, DC, and Richmond and Newport News, VA.

■ Employees of the **Aerospace Sciences Lab and the Management and Project Support Group** decorated a Georgia Tech tree at the Festival of Trees for the seventh year in a row. Proceeds from the purchase of each tree have **benefited Egleston Children's Hospital**.

■ **Myrtle Turner** was elected to the **board of governors** for the alumni association of Emory University's Rollins School of Public Health. The board serves approximately 1,600 Rollins alumni.

■ **Barbara Bell**, an administrative coordinator, was among 400 athletes invited to try out for the **Women's National Basketball Association's Detroit Shock**. She and 49 fellow athletes survived several rounds of elimination, putting them among the top 13 percent of athletes who tried out.

PHOTO BY STANLEY LEARY

Annie Pearce's specialty is investigating sustainable facilities and infrastructure. The structure behind Pearce is a prototype sustainable building.

■ Senior research engineer **Rich Combes** was among 17 Georgia Tech faculty and staff members who won the **Freshman Partner of the Year award**. He and Georgia Tech sophomore Arti Muralidhara helped make the transition to college life smoother for a group of 20 Tech freshmen.

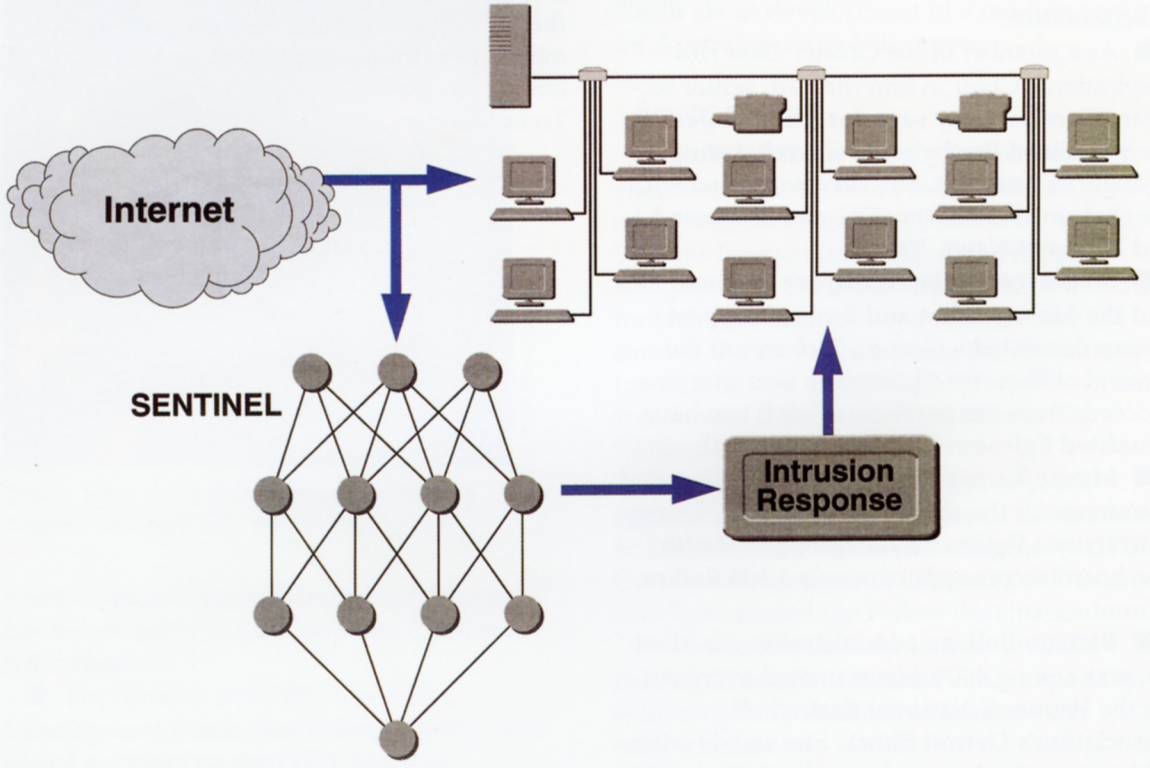
Featured Solution: Information Security

From customer records to advanced product research, computer-based information has become the cornerstone of operations for government and industry. Every day, threats to the safety of this "new currency" blare from news headlines: curious hackers, computer-based terrorists, industrial espionage and even warfare aimed at information and systems. Protecting this new commodity is of critical importance, as is the need to educate students and industry leaders on the subject.

This year, Georgia Tech moved to address both these issues while hosting the Sam Nunn Policy Forum. The forum was the keystone of a week-long focus on information security; it served to educate top industry leaders on information security challenges. Facing these challenges is not merely a technical matter — it requires an innovative fusion of public and corporate policy, international affairs and technology.

"We have those strengths, and at Georgia Tech the elements are already in contact with each other, unlike some schools," says Peter Freeman, dean of the College of Computing. "Georgia Tech also has a high degree of access to, and experience working with, top industry, government and academic leaders. When this is combined with our strengths in both basic and applied research, we bring a strong and integrated approach to the information security issue."

These strengths and a rich history of interdisciplinary research led to the announcement at the forum of the Georgia Tech Information Security Center's creation. The center is dedicated to research on the challenges of information security; development and commercialization of solutions to information security problems; and education of those tackling



GRAPHIC COURTESY JAMES CANNADY/KAY LINDSEY

SENTINEL is a demonstration project for developing an information security intrusion detection system that identifies previous and new types of attacks.

tomorrow's problems.

"Until now, efforts at information security have been ad hoc in that a problem is discovered and a Band-Aid applied," says J. Michael Cummins, the center's interim director. "There is no underlying conceptual framework to think through all these issues — particularly on a policy or strategic business level. We formed the Information Security Center to be the leader in developing that theoretical infrastructure, while providing specific solutions to both technical and policy issues."

GTRI researchers are a part of these important efforts. Already, work is in progress on projects relating to security in Asynchronous Transfer Mode networks, active networking environments, broadband networks, the Internet II project and telecommuting applications.

Researchers also are helping develop some of the infrastructure framework through creation of a standard methodology for evaluating the security of a network system. The Network Security Evaluation Criteria will allow administrators to evaluate another network's security so they can determine whether connecting to it would impact their own network's security. It also helps administrators identify improvements needed to elevate their networks to desired levels of security.

The need to detect both known and new types of attacks on a system is also being addressed by GTRI researchers; they are bringing the power of neural networks to information security. SENTINEL is a demonstration project on developing an intrusion detection system that identifies not only previous types of attacks, but new ones — something current rule-based systems cannot do. The system gains experience with each effort so that it "learns" the characteristics of attacks. That should allow the system to eventually predict attacks and monitor activities, collecting information for responses to attacks and the prosecution of those behind them.

From assisting with the development of methodologies and conceptual frameworks, to the innovative use of technology to meet challenges, GTRI will play a significant role in the Information Security Center's work on meeting the challenges of security in the Information Age.

PHOTO BY STANLEY LEARY

GTRI researchers use a Cray supercomputer and other machines to explore solutions to information security challenges.

PHOTO BY STANLEY LEARY

Georgia Tech President G. Wayne Clough speaks at the Sam Nunn Policy Forum, where the creation of the Georgia Tech Information Security Center was announced.

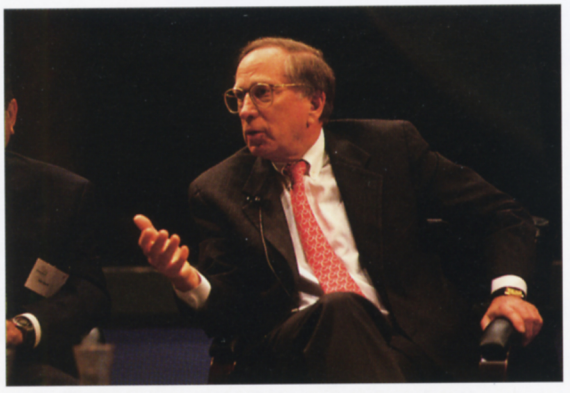


PHOTO BY STANLEY LEARY

Named for former U.S. Sen. Sam Nunn, pictured, the forum was the keystone of a week-long focus on information security.

