The GTRI Connector

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Gems of wisdom

• It is better to walk in a straight line than to travel in the best of circles.
— *Anonymous*

• Express an opinion, but send advice by freight.
— *Charles Clark Munn*

• Appreciation is like an insurance policy. It has to be renewed every now and then.
— *Dave McIntyre*

GTRI wins top security award

By Martha Ann Stegar, RCO

GTRI and Georgia Tech have received the ultimate recognition in the world of industrial security—the Cogswell Award.

The awards were announced by the Defense Investigative Service (DIS) June 30 at a ceremony in Dallas, Texas. Accepting the award for Georgia Tech were Research Security Director Bob Lang and GTRI Assistant Director Pat O'Hare, who attended on behalf of GTRI Director Don Grace. The Southeastern Regional Office of DIS is arranging an individual plaque presentation at Georgia Tech in August.

Of the 11,600 Department of Defense-cleared facilities in the United States that were eligible to compete, only 42 won the award. GTRI was by far the most complex installation to receive the award, according to O'Hare. Most of the other winners were small companies or small departments of large companies.

"It's unusual for a large facility to get the award," says Lang, "and Georgia Tech has never gotten it before." Tech is rated a 'super-A' facility in size and complexity because of the wide variety and diversity of its programs, he explains. "For instance, we have over 100 cleared computers here. The possibility for error is enormous," he says.

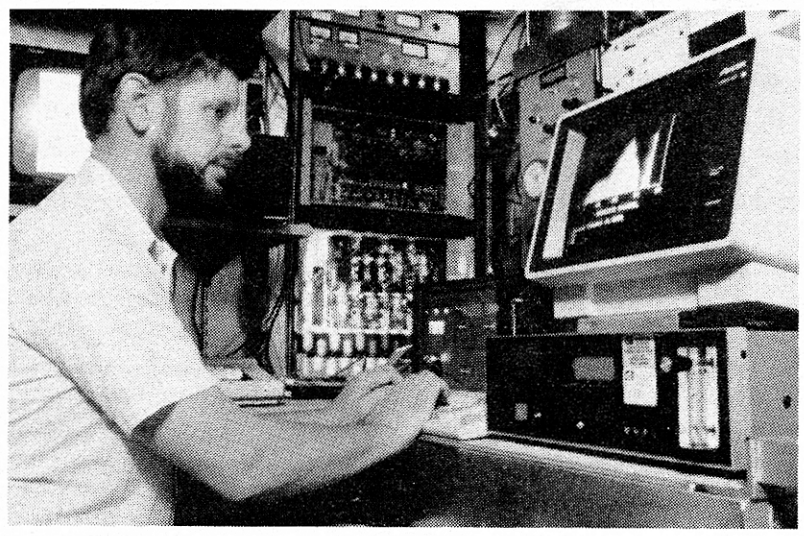
Georgia Tech didn't win solely because of its zero-deficiency inspection last March, Lang stresses. Even to be nominated, a contractor must have a good security program over a long period. The program also is judged on the basis of the knowledge and broad involvement of the facility officer (security director); the level of upper management support; stringent federal audits; and most importantly, the security awareness of the employees.

In giving the award, DIS made special note of the executive support given to industrial security by Don Grace and the fine job of managing in difficult times by Bob Lang, O'Hare says.

Georgia Tech was nominated by Virgil Hill, who was Tech's DIS representative for several years and is now field chief. "Virgil helped us grow to this stature," says Lang.

But Lang gives the lion's share of the credit to the many Tech employees involved in security. "It's our people knowing what to do and then doing it that makes the program work," he emphasizes. "Thanks are due to everybody for their alertness and conscientious efforts."

In addition to the honor, some practical benefits do accrue from receiving the award. "We won't get inspected for a year from the award date," Lang says. "However, our internal self-inspections are heavily relied upon at this time. Another advantage is that we and OCA can point to the award when describing our security posture in our proposals." ❑



Understanding the lower atmosphere

By John Toon, RCO

A comparison of two independent analytical techniques (one of them devised at GTRI) has given scientists new confidence in their ability to measure concentrations of a molecule which plays a key role in controlling several greenhouse and ozone-depleting gases in the lower atmosphere.

The comparison demonstrated that atmospheric chemists can now measure the OH (hydroxyl) radical well enough to test complex atmospheric photochemistry models, researchers from the National Oceanic and Atmospheric Administration (NOAA) and GTRI reported in the May 22 issue of *Science* magazine.

Continued on page 2

Fred Eisele uses a mass spectrometer in GTRI's mobile laboratory as part of an ion-assisted technique to measure concentrations of the hydroxyl radical in the lower atmosphere. (Photo by Joe Schwartz)

Observed & Noted

GTRI engineers advised the Georgia Tech student team that won first place in the Aerial Robotics Competition last month. Read what members of both winning Georgia Tech teams have to say about what they learned from the experience. *See pages 2 and 3.*

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What's new at ATDC? Director Wayne Hodges looks back at ATDC's progress over the dozen years since its inception and shares his plans for its future *on page 4.*

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ATDC has nurtured many fledgling spin-off companies from Georgia Tech research. Companies with a Georgia Tech connection are briefly described *on pages 4 and 5.*

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This month, **Spotlight on Internal Research** focuses on an improved method of testing phased-array antennas devised by GTRI researchers in RSAL and MATDL. *Details are on page 6.*

■

Do you need to use expensive Electronic Design Automation software from time to time? You can acquire it cheaply through a coordinated purchase plan being promoted by ESML. *Read pages 6 and 7 for the full story.*

■

On page 7, **Professional Activities** include three who received master's degrees in June: Rosemary Hall (EDL), Mark Hodges (RCO), and Duane Patterson (TSDL). Congratulations to them!

■

Take me out to the ball game! If you want to see Braves games at discounted prices, Harry Ross is the man to contact. *See page 8.*

■

Also on page 8, read about Bob Willoughby's retirement from ESML and Vickie Fennell's appointment as manager of the Baker MAPS unit.

Georgia Tech
RESEARCH INSTITUTE

News & Notes

Atmosphere

From page 1

"For the first time, there is sufficient confidence in the accuracy of the OH measurements that scientists are starting to use them to test their photochemical models," says GTRI's Dr. Fred L. Eisele, who collaborated with NOAA's Dr. George H. Mount in the study.

In addition to the confidence resulting from the comparison, the OH concentrations measured by the scientists were lower than expected, presenting "a new challenge to chemical theories of the lower atmosphere," Mount notes.

The OH radical provides the primary means for destroying many atmospheric gases such as hydrocarbons, carbon monoxide, and nitrogen oxides. It also will be the primary mechanism for breaking down the new generation of refrigerants designed to replace CFCs. Before scientists can obtain a complete understanding of photochemistry in the troposphere, they must be able to measure OH accurately.

But because hydroxyl is so reactive, it exists in extremely low concentrations, making it difficult to measure. At least three techniques have been developed to study OH, but because of their complexity, many doubts have remained about their precision.

Comparison of measuring techniques allows better testing of atmospheric models

Measuring techniques compared

To verify the accuracy of existing measuring methods, NOAA and GTRI scientists measured OH concentrations simultaneously at NOAA's Fritz Peak Observatory in Colorado during the summer of 1991. They used two techniques: a long-path laser spectroscopic absorption technique devised at NOAA and an ion-assisted chemical analysis method developed by Eisele at GTRI. Despite the differences in the two techniques, the researchers found surprisingly good agreement in results, lending strong credibility to the two experiments.

"The two measurements seem to agree well, certainly within the limits of errors of the two instruments," Eisele says. "The agreement is very encouraging. I think the fact that these different measuring techniques agree suggests that neither technique is probably in error by very much."

The study was the first to successfully measure OH using two independent techniques. Eisele and Mount believe the results of the comparison will reduce much of the skepticism concerning accuracy of OH measuring techniques. Both techniques were developed within the past five years.

Review of models planned

The results, which provided comparable results in the study of both polluted and unpolluted air, also may lead to a review of models scientists now use to study atmospheric photochemistry.

The instruments measured less OH than was predicted by the models, suggesting that another unknown reaction may be depleting OH from the air. In the past, says Eisele, scientists studying such results would have questioned the OH measurement, but new confidence from the comparative studies may instead prompt a search for previously unknown chemical reactions which may be causing the discrepancy.

"It has brought us to the point that we are testing the models rather than questioning the measurements," he explains. "I think there is still some skepticism, but it has died down tremendously with the comparison of these two dramatically different techniques."

Even though the results suggest good comparison between the methods, Eisele and Mount hope to obtain additional funding to repeat the studies for OH and related photochemical species. They would also like to include a third OH measurement technique.

Because existing techniques measure OH near the ground where chemical reactions can be affected by surface conditions such as vegetation, scientists want to know how well the data represents atmospheric reactions which occur above the surface. To remove the effects of local vegetation, Eisele and Research Technologist David Tanner are monitoring OH concentrations at the Mauna Loa Observatory in Hawaii this summer.

Because of the observatory's altitude and remote location, it often receives unpolluted air from the middle of the troposphere (lower atmosphere). Eisele believes the results from Mauna Loa will be more representative of the chemistry which occurs in unpolluted areas of the lower atmosphere. ❑

Aerial robotics competition: it's more than just flying

By Lea McLees, RCO

This time last year, every college team planning to enter the June 19, 1992, Aerial Robotics Competition was determined to build a one-of-a-kind autonomous flying robot—one that would pick up metal disks from a bin, transport them over a barrier, and deposit the disks in another bin. No one had ever built a vehicle that could perform such a task.

The record still stands; although four of eight entries briefly flew autonomously, no vehicle completed the entire objective during the competition in Bobby Dodd Stadium. Nevertheless, members of the two Georgia Tech teams say the hundreds of hours they spent developing their vehicles were worthwhile—so much so that they plan to return to next year's competition.

"There's nothing like success to motivate people—the creative juices are flowing," says Chris Thompson of the Electro-Optics Lab, faculty adviser/organizer of Georgia Tech Team Two, which placed first on June 19.

"Most of the people on our team said we are so close to completing the task that they want to continue working now," says Mark Gordon, graduate student/aerospace engineering and leader of Tech Team One, which placed third. "We think we should be able to fly the mission."

Team Two won $5,000 for the autonomous performance of its "flying gyroscope." Team One took home $2,000 for its helicopter's autonomous flight. Second place and $3,000 went to a helicopter team from Southern College of Technology in Marietta.

Why try?

The chance to win all or a portion of the $10,000 prize offered each year is not the only motivation or benefit involved in the contest, participants say. Additional rewards exist for those long days, nights and vacations spent huddled with teammates trying to plan for every complexity inherent in small autonomous flying machines. Shayne Kondor of Team One, graduate student/aerospace engineering, gained a lot of practical experience.

"I learned how to manage aircraft operations and flight testing," he says. "It was forced experience—and it turned out to be fun."

Thompson agrees.

"The camaraderie was great," Thompson says. "But I also developed an appreciation for the immensity of the problem. The big military contractors spend millions of dollars a year trying to do this."

Rod Smith, junior/electrical engineering and a Team Two member, learned a lot about three-dimensional tracking and satisfied a desire to tinker with equipment, "doing things that haven't been done." Team One's David Hooke, graduate student/aerospace engineering, echoed the comments of members of both teams who said they liked working with people in other engineering disciplines.

"If you know what goes into doing something you're not familiar with—coating balsa wood with composites, for example—you are more understanding," he comments.

Both groups solved a lot of potential problems as they readied their vehicles for competition. Team One developed two radio transmitters for its kit helicopter: one for the pilot to use during manual flight and one that was linked to the computer that guided the helicopter when it flew autonomously. The group also perfected a way of making their vehicle carry twice as much payload as it was designed for—but the modifications they made are a secret, they say.

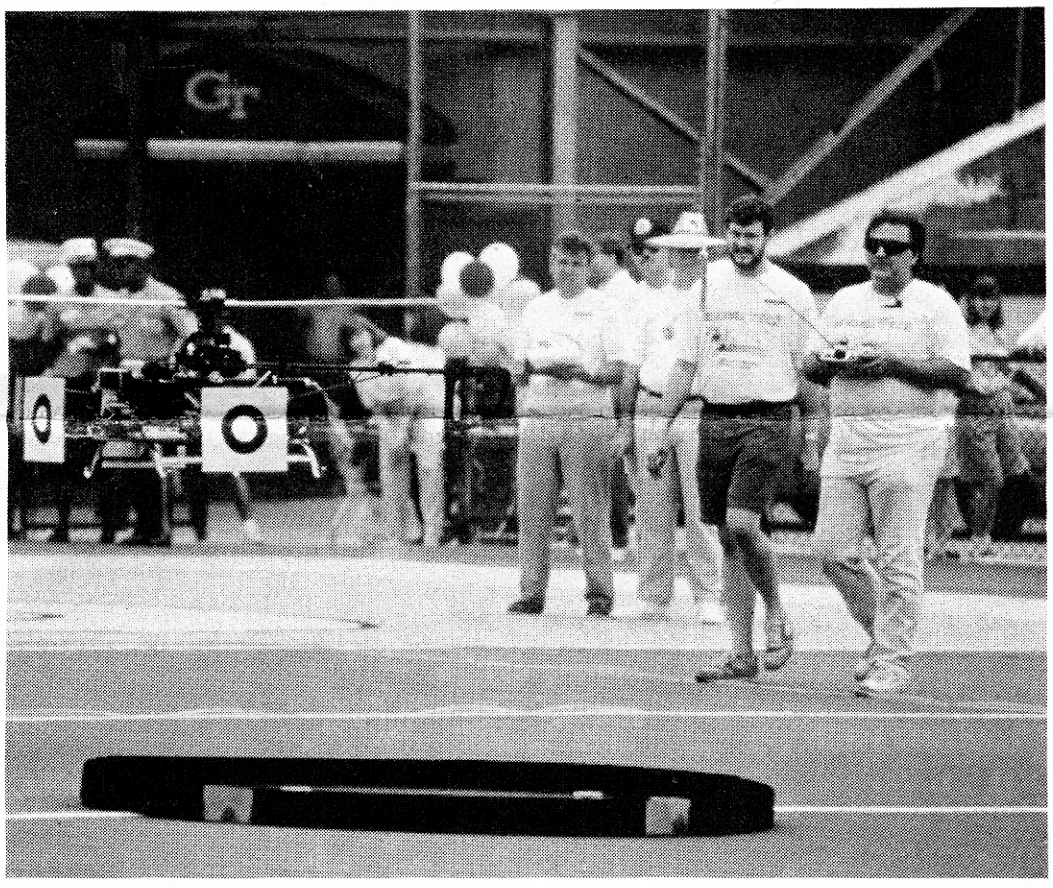
Team Two started with $30 worth of parts from a Turboplan, a round flying craft built in Austria in the late 1980s. They developed control surfaces, or rectangular fins, to stabilize their vehicle. They also crash-proofed it by surrounding the propeller with a metal and wood ring and incorporating a flexible hula hoop into their landing gear. The propeller was protected on impact, and if the craft hit the ground on any part of the hula hoop, it simply bounced to a stop.