Solutions for the State

GTRI provides innovative solutions that help Georgia companies become more competitive, meet federal safety and health regulations, and add new product lines. GTRI researchers also help state agencies find ways to improve weather forecasting, traffic planning and environmental remediation. Several projects assist the Warner Robins Air Logistics Center, a major contributor to the nation's defense.

■ The Georgia Department of Transportation sponsored a project to develop a prototype system for counting occupants in vehicles passing by at highway speeds. The system will provide traffic planning data. An infrared strobe light on a roadside tripod illuminates each passing vehicle's interior. The high-speed flash freezes the vehicle's motion, allowing an infrared camera to digitally record images indicating the number of occupants for computer analysis. Because the infrared light is invisible to human eyes, the flash does not distract drivers. One potential use of this data is assessing the impact of efforts to reduce air pollution by increasing vehicle occupancy.

PHOTO BY DAVID ROBERTS

This prototype system counts occupants in vehicles passing by at highway speeds.

■ Researchers are addressing the extensive paperwork requirements that motor carriers must prepare to receive operating credentials. Twelve states are participating in this study, which aims to develop common data requirements, common forms, integrated processes, unified credentialing cycles and requirements for a common Electronic Carrier Credentialing System (ECCS). The GTRI project team interviewed all carrier-credentialing agencies in participating states and documented each agency's functions, processes, forms, data items used and current information systems. From this information, the team developed a data element dictionary, a proposed Consolidated Carrier Credentialing form and an ECCS system specification.

■ In 1998, a particularly strong tornado struck northeast Georgia without warning, killing several persons and causing extensive damage. Five GTRI researchers are serving on the Governor's Task Force on Warning and Communications to help determine whether tornado forecasting and warning systems can be improved.

■ Through the Agricultural Technology Research Program and Traditional Industries Program for Food Processing, GTRI assisted poultry and food processing companies statewide. Researchers reviewed draft environmental legislation governing storm water, helping clarify areas of potential conflict with USDA regulations. The work led to changes allowing the legislation to achieve its goals without causing costly plant shutdowns. Engineers also launched PoultryNet, an Internet-based information system providing the poultry industry easy access to poultry-specific Web-based resources.

■ With help from Georgia Tech's Advanced Technology Development Center, researchers are commercializing a new hydrogel air-cleaning media they invented and patented. The

prototype system removes 50 percent of respirable-sized airborne particles and 80 percent to 90 percent of gaseous air pollutants. FY 98 research was aimed at advancing the work such that it can become a commercial product.

■ Two GTRI programs help companies meet occupational safety and health requirements for protecting their workers. The Safety and Health Consultation Program funds 13 professionals who visit small businesses throughout Georgia to help these employers identify, correct and prevent the reoccurrence of workplace hazards. The OSHA Training Institute Regional Education Center teaches courses in many areas of safety and health, including electrical and construction hazards, ergonomics, respiratory protection and industrial hygiene.

■ Environmentally impaired properties, many of them former industrial sites, pose problems for many Georgia communities. The Initiative for Community Outreach, Research and Education (ICORE) helps neighborhoods throughout the state deal with these issues through a comprehensive program of technical assistance and education. Participants included researchers from GTRI, Georgia Tech's School of Public Policy, College of Architecture, School of Civil and Environmental Engineering, and Economic Development Institute.

■ During FY 98 researchers provided solutions for Georgia's Warner Robins Air Logistics Center by redesigning, testing and qualifying obsolete hybrid microcircuits essential to the operation of the APG-63 and APG-70 radar systems. GTRI researchers also began work on the redesign of two shop-replaceable unit boards in the APG-70 radar. The work helps resolve reliability and obsolescence issues in these systems, which are used in U.S. Air Force fighter jets.

PHOTO BY STANLEY LEARY

The Initiative for Community Outreach, Research and Education (ICORE) helps neighborhoods deal with environmentally impaired properties such as this one.

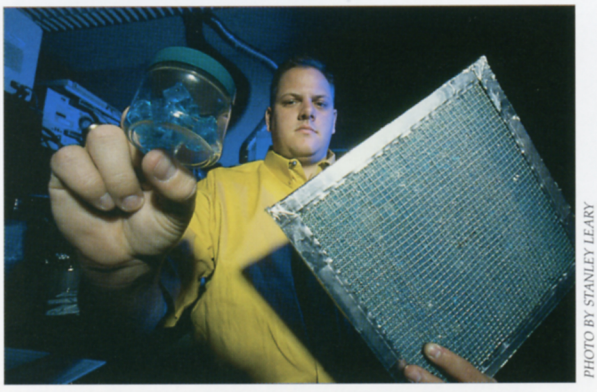


PHOTO BY STANLEY LEARY

Researchers are commercializing a new hydrogel air-cleaning media they invented and patented.

PHOTO BY STANLEY LEARY

Researcher Lisa Sills and DeKalb County Superior Court Judge Hilton Fuller examine data on a laptop connected to the court information system.

Automation in the Court

Challenge:

Providing on-line information about criminal activity and other court-related matters to officials in Georgia's state, superior and juvenile courts.

Solution:

A GTRI-designed database comprised of a TCP-IP network that can be used by account holders, primarily judges and clerks, wherever they have Internet access. More complete information about suspects' records means better decision-making.

Solutions for the Nation

GTRI is highly involved in national-level research. Its laboratories and field offices are continually expanding their extensive record of finding innovative solutions for the Department of Defense, the individual Armed Forces and numerous federal departments.

■ In FY 98 GTRI applied its modeling and simulation expertise to numerous research projects. One major endeavor involved developing for the U.S. Army an all-digital model of the Suite of Integrated Infrared Countermeasures (SIIRCM), which provides state-of-the-art protection for aircraft against passively guided infrared missiles. GTRI is modeling a three-dimensional scenario for SIIRCM, a joint project of the three U.S. military branches. When validated and accredited, these models will play a major role in decisions regarding development and procurement of the system.

■ At China Lake, CA, GTRI researchers are actively engaged in the Missile-on-a-Mountain program, a semi-active surface-to-air missile simulation facility. The first phase involved modifying a threat missile seeker, so part of it is placed on a three-axis rate table and part in a custom chassis. Only one portion of the simulation — the aerodynamic flight of the missile — is modeled by computer; actual threat hardware is used for the target-tracking radar, illuminator and missile seeker. A target aircraft can be flown within 200 feet of the seeker on the flight table to complete a hardware-in-the-loop simulation.

PHOTO BY STANLEY LEARY

This aperture printed circuit board is the fundamental lens building block for the lightweight airborne phased-array radar antenna.

■ The U.S. Army is more effectively managing and controlling its supply distribution processes using the GTRI-developed Wildcat computerized tracking system. With this system, managers access in real time the status of supply redistribution and progress of the issue, transport and receipt of goods. They employ user-friendly software, wireless data communications, business process analysis and management tools to reduce the cost of ownership of supplies. Phase 1 of the program provided central management for redistribution of assets throughout Fort Hood, TX, and in only six months has facilitated the savings of hundreds of thousands of dollars. Phase 2 transitions the system to the new Global Combat Support System-Army environment and extends the capability to Army installations throughout the United States and in Europe.