Better each year

All of the 1992 entries showed substantial improvements over the craft entered in the first competition in 1991, says Rob Michelson, executive vice president of the Association for Unmanned Vehicle Systems (AUVS), the event sponsor. Michelson is also Technical Area Manager for Battlefield Robotics and Unmanned Systems at GTRI.

"The biggest improvement was that the machines showed far greater stability," he says. "Every machine that competed last year crashed, whereas this year several machines demonstrated brief autonomous flights with only one landing 'catastrophically'."

Participation in the aerial robotics competition is a win=win proposition for all concerned, Michelson says. Industrial participants benefit by establishing closer ties with academics both in the exposure of potential future employees to the company and in the innovative product-related spinoffs which may result from the student interaction. AUVS has set up a foundation so industry can make tax-deductible contributions to support the competition, and is starting an unmanned ground vehicle competition based on the broad interest shown in the aerial robotics event.



AERIAL ROBOTICS COMPETITION: Top—Georgia Tech Team Two adjusts its "flying gyroscope" with hula hoop landing gear. The robot won first place and $5,000 for its autonomous performance. Bottom—Georgia Tech Team One took home $2,000 and placed third for its helicopter's autonomous flight. Here, it's hovering over the bin containing the disks to be retrieved. (Photos by Margaret Barrett)

Plenty of challenges remain for all the teams who plan to enter the 1993 competition. Navigation is an area everyone needs to do more work on, Michelson says. Team Two needs to improve controllability and stability, says team member Brett Lapin, graduate student/electrical engineering. Team One may decide to fabricate more of its own parts for the helicopter's mission equipment package, to make it smaller and lighter, Kondor says. Both teams are looking at their vision systems and how to make them work outdoors in bright, busy areas.

And what happens when someone successfully completes the task?

"Well, then we'll just have to figure out something 'difficult' for them to do the next time," Michelson says. ❑

Georgia Tech aerial robotics teams, 1992

Team One
Vehicle Type: Helicopter

1. Fred Anders, graduate student/mechanical engineering
2. Alan Berry, senior/mechanical engineering
3. Jeff Connelly, graduate student/electrical engineering
4. Howard Cooley, pilot
5. Dr. Eric Corban, Guided Systems Technologies
6. Mark Gordon, graduate student/aerospace engineering (team leader)
7. David Hooke, graduate student/aerospace engineering
8. Gregg Johnson, senior/aerospace engineering
9. Frank Kaminsky, junior/electrical engineering
10. Shayne Kondor, graduate student/aerospace engineering
11. Roger Kromann, graduate student/electrical engineering
12. James Lake, graduate student/aerospace engineering
13. Kirk Liemohn, senior/electrical engineering
14. Ken Mauragas, pilot
15. Klaus Obergfell, graduate student/mechanical engineering
16. Walter Patterson, graduate student/civil engineering
17. David Pauli, senior/electrical engineering
18. Wayne Pickell, graduate student/electrical engineering
19. Dave Runton, senior/electrical engineering
20. Jerry Shea, graduate student/electrical engineering
21. Greg Walker, National Aeronautics and Space Administration

Faculty Advisers: Dr. Dan Schrage, aerospace engineering; Dr. J. Prasad, aerospace engineering; Dr. Nelson Baker, computer engineering; Dr. Steve Dickerson, mechanical engineering; Dr. Ron Arkin, computing; Dr. George Vachtsevanos, electrical engineering

Team Two
Vehicle Type: Flying Gyroscope

1. Jim Clark, graduate student/mechanical engineering
2. Brett Lapin, graduate student/electrical engineering
3. Corey Maye, sophomore/aerospace engineering
4. Rod Smith, junior/electrical engineering

Faculty Advisers: Richard Carey, EOL/GTRI; Wiley Holcombe, EOL/GTRI; Chris Thompson, EOL/GTRI (team leader); Mike Burrow, BEC/OIP ❑

"The camaraderie was great. But I also developed an appreciation for the immensity of the problem. The big military contractors spend millions of dollars a year trying to do this."

–Chris Thompson
GIT Team 2 Leader

New radar booklet is marketing tool

A new 32-page booklet on radar research and development at GTRI has been produced by the Radar Program Area Development Committee and the Research Communications Office.

The booklet has sections with text and full-color pictures on radar systems, radar vulnerability assessment, radar signal processing, radar phenomenology, GTRI radar training programs, and research facilities. Frank Williamson and Jim Kloeppel were editors for the booklet, which was sponsored by the Program Development Office.

To request copies, contact the Program Development Office at 894-6171. ❑

Profile & Insight

What's new at ATDC

By Martha Ann Stegar, RCO

When Wayne Hodges joined the brand new Advanced Technology Development Center (ATDC) as associate director in January 1981, it was housed in a small wing of the Hinman Building and had a budget of $185,000. Today it occupies a $5-million complex on the edge of the campus as well as two satellite centers in Augusta and Warner Robins, and its budget is $1.5 million.

"We're thriving despite the recession," reports Hodges, who became ATDC's director last year. "Our incubator space is 97% full, with 27 companies renting our facilities. Sales for ATDC member and graduate companies last year totaled $163 million—this figure has increased every year since we started tracking it in 1986."

Since Hodges took the helm, ATDC has narrowed its focus to its primary mission: to promote high-tech start-up companies. "In the past, we did everything from recruiting out-of-state companies to conducting educational seminars," he says. "Now we're concentrating on helping researchers commercialize their ideas and broadening our contacts with established firms that can become corporate partners with start-up companies."

Hodges sees an exciting change in the mix of member companies. "We're seeing more early-stage start-ups from state universities, particularly Georgia Tech," he reveals. "Traditionally, our companies have come from business—only 30% originated from academia and R&D groups. Now, there's more emphasis on new ideas from the research lab. In the near future, we hope to make this ratio 50/50 university/business."

ATDC is encouraging more university entrepreneurs through the Faculty Research Commercialization Program that it started at Georgia Tech last year. The program provides the financial and business development support necessary to move research technology from the conceptual laboratory stage toward a commercially viable product.

"Two of the new technologies that we funded under this program are now being successfully commercialized," Hodges says. "They are the Montage multimedia electronic mail system, developed by Bill Putnam and others in the College of Computing, and the 3-D optical digitizer, developed by Mike Sinclair and others in the Multimedia Technology Lab, which rapidly and inexpensively scans three-dimensional objects." *(For a description of these and other ATDC companies with a Georgia Tech connection, see sidebar story.)*

This year, the legislature appropriated $150,000 to extend the pilot program to the six universities belonging to the Georgia Research Alliance.Three projects will be selected for $50,000 funding apiece. "We hope to find matching private funding," Hodges says. "We have particularly good contacts with telecommunications and multimedia companies."

Hodges stresses that this is a pilot program. "If it's successful, we hope the state will increase the amount of funding and make it an ongoing state activity," he says.

He wants to encourage private sector companies to use ATDC to help them find good ideas and potential products that will fit into their needs. "Corporate commercialization is an important part of what we do now," he says. "It's one of the best opportunities for financing start-up companies we have."

To this end, ATDC is working with OCA's technology licensing and legal personnel. It also is creating a new staff position to direct a corporate partnering program that is starting in July. And it will have a corporate investors conference in October to give ATDC member companies a forum for presenting their ideas.

ATDC plans to work in all three technology areas identified by the Georgia Research Alliance as important for development in the state: telecommunications, genetics and the environment. It is currently trying to bring together a consortium of established telecommunications companies which it will assist in finding new ideas and products from university researchers and start-up companies.

An annual open house also gives ATDC companies public exposure. One ATDC company gained three investment contacts from the open house held in April, which 375 invitees attended. ATDC plans to have another open house just for the campus community. "We're more closely aligned with Georgia Tech now," Hodges says. "There's a lot of synergy with what goes on at Tech."

"Our incubator space is 97% full, with 27 companies renting our facilities. Sales for ATDC member and graduate companies last year totaled $163 million—this figure has increased every year since we started tracking it in 1986."

—Wayne Hodges ATDC Director

A profile of ATDC

The Advanced Technology Development Center (ATDC) was created in 1980 by the Governor, the General Assembly, and Georgia Tech to increase the state's high-technology business base. ATDC fulfills this objective by providing business assistance to start-up technology companies in Georgia.

ATDC selects early-stage companies for membership based on their application of new technologies, quality of the management team, product marketability, and growth potential. It gives special consideration to firms that develop new technologies in telecommunications, computer hardware and software, biotechnology, aerospace, multimedia, environmental applications, and advanced materials.

ATDC offers technical, business management, and financial support services to help entrepreneurs build and successfully operate a new technology business. The eventual goal is for each company to graduate from the program as a successful business enterprise. Currently, there are 28 member companies and 19 mature enterprises that have graduated from the program. Founders of graduate companies often serve as mentors to founders of new companies.

Many fledgling companies rent incubator space at ATDC's Technology Business Center on the Georgia Tech campus, where they have access to professional business consulting, contact with university research faculty, and modern office and laboratory facilities with central staff support in a strong entrepreneurial working environment. Others locate nearby in greater Atlanta, or are served by satellite ATDC offices in Augusta and Warner Robins. ATDC/Augusta, formed in 1987, focuses on health science, telecommunications, environmental sciences, electronics, and software. ATDC/Warner Robins opened in 1988 to encourage the development of new defense and aerospace technology firms. GTRI's Industrial Extension Service facilitates ATDC's services in other areas of the state.

ATDC also works with established out-of-state high-tech corporations to provide them information on state resources and on-campus space for a research and development division or an initial marketing office. This allows them access to Georgia Tech facilities and personnel and opportunities to team up with ATDC's early-stage companies. Some of the companies that have used this service are AMP, NCR, Sperry, Denon, and Bell Northern Research.

Currently, one third of ATDC companies are software developers, while 10% are in communications and 8% in the environmental field. Process control, medical technology, materials, and biotechnology each represent about 6% of the member companies. Aerospace, electronics, energy, information systems, and radar and instrumentation each have approximately 4%, with laser technology and multimedia each accounting for some 2% of the total.

As these companies grow and flourish, new jobs and opportunities are created in the economy, and new revenues accrue to state and local governments. Last year, 18 graduate firms had income totaling $157.1 million and provided 1,047 jobs, while 34 member firms generated another $5.9 million in income and 135 jobs. ATDC calculates the 1991 gross economic impact of ATDC-affiliated companies as follows: 4,116 jobs created, $240.4 million in economic activity, $44.7 million in employee income, $12 million in state government income, and $7 million in local government income. Not a bad payoff for the state's investment in ATDC! ❑

ATDC companies with a Georgia Tech connection

March 1992

MEMBERS (12)

- **BioTec Research & Development, Inc.:** Retired Georgia Tech Professor Heath Herman is president of the company, which was incorporated in August 1990. Has developed a process method for the production of calcium magnesium acetate (CMA), an environmentally safe highway and airport de-icing chemical, that is much cheaper than methods currently employed. *Biotechnology.*

- **Ceramic Fillers, Inc.:** Joe K. Cochran (MatEng), founder, with the late A. Ted Chapman. Founded 1986, joined ATDC 1987. Manufactures hollow ceramic spheres for use in high-temperature refractory applications. *Materials.*

- **Dickerson Vision Technologies, Inc.:** Steve Dickerson, MHRC/ME, formed the company in 1990 to manufacture and market industrial-grade, integrated vision systems. The initial product (STINGER 70 IVS) is the first vision system to fully integrate in one small package all of the components of a full vision system, including optics, illumination, frame grabber, digital computer, and communications. Price is 10% to 20% of that for competing systems with similar functionality. *Process control.*

• **Environmental Treatment Systems, Inc.:** Edd Valentine and Chuck Ross, ESTL/GTRI. Environmental management firm formed in 1987 to provide wastewater treatment equipment and design services to industrial clients. Products include a series of dissolved air flotation equipment for industrial wastewater treatment, a high-rate anaerobic process for biological wastewater treatment, and a thermal dewatering system for removing water from wastewater sludges. *Environmental.*

• **Guided Systems Technologies:** Founded in 1989 by Tech AE graduate Eric Corban to serve the aerospace industry with aerospace systems, engineering and analysis. Engaged in cost-benefit analysis of advanced helicopter main rotor technology, design and evaluation of advanced subsystems for military helicopters, and research directed at development of advanced real-time guidance and control technology for fighter aircraft and airbreathing hypersonic vehicles. Routinely employs Tech faculty (primarily on a consulting basis) and graduate students (part-time basis). Rotorcraft work played off the capabilities of Tech's Center of Excellence in Rotary Wing Aircraft Technology. *Aerospace.*