■ GTRI provided operational and technical support in the areas of distributed simulation time management and testing to the High-Level Architecture (HLA) Architecture Management Group Technical Support Team of the Defense Modeling and Simulation Office. This work included chairing technical exchanges and maintaining/evolving HLA time management and testing documents, as well as developing training materials to educate broader audiences about time management and testing.

■ Researchers conducted time management experiments for synchronized data management that included developing techniques to efficiently implement the synchronized data

management mechanism, developing a proof-of-concept prototype and collecting performance measurements. GTRI also developed software tools and processes to support HLA compliance testing. The Certification and Conformance test process developed by GTRI ensures that DoD simulations conform to HLA architecture specifications.

■ GTRI continues to investigate novel approaches to low-cost, lightweight antenna structures. Researchers have developed an approach that uses patterned sheets of one or more conducting/non-conducting elements with random levels of interconnectivity as a broadband antenna. Since such systems can be made in planar forms and have reduced sizes over comparable antennas, they can be tailored to missions that require small, surface-mounted antennas in a lightweight form. GTRI is also using photonic-bandgap materials to improve the performance of surface-mounted antennas such as patches or dipoles. The materials are being used to form radiating antennas and transmission lines using a patented technique.

■ In the field of localized RF measurements, GTRI has devised a laboratory-scale measure-

PHOTO BY STANLEY LEARY

This flat-panel display supports the U.S. Air Force's ALR-69 Radar Warning Receiver System. It is compatible with cockpit night vision imaging systems, while maintaining sunlight visibility.

PHOTO COURTESY CHARLES CRAWFORD

Investigators used GTRI-developed regime recognition algorithms to analyze instrument usage data from six U.S. Air Force HH-60G helicopters.

ment system to perform accurate VHF-SHF radar cross-section (RCS) measurements in a relatively small space. Researchers have developed a technique to determine RCS from localized measurements and to utilize that near-field measurement to image the true current distribution on the measured target. Though the technique is related to the near-field scanning, the GTRI approach utilizes the finite size of the scan plane to optimize the results, considerably reducing the required scan-plane size while maintaining measurement accuracy. Moreover, the approach can be applied to any type of scan surface.

■ GTRI engineers are working on final integration of the U.S. Army's XM-15S Simulator, which simulates a mobile, land-based threat surface-to-air missile system. Researchers developed and integrated target acquisition and track radar systems for the XM-15S with embedded computer systems in a mobile tracked vehicle; radar transmitters coupled with waveform generator hardware/software to provide accurate high-power RF signatures; a frequency-scanned, flat-plate-array antenna that provides the correct RF radiation pattern for the acquisition radar; and a corporate-fed, phased-array antenna used with the track radar subsystem. Embedded real-time digital signal processing utilizing high-speed array processors is used to process radar returns from low-noise receiver systems.

■ Researchers are addressing the extensive paperwork requirements that motor carriers must prepare to receive operating credentials. Twelve states are participating in this study, which aims to develop common data requirements, common forms, integrated processes, unified credentialing cycles and requirements for a common Electronic Carrier Credentialing System (ECCS). The GTRI project team interviewed all carrier-credentialing agencies in participating states and documented each agency's functions, processes, forms, data items used and current information systems. From this information the team developed a data element dictionary, a proposed Consolidated Carrier Credentialing form and an ECCS system specification.

PHOTO COURTESY CAITLIN FLOWERS

GTRI assisted in recent, highly successful tests in which an F-15 like the one shown fired five missiles against an F-106 protected by DAMES equipment. There were no losses to airborne instrumentation or aircraft.

■ GTRI engineers are developing a novel, lightweight phased-array radar antenna design. The completed antenna is designed to be suspended from a tethered balloon for combat fire-control functions. Unlike most antennas, where size and cost are critical, this new design emphasizes weight and power efficiency. Accordingly, researchers chose a 3.2-meter circular space-fed lens array consuming less than 15 kilowatts of prime power. The design employs nearly 16,000 array elements, with the number of radiating elements minimized to reduce weight, power consumption and cost.

■ In support of the Air Force's ALR-69 Radar Warning Receiver system, a GTRI team developed a flat-panel display that replaces an older CRT display. The highly reliable new display is compatible with cockpit night vision imaging systems through the use of electroluminescent display technology, while maintaining sunlight visibility. The development effort, which included a number of advances in the use of commercial technology in military systems, upgraded the ALR-69 system economically.

■ GTRI is exploring the unique potential shown by organic polymer conductors for EM spectral technologies. These novel materials have the capacity to simultaneously exhibit variable IR transmittance, chromism (transitioning between green, blue and clear/yellow states) and DC conductivity with low applied voltage. To explore these organic conductors' technological implications, GTRI scientists are using IR and optical spectroscopy to characterize these materials. Their research will facilitate the design of flexible, cost-effective membranes for the IR and visual regimes.

■ During FY 98, GTRI engineers developed and installed a radar test system under the SADS IIR Threat Instrumentation Program. The test system emphasizes non-invasive techniques and offers maximum continued testing, particularly during world crisis situations. The Threat Instrumentation Program allows detailed information to be extracted from the existing SADS IIR radar system. This information is then used to allow testing of electronic warfare countermeasures against the radar system in a real-time, real-world environment while also allowing real-time missile miss-distance scoring without having an actual missile

Laptops Take to the Skies

PHOTO BY STANLEY LEARY

FalconView aboard a C-130 aircraft parked at Dobbins Air Force Base near Atlanta.

Challenge:

Helping pilots in the U.S. Air Force and Special Operations Forces plan flights quickly and efficiently.

Solution:

GTRI, the U.S. Air Force Reserve and the Air National Guard harnessed computer technology and declassified imagery, enabling pilots to download the latest mapping data on no-fly zones, obstructions and more. Pilots can now plan flights on laptops, eliminating the need to draw and transfer notations from map to map by hand.

endangering pilots and equipment.

■ GTRI is currently completing development for the U.S. Air Force of an improved electronic defense suite for the HH-60G helicopter. Under this program, GTRI engineers have developed an integrated electronic warfare system that will replace the current electronic countermeasures capability with an integrated capability. This system will decrease the aircrew workload by consolidating the controls and threat displays for multiple subsystems, and provide better threat identification and countermeasures response capability.

■ For the U.S. Air Force Special Operations Command, GTRI engineers helped develop the C-130 Electronic Warfare (EW) Bus System, an integrated electronic countermeasures suite for the C-130 aircraft with centralized display and control. Two primary functions of this bus system are to report threats for display on an electronic warfare officer display unit, and to control threat responses. The threat-response process implements the correlation and response management functions within the EW bus processor. The EW bus also implements an embedded-training function to simulate the operation of threat systems without requiring threat generators.

GRAPHIC COURTESY JIM COLEMAN

Via the Wildcat Logistics Distribution Management System, GTRI is helping the U.S. Army more effectively manage its horizontal and vertical supply distribution processes.

■ Engineers from GTRI are conducting research to characterize and evaluate infrared defensive systems alternatives for the C-130 aircraft, used for military and other support worldwide in hostile environments containing a variety of infrared (IR) threat systems. Georgia Tech, which has been involved in many previous C-130 IR countermeasures effectiveness evaluations, is using all existing information, models and databases to evaluate the effectiveness of several current countermeasures used aboard the C-130.

■ The component retirement times for helicopter dynamic components are calculated from the strength of the components as measured in the laboratory, the loads on these components as measured in flight test, and the estimated frequency of occurrence and magnitude of these loads during usage. A GTRI-led team installed instruments in six Air Force HH-60G helicopters and tracked usage during actual search-and-rescue missions for more than 1,400 flight hours over 20 months. The investigators used GTRI-developed regime-recognition algorithms to analyze usage data. The survey findings will result in new component retirement times based on actual measured usage that both enhance safety and reduce operating cost.