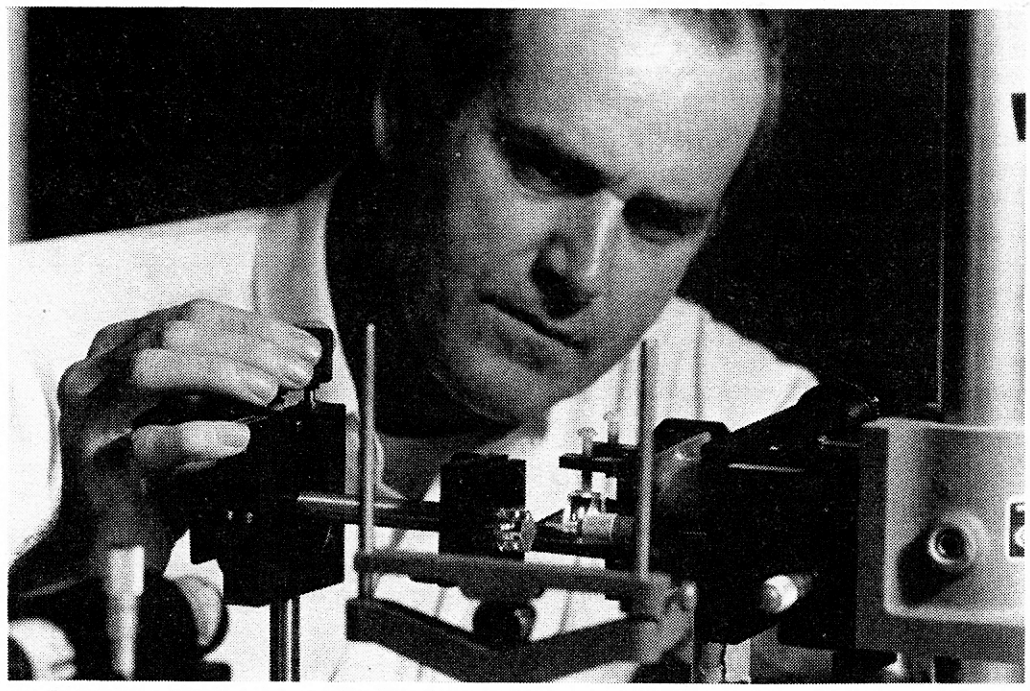
• **Laser Atlanta:** Formed in 1989. Is developing a laser-based speed detection system to replace existing microwave-based police radars. Has exclusive license for laser technology by Georgia Tech for non-invasive early diabetes and cataract detection. Also has received patents for an erbium YAG laser dentistry system. *Laser technology.*

• **Montage:** Bill Putnam, College of Computing. One of the first projects evolving out of Georgia Tech's Faculty Research Commercialization Program administered by ATDC. Montage multimedia electronic mail system provides a fast, inexpensive, easy-to-use and auditable channel for information exchange in almost any media type or format between users of computer workstations. *Multimedia.*

• **Multimedia Technology Lab:** Mike Sinclair, MMTL, OIP. One of the first projects evolving out of Georgia Tech's Faculty Research Commercialization Program. Is commercializing its 3-D optical digitizer, which rapidly and inexpensively scans three-dimensional objects. Applications include film and television media, reconstructive surgery, industrial design, scientific visualization. *Multimedia.*

• **Photonic Sensor Systems, Inc.:** Nile Hartman, PSL/GTRI, is inventor and co-principal. Incorporated January 1992—patented, integrated optic sensing technology for monitoring and control in areas where conventional technology has proved inadequate. Pursuing market applications in environmental monitoring, process control, and biomedical sensing. Advantages of this technology include sensitivity, broad dynamic range, stability, passive operation, compactness, ease of manufacture, and low cost. *Process control/environmental/biotechnology.*

• **Sonotech, Inc.:** Regents Professor of Aerospace Engineering Ben Zinn, founder and president. The firm, founded in 1985, is a developer and fabricator of tunable pulse combustors that produce significant energy savings, increased productivity, and reduced emissions in energy-intensive industrial processes and incinerators. *Environmental/energy/process control.*



Nile Hartman (PSL) is co-principal of Photonic Sensor Systems, Inc., an ATDC start-up company. He is the inventor of patented, integrated optic sensing technology for which the company is pursuing market applications in environmental monitoring, process control, and biomedical sensing. (Photo by Joe Schwartz)

• **SpectraLogic, Inc.:** Established in 1986 as a full-service engineering and product development firm dedicated to providing superior engineering and industrial design services. President Doug Armstrong founded the company while a sophomore at Georgia Tech, and the majority of its staff are Tech grads. Company also has collaborated with GTRI engineers on various projects. *Product development.*

• **System Computing Corp.:** Formed in 1991 to provide system solutions to problems through the use of advanced computer technology, to promote the insertion of state-of-the-art computing technology from the academic to the industrial sectors, and to broaden the applications of computing technology. Currently promoting and developing two key technologies devised by Georgia Tech's Computer Engineering Research Lab (CERL): the advanced parallel function processor (APFP) and the guidance, navigation, and control (GN&C) processor. *Software.*

GRADUATES (5)

• **Atlanta Signal Processors:** Ron Schafer, Regents Professor, EE. Founded in 1981 to develop and market digital signal processing hardware and software products. *Electronics.*

• **ERDAS:** Nick Faust, EOL/GTRI. Founded in 1979 to produce image processing and computer mapping systems and services for site engineering, land management, remote sensing, mineral exploration, coastal management, forest management, and site selection. More than 120 ERDAS systems are now installed on five continents and the Caribbean Basin. *Software.*

• **Ivex Corp.:** Founded in 1984 to develop and market visual display systems for simulation. Several GTRI people were involved in the original research phase. Applications include flight and combat simulations, interactive 3-D topographic maps, land vehicle simulation and weapons skills training, and missile sensor testing. *Aerospace.*

• **Millimeter Wave Technology, Inc.:** Dennis Kozakoff (president), former EML/EES (GTRI). Founded in 1982—producer of low-cost MMW and microwave antennas and components. They include radar simulators, MMW communications systems, and satellite microwave receivers. *Radar & instrumentation.*

• **Theragenics Corp.:** Incorporated in 1981 by John Russell, former director of Georgia Tech's Nuclear Research Center, to develop cancer therapy products. John Carden, who formerly taught health physics in Tech's Nuclear Engineering School, is the vice president for research and development. The firm currently is marketing TheraSeed Pd-103 for treatment of prostate cancer and other localized solid tumors; TheraSphere Y-90 is a commercial product for treatment of liver cancer in Canada and under investigation in the U.S. *Medical.* ❑

GTRI research in the news

In the February-April period, GTRI research received the following national publicity:

• *The New York Times* (1,762,015 circulation) published an article about ESTL research on improving indoor air quality. It also received attention in *Science News* (250,000), *Design News* (170,000), *The San Antonio Light* (166,722), *Building Operating Management* (68,000), *Construction Specifier* (19,000), *Environment Today* (54,000), and *Environmental Science & Technology* (12,500). Information about this work has now appeared in publications with more than 2.6 million readers.