■ GTRI recently provided the U.S. Air Force with an airborne radar target generator system for testing and developing advanced airborne radar. The pod-mounted system will be initially mounted on an AT-38 aircraft and is compatible with other aircraft, such as the F-15 and F-16. The system generates simulated targets that appear as true airborne targets, created by accurately repeating the waveform received from an airborne pulse Doppler radar and applying computer-controlled variations. Using a graphical interface on a laptop computer, users can specify the parameters of the 15 simulated target scenarios available during a single flight test.

■ Engineers from GTRI have been working on a Defense Advanced Research Projects Agency target measurement program called Semi-Automated Imint Processing (SAIP). In support of SAIP, a semi-automated target recognition effort, investigators collected high-resolution, full polarimetric inverse synthetic-aperture radar data for numerous targets. This data aids

template generation for the target identification aspect of the program.

■ GTRI researchers are part of a team developing a unique PC-based flight simulator for the F-16, T-1A and T-38 aircraft. GTRI provides high-fidelity aircraft mathematical models for the research, which is currently being used to quantify detrimental effects of prescription drugs on piloting skills. The simulation program was recently moved from the DOS operating system to Windows to allow faster and more precise sampling of the pilot controls, speedy updating of graphical images, and fully rendered 3-D graphical images that are compatible with thousands of existing "scenery" files.

■ This year GTRI completed final design and development of the Bistatic Coherent Measurement System (BICOMS), a state-of-the-art broadband, monostatic and bistatic radar cross-section measurement system for the Air Force. BICOMS is a distributed radar system consisting of instrumentation located at three primary sites: a mobile radar unit (MRU), a fixed radar unit (FRU) and target pit areas. Timing, control and bistatic coherency are obtained by linking the sites through fiber-optic links. During FY 98, all subsystems were developed and integrated into the MRU and FRU; the systems were tested at GTRI's Cobb County Research Facility and shipped to the Air Force's measurement facility for installation, testing and training. BICOMS is scheduled to be operational on January 15, 1999.

■ GTRI has begun work on the Realistic Operational Communications Scenarios System program for the U.S. Marine Corps. Investigators are developing a system concept and defined functions that will support the test and evaluation of Marine Corps tactical data networks. The program's purpose is to evaluate Marine Corps data network function under accurately simulated battlefield conditions.

■ GTRI saw successful completion this year of the Defensive Airborne Missile Electronic-Countermeasure System (DAMES) for the U.S. Air Force. Originated by GTRI scientists, the DAMES concept has gone through 10 years of development and testing. GTRI assisted in recent live-fire tests conducted over the Gulf of Mexico in which an F-15 fired five missiles against an F-106 that was protected by the DAMES equipment. The tests were highly successful, with no losses to the airborne instrumentation or aircraft.

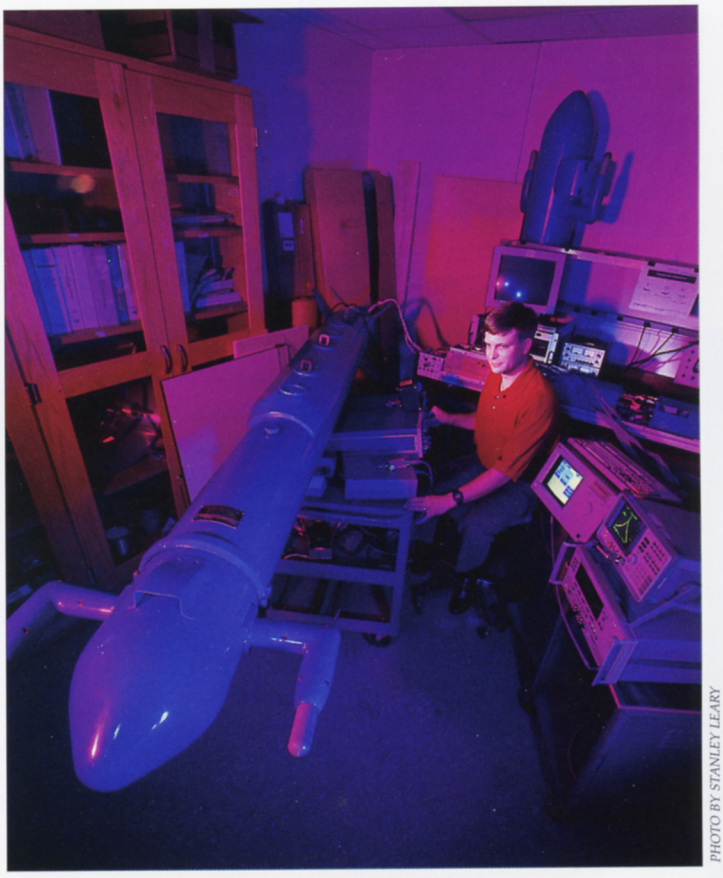


PHOTO BY STANLEY LEARY

The airborne radar target generator system that will be enclosed in this pod and mounted on an AT-38 aircraft will be used to test and develop advanced airborne radar.

■ GTRI researchers are helping advance communications technology through several projects. One is development of military wireless systems for tactical applications, which includes implementation of a unique communications waveform that can adapt to the radio-frequency environment through the use of wavelets and other signal processing techniques.

■ In another project supporting military operations, GTRI is conducting a top-down examination of U.S. Army base telecommunications infrastructure. The aim is to enable investments in new networking technology that will be supportable well into the 21st century while allowing rapid deployment of Army troops anywhere in the world with links back to critical command resources.

■ Researchers are also continuing to develop innovative network transport technologies designed to make transfer of data more reliable, secure and manageable. One method, called spread routing, blends aspects of networking technology with state-of-the-art spread-spectrum technology used in wireless communications, particularly in the military. In other transport technology research, GTRI is examining quality-of-service in today's Asynchronous Transfer Mode networks to support ever-higher demands on networks due to Internet growth.

■ Human factors researchers at GTRI are helping upgrade the AH-1W and UH-1N helicopters for the U.S. Marine Corps. The H-1 Upgrade Program is concerned with modernizing the drive trains, cockpits and avionics suites for the AH-1W and UH-1N. GTRI is supporting the cockpit upgrade, focusing on implementation of the advanced features of tomorrow's cockpits: integrated digital maps, tactical digital communications and systems management.

■ GTRI is exploring the potential applications of plasma arc technology — plasma, which occurs naturally as lightning, is an ionized gas of 12,000 C created by converting electric energy to thermal energy. Current GTRI research applies the plasma torch to destruction of buried chemical and biological wastes, soil stabilization, and landfill and contaminated soil remediation.

Prescription Realism

Challenge:

Determining whether prescription and over-the-counter drugs can affect pilot performance in the cockpit. Traditional flight simulators are expensive and are not designed for drug impairment studies.

Solution:

GTRI assisted NTI Inc. of Dayton, OH, in creating a realistic flight simulator that runs on an off-the-shelf personal computer in near real time. The simulator collects data on pilot actions, which will help scientists determine if and when common medications affect pilot performance.

PHOTO BY STANLEY LEARY

This inexpensive, realistic flight simulator helps scientists determine if and when common medications affect pilot performance.

Solutions for the World

GTRI's research has an impact far beyond laboratory walls. Results not only address specific challenges or goals, they can change things around the world. From new ways of doing things to making old things new again, FY 98 research provided innovative solutions for the globe.

■ How do you transform a complex, older aircraft requiring a three-person crew into a state-of-the-art system with a crew of two? GTRI human factors experts worked with Litton Corporation and Kaman Aerospace to do just that for the SeaSprite helicopters of the Royal Australian Navy (RAN). The researchers focused on the design of controls and displays that will be the heart of the new system. They worked with RAN aircrews to develop the design, so meshing of machine and people is smooth and seamless.