• Cable News Network produced a story on the study of electro-optic components carried on the Long Duration Exposure Facility. The story—concerning research in GTRI and the School of Electrical Engineering—ran four times.

• The sonic boom simulator used by Krish Ahuja (AERO) was described in *The Chicago Tribune* (1,131,226), *The Baltimore Sun* (237,519), and *The Chronicle of Higher Education* (84,208).

• An article about smart materials research in GTRI and the School of Aerospace Engineering appeared in *Research & Development* (120,111).

• *Microwaves & RF* (60,500) and *The Florida Times-Union* (184,394) published articles about a new type of broad-band antenna developed in GTRI and now being commercialized by its inventors, Johnson Wang and Vic Tripp. ❑

News & Notes

Spotlight on Internal Research

This is the fourth in a series of articles reporting on projects funded by GTRI's Senior Technology Guidance Council (STGC).

Improved antenna testing: takes less time and money, produces better results

By Lea McLees, RCO

How would you like to buy a multi-million-dollar piece of equipment and never be able to fully test its performance because that process was cost-prohibitive? That's been a common problem for phased-array antenna users for more than 30 years—and GTRI researchers may have found a solution.

Principal research engineers Josh Nessmith (RSAL), Larry Corey (MATDL), and colleagues such as Research Engineer II Mark Mitchell (MATDL) have developed mathematical formulas and a computer simulation that use the results of a limited but controlled series of measurements, translating them into a set of corrections applied to antenna beam-pointing data. Their work can reduce the error between an antenna's actual performance and users' estimates of it, helping people make better use of their equipment. The researchers also believe they can make the technology portable, enabling study of huge antennas that cannot be moved to testing sites and thus may never have been evaluated.

Phased-array antennas can be made up of just a few or many thousands of radiating elements. The elements are electronically combined to form and point the beam in different directions. The beam is used to detect and follow targets, aiding in communications, defense and other endeavors. Some phased-array antennas are relatively small; others are so large they are built into the sides of buildings or ships.

A better way to predict

When they began their STGC project in July 1989, the GTRI researchers believed that modern phased-array antenna beams could be pointed more accurately than most people thought. Theories of the effects of random component errors on phased-array antenna beam-pointing performance had not been updated for 30 years. The researchers guessed that the old formulas for predicting phased-array antenna performance were limited in their application.

They were right. The initial formulas for determining phased-array performance were based on averages of performance for all antennas produced, not on each individual antenna's capabilities. Measuring each individual antenna's performance would provide a better idea of how well that antenna was working, helping engineers reduce the error between their estimates of performance and the actual capability of antennas once calibrated.

But evaluating each antenna in depth had been an obstacle for years, a process requiring lots of money and time. Getting evaluation time at special testing sites—assuming an antenna is small enough to be moved to one—can cost thousands of dollars a day. Measurements of a C-band antenna's performance, for example, must be made over approximately every square inch of the equipment's surface, Corey notes. For a 12-x12-foot antenna, that equates to about 20,000 measurements to test just one beam position out of the thousands possible—at only one frequency and one temperature. Testing just a small portion of an antenna's capability could require several weeks.

To solve this problem, the researchers devised formulas that were based on the idea that the error between predicted and actual performance must be similar for antenna beam positions that are close to each other. Their work also took into account the idea that the pointing error would change slowly over specific intervals. The treatment of these errors as systematic differs from past work, which used random numbers to generate error estimates. In addition, the GTRI researchers' formulas can take into account other characteristics that affect error estimates, such as deformations in the shape of an antenna.

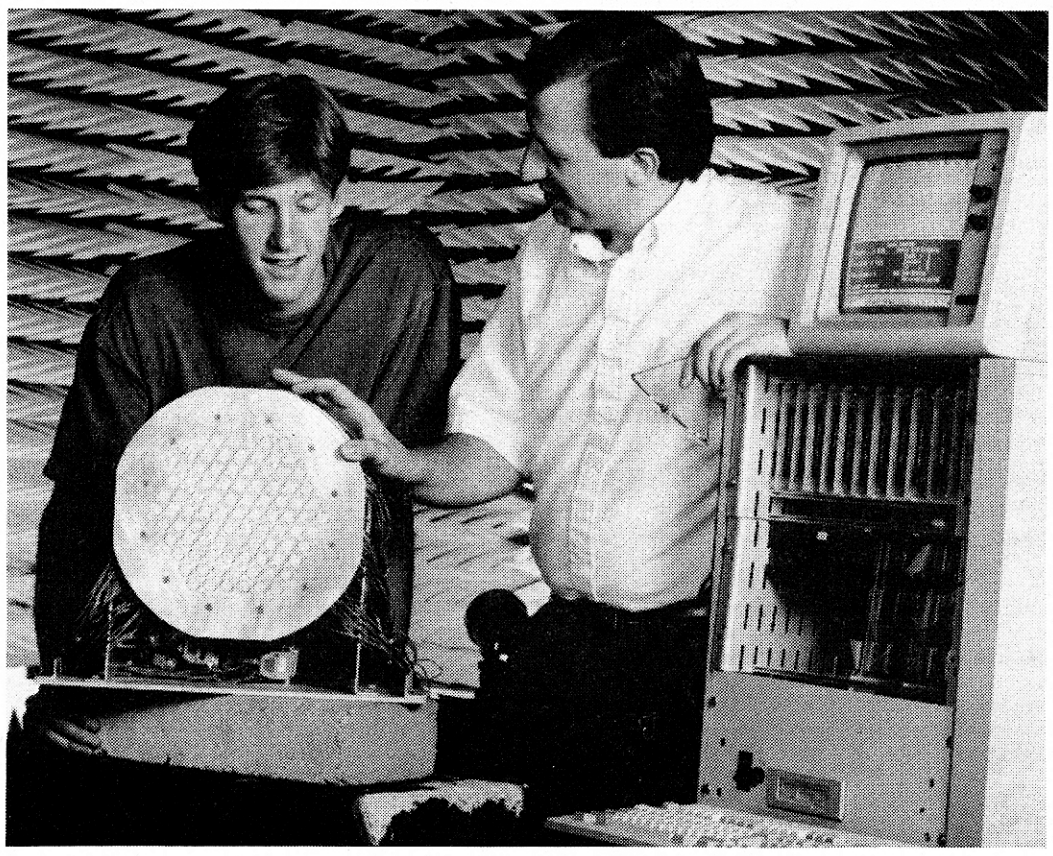
Mitchell tested the theories on two small phased-array antennas, one with 100 elements and one with 500 elements. He found that the pointing performance of the antennas could be calibrated accurately with only four or five measurements, compared to the hundreds or thousands which could have been required without the new approach. Before using the new formulas and calibration, the average beam-pointing error of one test antenna was .5 degree; after calibration, the error was approximately .1 degree.