■ Work on GTRI's FutureCar has evolved into several new areas. More than 30 years' experience using pneumatic aerodynamics to replace large lift/control surfaces such as aircraft flaps is now being applied to diverse ground vehicles. Research into heavy vehicle applications such as tractor-trailers and buses for the Department of Energy is being funded, and a proprietary effort for a Formula 1 racing team is nearing completion. In each case, the focus is improving aerodynamics, control and fuel efficiency. What is now being done for racing and commercial vehicles may soon find its way onto everyday vehicles.

■ Homes and offices could benefit from GTRI's studies of volatile organic compound emissions from fungi growing on different types of building materials. With Georgia State University colleagues, researchers are examining whether changes in such emissions — which can cause indoor air quality problems known collectively as the "Sick Building Syndrome" — are correlated with nutrient base, colony age, fungal species, light cycles and humidity. Long-term plans call for investigating the effect of biocides on volatile emissions and fungal growth.

A unique antenna developed by GTRI researchers was designed for out-of-this-world performance. The two-foot-long device will be placed inside the crew lock of the NASA-led International Space Station, allowing space station communication with wearers of Russian-designed space suits. These suits operate on a frequency much lower than that of U.S. communications gear, and so require a special design that must also function as a handhold for the crew. Researchers produced a design that met all the requirements.

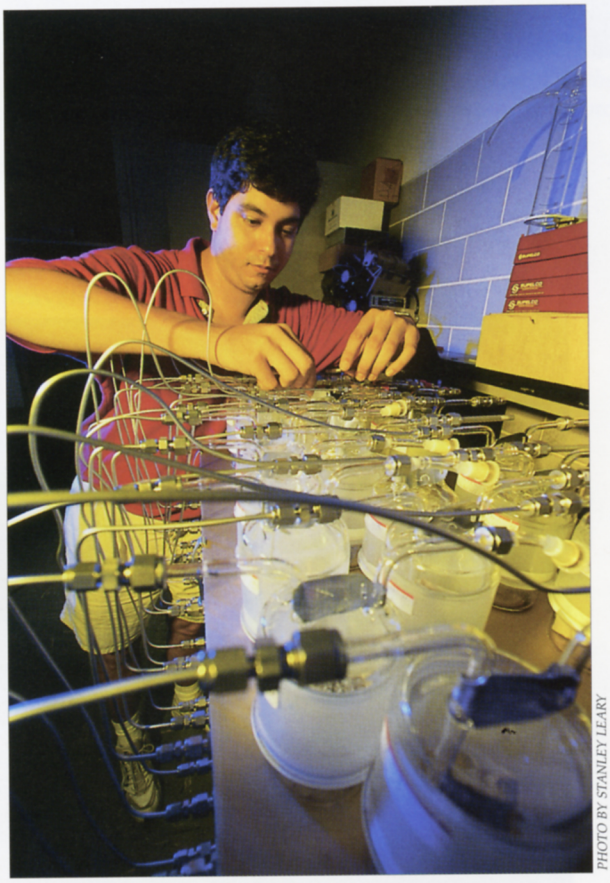


PHOTO BY STANLEY LEARY

Researchers are studying variations in volatile organic compound emissions from fungi growing on different types of building materials.

■ Understanding atmospheric chemistry is crucial to meeting challenges posed by natural and human changes. With support from the National Science Foundation, GTRI researchers

PHOTO BY STANLEY LEARY

GTRI researchers developed a unique radiator and radiator feed design for a very low-cost, flat-panel, electronically steerable phased-array antenna.

investigated and expanded knowledge of sulfur compound reactions in the troposphere, and potential new atmospheric sources and sinks of nitrous oxide. Nitrous oxide is a greenhouse gas and is central to the catalytic chemistry that destroys stratospheric ozone.

■ 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. GTRI researchers are providing system engineering support to the verification and validation process for AN/ALR-46(V) and AN/ALR-69(V) radar warning receivers being prepared for allies at the Warner Robins Air Logistics Center. This support is speeding up software testing, making possible timely deliveries of these crucial units.

■ Phased arrays offer advanced capability for radar and communications antenna systems. As part of the Flat Panel Array Consortium, a group of industry leaders funded by the Defense Advanced Research Projects Agency, GTRI is creating a very low-cost, flat panel, electronically steerable phased-array antenna for military and civilian use. GTRI researchers developed a unique radiator and radiator feed design that will improve performance while reducing the complexity and cost of manufacturing. The initial application is to provide communications for aircraft with the MILSTAR and GBS satellite systems.

PHOTO BY STANLEY LEARY

GTRI human factors experts helped design the controls and displays at the heart of the Royal Australian Navy's redesigned SeaSprite helicopters.

Solutions for Industry

Having recognized a need to diversify its customer base, GTRI has devoted additional resources to increasing its non-governmental, industry market share over the last two years. As a result, GTRI's percentage of industry awards has grown from less than 2 percent in 1996 to nearly 8 percent in FY 98. At the same time GTRI enhanced its commercial outreach program through its annual Industry and Technology Day, doubling attendance at that event from 1997 to 1998.

The innovative solutions that resulted from GTRI's new and ongoing research for industry paid dividends in many areas. Researchers developed demonstration prototypes for a new telecommunications product, made advances in a rapid charging process for batteries and moved a photonics-based pollution sensor closer to the commercial marketplace. Work continued on new phosphor materials, electromagnetic protection for devices, new technology for agricultural companies and aerospace research applications for industry.

■ Wavelength Division Multiplexing (WDM) will be instrumental in bridging the gap between the maximum possible speed of electronics and the virtually unlimited bandwidth available within the optical medium. While new products recently have been introduced to convert high-speed electronic signals to the optical domain and subsequently multiplex them over fibers, GTRI researchers are designing and prototyping the next generation of all-optical switching equipment using WDM.

■ Packet-switched networks traditionally have been designed for efficient data forwarding, including only a minimum of processing for functions such as basic congestion control. With Georgia Tech's College of Computing, GTRI researchers are designing "active networks" which allow users to dynamically and efficiently introduce new capabilities within a network upon demand.

■ GTRI research into pulsed battery charging — originally for improving charging rates for lead-acid vehicle batteries — also appears to have benefits for rapid and slow charging of cellular telephone and other types of batteries. Researchers designed and fabricated a test charging system that uses a proprietary waveform during the charging process. The system was employed successfully in various testing scenarios.

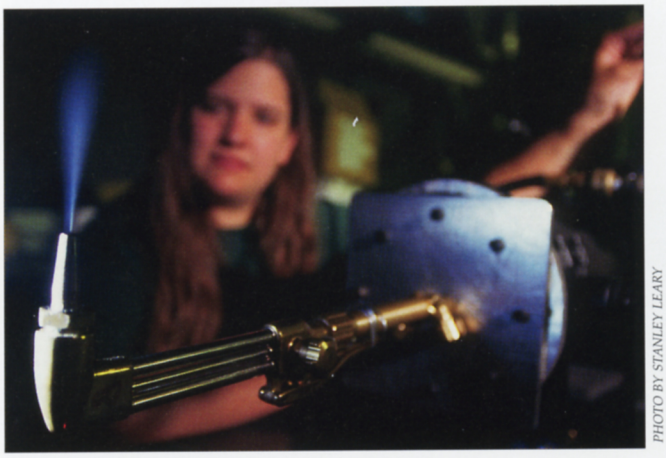


PHOTO BY STANLEY LEARY

Using aerodynamics testing, researchers will determine whether changes in nozzle design will enhance metal-cutting flame torches.

■ GTRI-developed optical sensor technology is the basis for the E-SMART environmental monitoring and analysis system being commercialized by Atlanta-based Photonic Sensor Systems Inc. Consisting of integrated optic chemical sensors and data management hardware and software, the system operates in real time to measure low levels of contaminants. During FY 98, GTRI supported company efforts to move the system into the commercial marketplace.