Benefits galore

This technology can be used not only to improve existing antenna performance—those designing and building new antennas can use it to set specifications, confirm that the design works, and then test the equipment once it is installed. The specifications for antenna design may not have to be as high, and thus not as expensive, as they have been in the past, because the GTRI researchers have shown the equipment can perform better than was previously thought. The formulas and simulation can be applied to any field that uses phased-array antennas, such as communications, satellite and defense systems.

This STGC project has resulted in a number of presentations to present and potential sponsors, a paper in the 1991 *GTRI Technical Journal*; and material for use in three short courses. The work on this project has been useful in winning contracts in other GTRI research areas, such as near-field measurement, and has been used in other STGC projects. In addition, the group finished its work on time and had enough money and funding to construct one of the small phased arrays they tested. That antenna can now be used for other research.

Others who participated in the work are co-op students Mark Fisher, Laurie Bigler, and Bill Comisky, and former GTRI employees Esko Jaska and Susan Park. ❑



Co-op student Bill Comiskey (left) and researcher Mark Mitchell inspect a small antenna they use to test the formulas and computer simulation they helped derive to predict antenna beam-pointing accuracy. (Photo by Gary Meek)

Coordinated purchase can make expensive software tools cheap

GTRI researchers and those in the wider Georgia Tech community have a chance to purchase a $50,000 Electronic Design Automation (EDA) software package for about $500 a copy—IF enough interest is shown.

Neil Lareau, a research engineer in the Electronic Support Measures Lab, is coordinating an effort to make the opportunity available to all potential users of EDA tools at Tech.

"So much logic is packed onto circuit cards now that thorough electronic design and simulation is required to avoid excessive rework costs," Lareau says. "EDA tools make this task more manageable and are required for doing large or fast designs."

Most GTRI labs design electronic systems and have a periodic need to use these tools, he explains. But there's a catch: they are very expensive. A basic set of EDA tools will cost about $50,000 for software and manuals, Lareau says. When the necessary simulators, libraries and other tools are added, the price doubles to $100,000. Maintenance agreements can add several thousand dollars a year to the total cost.

The solution, Lareau says, is to buy a common set of design tools. "Several of the major EDA tool vendors have expressed a desire to place their products at Tech, and most of these vendors offer discounts to educational institutions," Lareau says. "Two companies have approached us about making large donations to Georgia Tech, and we need to find out who in GTRI and the academic schools need to use EDA tools."

One such EDA tool vendor is the Viewlogic Corporation. According to Lareau, Viewlogic is interested in establishing a large presence at Georgia Tech and is offering a basic digital design framework along with its logic libraries and simulation libraries. The value of the package is approximately $50,000 per license, he says. The base price for educational institutions is $1,500 per license, but the price drops to $750 each for 20 licenses, and Lareau believes Tech will be able to negotiate a price of about $500 each for 30 or more licenses. This price includes software updates and new releases, and there is no yearly maintenance fee.

If you are interested in this extraordinary offer, or in promoting GTRI-wide coordination on similar capital equipment purchases, please contact Neil Lareau, ESML/GTRI, at 894-7117 or PROFS NLAREAU as soon as possible. ❑

Professional Activities

Aerospace Lab

Krish Ahuja was one of the organizers of the DGLR/14th AIAA Aeroacoustics Conference held in Aachen, Germany, May 10-14, and chaired a session. He presented an invited paper entitled "Supersonic Jet Noise Measurement." Also presented were two other papers prepared by Dr. Ahuja and his students: "Supersonic Jet Noise Reduction by Coaxial Rectangular Nozzles," by Ahuja, **John Manes**, and **Kevin Massey**, and "A Review of Crack Propagation Under Unsteady Loading," by **Holly Bryan** and Ahuja.

Computer Science & Information Technology Lab

John Gilmore presented an invited talk, "The Changing Role of Artificial Intelligence in the Military," June 2 at the International Expert Systems Conference in Avignon, France. He was also part of an invited panel discussion on artificial intelligence in the '90s and chaired a session on robotics.

In June, **Rick Peterson** presented a paper written by **John Gilmore** and **Andrew Czuchry** and entitled "A Neural Network Model for Route Planning Constraint Integration" at the International Neural Network Conference in Baltimore (MD).

Countermeasures Development Lab

At the Tri-Service Radar Symposium at the U.S. Military Academy at West Point June 23-25, **Don Lewinski** gave a paper, coauthored by **Mark Smith**, entitled "ECM Applications and Effectiveness of Digital RF Memories," and **Bob Wohlers** presented a paper, coauthored with **D. Davis**, entitled "Investigation of Statistical Backscattering of Aircraft Targets for Non-cooperative Target Identification."

David Flowers has been elected vice chair of the Atlanta Chapter of the IEEE Aerospace and Electronic Systems Society.

Economic Development Lab

Rosemary Hall (Dublin Regional Office) received her master's degree in business administration from Georgia College on June 13.

John Mills (Columbus Regional Office) was installed as president of the Georgia Society of Professional Engineers at its annual meeting on June 27.

At the 17th Annual Conference of the Technology Transfer Society in Atlanta June 23-26, **Carol Aton** and **Leigh McElvaney** (ESTL) presented a paper entitled "Results from Testing Transfer Models."

Electromagnetic Environmental Effects Lab

Hugh Denny and **David Millard** attended an IEEE Video Conference Planning Meeting June 17.

Donald Clark attended the Anechoic Chamber Operators Meeting in Boulder (CO) in mid-June.

On June 18, **John Daher** attended the First World Congress for Electricity and Magnetism in Biology and Medicine in Orlando (FL).

Glenn Champion attended the European Conformity Assessment Seminar presented by Underwriters Laboratory June 17-21 in Chicago.

Environmental Science & Technology Lab

Michael Lowish was the featured speaker at a Confined Space Entry training course on June 5 sponsored by the Savannah Area Chapter of the American Society of Safety Engineers. He also presented three lectures at the 1992 Safety Workshop for the Poultry Industry held in the Manufacturing Research Center June 11-12.

At the recent Commercial Flower Growers Convention, **Paul Schlumper** gave a presentation on worker and community right-to-know requirements.

Steve Hays was guest speaker at the Atlanta Metro Rental Association's conference on July 7, speaking on safety and health concerns.

Materials Science & Technology Lab

A 688-page *Handbook of Molecular Sieves: Structures, Synthesis, and Properties* compiled by **Rosemarie Szostak** was published in June by Van Nostrand Reinhold. The unique book is the only up-to-date, A-to-Z compilation of commercial and research zeolites data currently available. She also is the author of the 524-page *Molecular Sieves: Principles of Synthesis and Identification*, published by the same company in 1989, which will go into a second edition next year. In May, Dr. Szostak was a visiting lecturer at the Hong Kong University of Science and Technology.