■ Through the Phosphor Technology Center of Excellence, researchers progressed significantly toward developing a new phosphor material for use as a blue emitter. By analyzing defects and energy-transfer processes in these strontium sulfide materials, researchers developed improved stoichiometry and new luminescent activator systems. Center scientists also began new programs in thin film phosphors for image intensifiers and small-scale field emission device displays.

■ As electronic components become smaller and smarter, they allow development of

On-Location Environmental Monitoring

PHOTO BY STANLEY LEARY

The E-SMART environmental monitoring and analysis system measures low levels of contaminants on site in real time.

Challenge:

Developing an efficient, less expensive way to perform environmental monitoring. Traditionally technicians collected samples at the site of contamination and brought them to a lab for testing – an expensive, time-consuming process.

Solution:

Smart, integrated optic interferometric sensors developed at GTRI and patented in 1997. E-SMART continuously measures chemical contaminants at the site of contamination.

increasingly sophisticated pacemakers and other implantable medical devices. At the same time, theft concerns have expanded electronic article surveillance systems use, which generate fields of electromagnetic energy during operation. Through the EAS/Medical Device E3 Test Center, GTRI researchers worked with manufacturers of both types of systems to understand and help prevent potentially harmful interactions.

■ In a separate program, researchers are helping an industrial sponsor meet electromagnetic vulnerability standards necessary for products sold in Europe. Meeting the standards, which are similar to, but not as severe as, requirements for military equipment, will help the company produce more robust products and compete globally.

■ Through the Agricultural Technology Research Program (ATRP), GTRI supported the poultry industry in addressing key labor availability and worker injury challenges. Researchers successfully field tested the Intelligent Integrated Belt Manipulator, a low-cost robot for moving packaged poultry into packing cartons, and began development of an intelligent product-transfer system to automate the transfer of live birds from conveyor to shackle lines. They also conducted field studies using the Ergonomic Work Assessment System to identify measurable cutting mechanics, which can influence formation of repetitive motion injuries. ATRP further supported research for the industry in information, food safety and environmental technologies.

■ For an aeronautics company's C-130J program, GTRI provided test and integration support assistance. Researchers conducted avionics system analysis, identified educational needs and taught short courses for avionics personnel.

■ Recently begun work will help a company remotely detect wooden power pole components that need replacing. Researchers are studying two techniques for distinguishing the rotted wooden crossbars using vibratory response or the spectrum of reflected light. Both would use aircraft-mounted sensors and a neural network algorithm for interpreting data. The work is being conducted through the National Electric Energy Testing, Research and Applications Center.

■ New research also will help manufacturers of metal-cutting flame torches. Using aerodynamics testing, researchers will determine whether changes in nozzle and mixer design can reduce flame damage to the torch and offer finer, more efficient cutting power.

■ With funding from the Veterans Affairs Rehabilitation Research and Development Center, researchers assisted two area nursing homes in defining and addressing indoor noise levels. After making noise measurements, they began researching and testing different materials for use in noise-absorbing "quiet curtains" for the homes.

Solutions for Education

Dedication to education has been a cornerstone of GTRI's operations since its inception. From kindergartens to colleges and industries, GTRI has long provided innovative solutions for learning and for the environments where learning takes place.

■ During FY 98, GTRI provided a number of important services to K-12 education in Georgia. Foundations for the Future (F3), a partnership between higher education and industry that promotes K-12 telecommunications access in Georgia, was responsible for several developments in this area. A "classroom of the future," called the F3 Forum and funded by AT&T, was installed at the Georgia Public Broadcasting facility in Atlanta. The classroom contains state-of-the-art wireless digital equipment to support training efforts. F3 also co-sponsored a statewide conference addressing the potential impacts of the Universal Service Fund on Georgia schools and libraries. More than 300 people participated.

■ Middle and high school students are learning more about Georgia's poultry industry while developing important math and science skills thanks to "PoultryPlus," an interactive CD-ROM. Developed by GTRI researchers with educational and industry collaborators, PoultryPlus is being field tested at more than 35 Georgia schools; plans to license the CD for commercial release are in progress.

■ GTRI research is benefiting classrooms, as well as the instruction offered in them. In FY 98 researchers began investigating the importance of active humidity control and continuous ventilation to indoor air quality (IAQ) in schools. One of the few IAQ studies in schools designed to produce statistically significant data, the investigation's results will be important to President Bill Clinton's school improvements initiative.

■ The many laboratories and programs of GTRI provide excellent learning opportunities for dozens of students and professionals each year seeking research experience. One notable visitor to GTRI during FY 98 was Sabrina Greco. After completing her doctorate at the University of Pisa, Italy, Greco spent six months working with Jim Sangston of GTRI's Sensors and Electromagnetic Applications Laboratory, studying radar target detection in non-Gaussian sea clutter. The results of their collaboration will be presented at the 1999 National Radar Conference.

■ GTRI research also helps educate people on the job, as is the case with the Factory Automation Support Technology wearable computer system. The system provides hands-free mobile access to electronic maintenance and repair manuals. Researchers also are developing live, two-way video conferencing capabilities that enable remote experts to support technicians as they repair malfunctioning equipment on the factory floor.

■ On another education front, researchers are developing an activity based costing (ABC) study model for industry, government and academia. The computer-based automated system guides the conduct of the study effort — or, for those who have no experience with ABC studies, the model provides step-by-step instructions for conducting the study. The basic concept for the model was designed at GTRI during the last fiscal year; a detailed design is in progress.

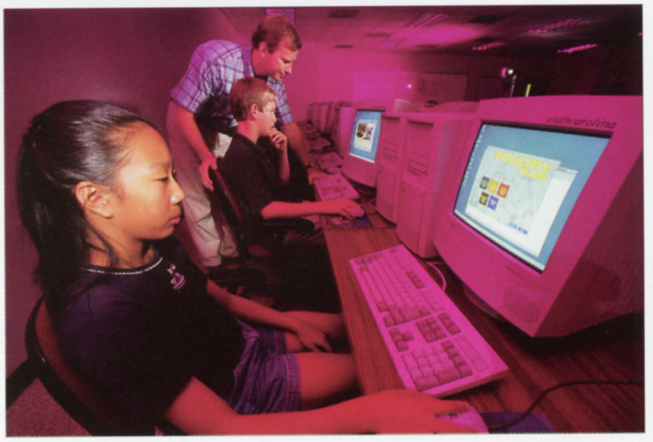


PHOTO BY STANLEY LEARY

Middle and high school students are learning more about Georgia's poultry industry while developing important math and science skills thanks to the "PoultryPlus" interactive CD-ROM.

Leveraging Georgia Tech's Power for Solutions

GTRI researchers regularly collaborate with colleagues in Georgia Tech's schools and colleges, as well as with those in industry, the state and other academic entities. These alliances enhance service and provide vital, innovative solutions for the state, the nation and the world. Many important FY 98 accomplishments resulted from campus collaborative efforts.

■ Working with the Center for Integrating Science, Mathematics and Computing, Georgia Tech's K-12 outreach unit, GTRI became a franchise of GLOBE — Global Learning and Observations to Benefit the Environment. This federally funded project collects environmental data for use by the world science community while teaching students valuable math and science skills. The new GLOBE program involves subject matter experts from GTRI, Georgia Tech schools and colleges, and other organizations.

■ With colleagues from Georgia Tech's School of Public Policy and George Mason University, GTRI researchers are helping the U.S. Air Force explore public-private enterprise arrangements. Researchers will analyze various privatization options and examine the multiple managerial, legal and contractual issues involved in privatization schemes.

■ GTRI researchers also are collaborating with campus colleagues on the new Georgia Tech Information Security Center, announced during FY 98. GTRI researchers offer expertise in projects relating to security in a variety of networks; are helping create a standard methodology for evaluating the security of a network system; and are applying neural networks to solving information security challenges.

■ With help from the Georgia Tech's Advanced Technology Development Center, researchers are commercializing a new hydrogel air-cleaning media they invented and patented. Preliminary testing shows the prototype system removes 50 percent of respirable-sized airborne particles and 80 percent to 90 percent of gaseous air pollutants. FY 98 research was aimed at advancing the work such that it can become a commercial product.

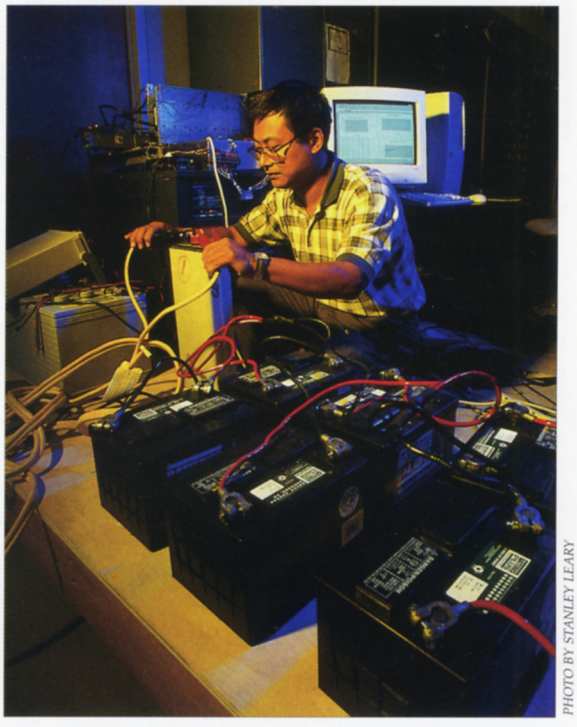


PHOTO BY STANLEY LEARY

Researchers are designing a fast, energy-efficient charging algorithm for commercial batteries used in heavy electric vehicles. The work also has applications for consumer products.

■ GTRI researchers also posted technical achievements working with off-campus colleagues. Collaborating with Georgia's Food Processing Advisory Council (FoodPAC), GTRI developed G.E.O.R.G.E. (Grapefruit Evaluation with On-line Recognition Grading Environment), a software program that inspects grapefruit at very high line speeds and identifies quality flaws. The team also worked with Durand-Wayland, a Georgia equipment manufacturer, on this project.

■ In another FoodPAC project, GTRI researchers began modifying the Intelligent Integrated Belt Manipulator (IIBM). The redesign will make the IIBM useful as an automatic robotic packaging system for putting bagged frozen product into individual cartons.

■ Defense Advanced Research Projects Agency funded research conducted through the Southern Coalition for Advanced Transportation focuses on designing a fast, energy-efficient charging algorithm for commercial batteries used in heavy electric vehicles. The charging technique will benefit all electric vehicles requiring rapid charging, specifically buses and military tanks. The work also has applications for consumer products, including laptop computers, cellular phones and industrial forklifts.

■ GTRI, other research institutes and several universities collaborated on a project to model hybrid electric vehicles. The modeling and simulation tools generated will be used by the Department of Defense to predict vehicle performance and guide investment decisions on new technologies.

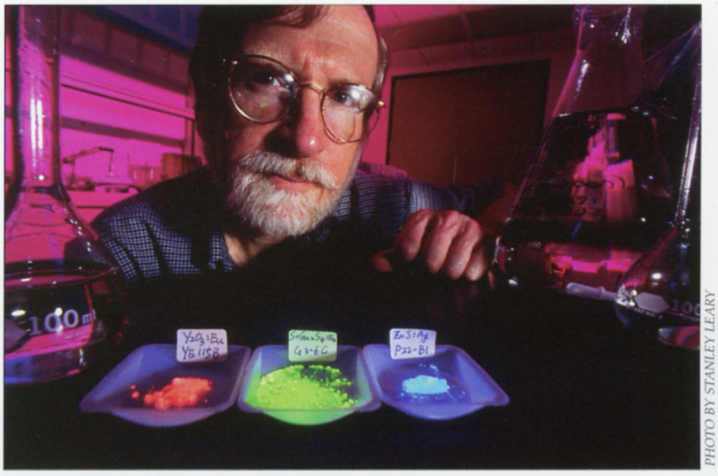
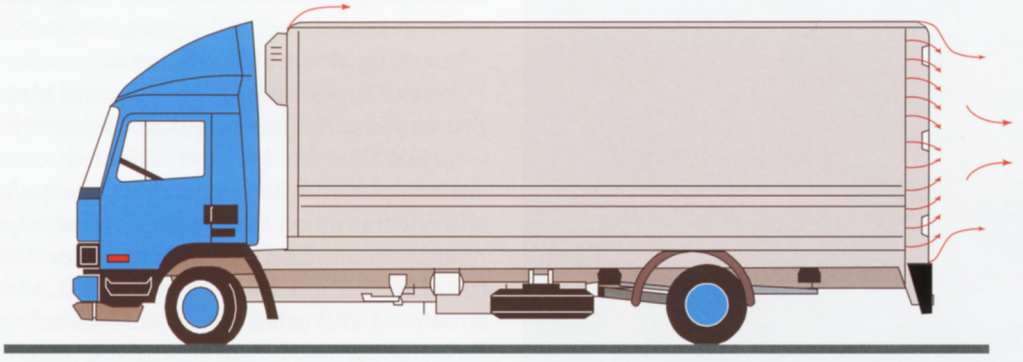
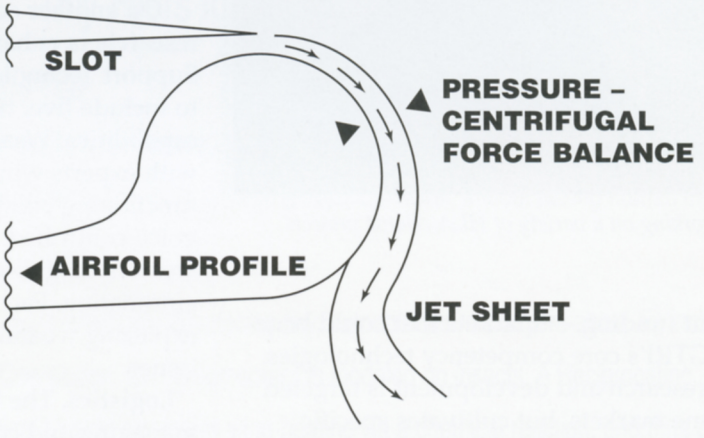


PHOTO BY STANLEY LEARY

Researchers develop new phosphor materials through the Phosphor Technology Center of Excellence.



TANGENTIAL BLOWING OVER ROUNDED COANDA SURFACE



GRAPHIC COURTESY DAVID PAREKH AND KAY LINDSEY

Active flow control helps control performance-limiting physical phenomena such as turbulence and flow separation.

Tomorrow's Solutions

GTRI explores potential new and innovative research solutions via new initiative groups, and internal research and development. New initiative groups are teams of researchers from GTRI, Georgia Tech's schools and colleges, other universities and industries. They identify and pursue research markets with significant funding — markets that could benefit from GTRI's core competency technologies. Internal research and development is targeted at the same markets, but cultivates specific research projects.

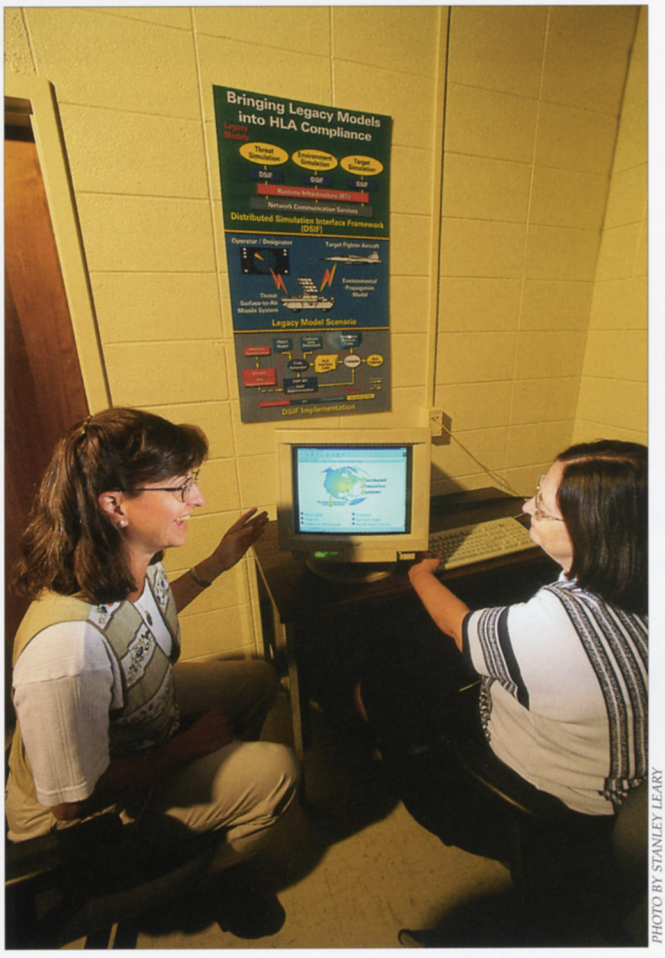


PHOTO BY STANLEY LEARY

Researchers are working on a variety of HLA-related projects.

New Initiatives

Law Enforcement, Corrections and Courts Technologies. During FY 98 GTRI researchers fine-tuned a database for the Georgia courts system, and honed technology that allows law enforcement officials to combat drug traffic in the Southwestern border states. Plans for FY 99 include extending the courts automation program to other court levels, states and state agencies; expanding the counter-drug program to additional states and regions; and commercializing technologies. Researchers also will develop tools for the battle against chemical and biological warfare by using sensors that can detect drugs, selected chemical compounds, explosives and harmful agents in water.

Learning Technology. Foundations for the Future (F3), a joint project including Morris Brown Research Institute, the University of Georgia, EduLinc Inc. and GTRI, educated Atlanta public school teachers, principals and administrators on classroom computer use and related issues. The F3 Forum, a classroom of the future, introduced the latest wireless, video streaming and other classroom technologies. Researchers also began producing a technology awareness video for K-12 school administrators. More than $2 million in grant money for 18 Georgia school systems was generated with technical assistance from researchers in this program.

On another education research frontier, researchers enhanced the Factory Automation Support Technology wearable computer system to include live, two-way video-conferencing capabilities. Wearers can collaborate remotely with experts worldwide while repairing malfunctioning equipment. Other research includes voice-controlled 3-D scenes and objects to help wearers diagnose, repair and maintain complex automation. Factory field trials continue, exploring wearable computer-human interface issues.

Logistics. The U.S. Army is more effectively managing and controlling its supply distribution processes with logistics assistance from GTRI. Using the GTRI-developed Wildcat

computerized tracking system, managers access in real time the status of supply redistribution, progress of the issue, and transport and receipt of goods. They employ user-friendly software, wireless data communications, and business process analysis and management tools. Phase 1 of the program provides central management for redistribution of assets throughout Fort Hood, TX. Phase 2 transitions the system to the new Global Combat Support System-Army environment and extends the capability to 11 additional Army installations in the United States and Europe.

Modeling and Simulation. Current work includes High-Level Architecture (HLA) Testing and Time Management Support, as well as development of an HLA Federation Verification Tool.

GTRI researchers are members of the Simulation Interoperability Standards organization, participating in the IEEE Standards Development Group for HLA and the Simulation Interoperability Workshop forums. Researchers also are applying self-description techniques to data interchange formats for modeling and simulation used throughout the U.S. Department of Defense.

Simulation research also is being focused on the newest U.S. Air Force Training Initiative, the Distributed Mission Training (DMT) system. Current tasking examines the feasibility of integrating unmanned aerial vehicle simulation systems into the DMT network.

Internal Research

Micro Air Vehicles. Researchers continued developing a six-inch micro air vehicle that could be used in warfare, agriculture, and environmental areas. The "Entomopter" moves with help from a Reciprocating Chemical Muscle, which generates wing-beating via a chemical reaction. Patents have been submitted for various components of the flying machine, and various wing designs are now being tested.

High-Level Architecture Work. In the area of distributed simulation systems, GTRI developed and demonstrated a High-Level Architecture simulation interface software framework. The Department of Defense, a major user of computer simulations, now requires that all its models and simulations be brought into compliance with HLA or retired. Developing the framework means GTRI can make its simulations compliant, and help government and commercial organizations do the same.

Phased Array Radar. Another FY 98 project explored the use of phased array radar for tracking aircraft and monitoring weather. As part of that project, researchers developed T-BAT, a new spreadsheet-based radar timeline analysis tool. T-BAT allows users to plan and assess the feasibility of radar resource allocation — a function that will become critical if phased-array-radars are adapted for multifunction use at civilian airports.

Tiny Fliers for the Future

PHOTO COURTESY ROB MICHELSON

A single plastic Entomopter wing structure with interstitial film.

Challenge:

Gathering data for warfare, agriculture and environmental uses – for example, searching for survivors in a building after a disaster without risking human lives.

Solution:

GTRI researchers are developing tiny, autonomous microflyers about six inches long. One design, the "Entomopter," is modeled on insects. A Reciprocating Chemical Muscle generates wing-beating via a chemical reaction, and thus propels the craft.

External Advisory Council

The Georgia Tech Research Institute External Advisory Council advises the organization on strategies and programs that will help GTRI meet challenges and attain goals. The Council is composed of proven local and national leaders in industry, research, government and academia. The Council normally meets twice a year, with ad hoc meetings on specific issues convened as necessary.

The Council's mission is to:

- Advise and make recommendations on programs that will help achieve objectives specified in GTRI's strategic plan.
- Review the applicability and viability of research and economic thrusts, given national priorities, and provide guidance in strategic business development.
- Offer guidance in recruiting key research personnel and setting standards of excellence for GTRI programs.
- Help determine a balance in allocating GTRI discretionary assets among priorities such as program development, internal research and equipment allocations.
- Help link GTRI to evolving national research, industry and educational priorities.

PHOTO BY STANLEY LEARY

Seated, L-R: Gerald Dinneen, U.S. National Academy of Engineering (retired); Gen. Gerald Carey (USAF, retired); state Sen. James Tysinger; William Todd, founding president, Georgia Research Alliance. Standing, L-R: state Rep. Richard Royal; Ben Dyer, president, Intellimedia Commerce Inc.; Joseph Saloom, consultant in technology; Gen. Tom Marsh (USAF, retired), director and chairman of the board, CAE Electronics Inc. and Converse Government Systems Corporation; Edward K. Reedy, vice president and director, GTRI. Not pictured: Robert Cooper, president, CEO and chairman/board of directors, Atlantic Aerospace Electronics Corporation; Allan Ecker, senior vice president of technical operations and chief technical officer, Scientific Atlanta; John Fabian, president and CEO, Anser Corporation; Jerry Tuttle, senior vice president, ManTech International, and president, ManTech Systems Engineering Corporation; and John Welch, executive vice president, Burdeshaw Associates Ltd.

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