Microwave & Antenna Technology Development Lab

Johnson Wang recently traveled to Vancouver, British Columbia, Canada, to present a paper, "A New Class of Wideband Low-Profile Conformal Antennas—Its Impact on Wireless Communications," at the IEEE International Conference on Selected Topics in Wireless Communications. Coauthors were **Glenn Hopkins** and **Vic Tripp**.

Physical Sciences Lab

IEEE Quantum Electron will publish an article by **H.K. Chiang, Richard Kenan** (EE), and **Chris Summers**, entitled "Spurious Roots in Nonlinear Waveguide Calculations and a New Format for Nonlinear Waveguide Dispersion Equations," in its July issue.

A paper by **G. Tompa** and **Chris Summer**s, "Metallorganic Chemical Vapor Deposition of CdTe and ZnTe," will be published in the *Proceedings of the American Vacuum Society, 38th Symposium.*

Chris Summers, B.K. Wagner, Rudy Benz, D. Rajavel and **A. Conte-Matos** are the authors of a paper, "Gas Source Molecular Beam Epitaxy of CdTe and HgCdTe," to be published in the *GACIAC Proceedings of the Second Workshop on Electro-Optical Materials.*

Research Communications Office

Mark Hodges received a master's in technology and science policy from Georgia Tech in June.

The second edition of **Jim Kloeppel**'s book, *Danger Beneath the Waves: A History of the Confederate Submarine* **H.L. Hunley**, has just been released by Sandlapper Publishing of Orangeburg (SC). His article, "Swamp Angel's Reign of Terror," appeared in the March-April issue of *Civil War* (The Magazine of the Civil War Society), and *Lapidary Journal* published "Bite Out of Time," his article on collecting shark teeth and other fossils in Venice (FL), in its July issue.

Signature Technology Lab

Bill Bell, John DiMarco, Keith Kelly, Paul Kemper, and **Robert Rice** attended the HAVE Forum Conference on Low Observables June 22-25 at Wright-Patterson AFB (OH). Bell presented a paper titled "Aircraft Acoustic Signature Analysis," and DiMarco presented one called "Experimental Analysis of Infrared Signatures for Low Observables."

At the JANNAF-SPIRITS Group Meeting held in Huntsville (AL) June 17, **John DiMarco** presented a paper on "Comparison of Infrared Signatures Predicted from SPIRITS with Experiment." He also attended a conference hosted by George Washington University on Motion Stabilization Systems July 8-10.

Keith Kelly attended IEEE's Antennas and Propagation Symposia in Chicago July 18-25.

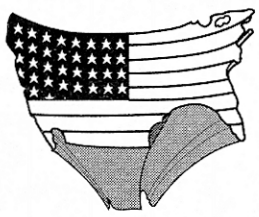
Threat Systems Development Lab

Duane Patterson received his MSEE from Georgia Tech in June. ❑

Focus on Folks

***Congratulations to John Mills on his installation as president of the Georgia Society of Professional Engineers, and to Rosemarie Szostak on the publication of her new* Handbook of Molecular Sieves.**

Focus on Folks



Congratulations to new U.S. citizen Paolo Chiappina!

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Personnel News

Computer Science & Information Technology Lab

Larry Morrow is a new project coordinator, starting in July.

Economic Development Lab

The Gainesville Regional Office has moved to 332 Washington Street, N.E., Suite 204, Gainesville 30501.

Tim Israel is transferring from the Gainesville Office to Atlanta, where he will work full time on Georgia Productivity and Quality Center projects.

Electronic Support Measures Lab

Bob Willoughby is retiring effective July 31 after 12 years at GTRI. Bob served as head of the Emitter Identification Branch from 1984 to September 1991. Since then, he has been on the lab staff supporting TQM and general lab administration. Prior to 1984, he served as a senior researcher and group leader. His co-workers will miss his services to the lab, as well as his presence.

John Maguire has transferred to the Program Development Office of OOD. Among his several responsibilities will be to identify competitive task and delivery order contract opportunities for GTRI and assist in developing them.

Management & Project Support Group

Vickie Fennell has been appointed manager of the Baker Building MAPS unit, effective July 9. She replaces **David Benham**, who resigned several weeks ago. From 1983-88, she performed similar duties in the former Systems and Techniques Lab, and most recently worked as an information analyst in the Threat Systems Development Lab. She has both bachelor's and master's degrees in business administration.

Michele Brown has accepted responsibility as associate editor of the GTRI CONNECTOR for labs in CRB.

Microwave & Antenna Technology Development Lab

Four student assistants/co-ops graduated in June and have terminated: **Patrick Thompson, Mark Fisher, Theodore Browning**, and **Chris Elliott.**

Signature Technology Lab

William Kreutel has joined STL as a PRE, coming from Electromagnetic Sciences. He has a PhD in EE from George Washington University.

Another new employee is **Jeffrey Garnett**, RE II, a recent University of Iowa graduate with a PhD in EE.

Jim Maloney is a new student employee. He plans to receive his PhD in EE from Georgia Tech in September.

Threat Systems Development Lab

The following persons transferred from the Advanced Technology Lab effective July 1: **Robert Goodman, Douglass Henry, Dwayne Mills**, and **Duane Patterson**.

James Cooper and **Marvin Hill** are terminating July 31.

Student assistant **Lisa Goodman** was graduated from Georgia Tech in June with a degree in management. ❑

GEESE FIND NEW HOME: The lake at the Cobb County Research Facility (CCRF) no longer is home to some 50-60 Canada geese. They were moved last month to a more protected rural environment on the Georgia-South Carolina border.

The U.S. Department of Agriculture rounded up the geese in June and took them to Lake Russell, which previously had had no Canada geese.

According to CCRF manager Rusty Embry, the goose population had gotten out of hand, creating problems. "Employees complained about the mess they left and sponsors complained of being attacked. They also were flying between our pond and another at Dobbins Air Force Base. In the process, they were flying across the Dobbins runway, creating a hazard for their pilots and aircraft," he says. Still at CCRF are three adult ducks and three ducklings. (Photo by Anita Edwards)

SPORTS

Tech night at the Braves

Nearly 400 employees, family and friends of GTRI and other Georgia Tech departments attended the Atlanta Braves-Houston Astros baseball game July 27. The group, sitting together in the upper level, was publicly recognized. The "Tech night" was arranged by Harry Ross (Research Property Management), who took the orders and purchased the tickets for half-price.

Harry also is swinging a similar half-price deal for the Braves-Los Angeles game on Labor Day afternoon (September 7). He says these are the last half-price tickets he can get this season, but he can get a 10% discount any time for groups of 30 or more. The farther ahead you order your tickets, the better chance you have of getting really good seats, he advises. The last three games of the season (Fan Appreciation Weekend) are October 2-4, and Harry is taking ticket orders now. If interested, call Harry at 894-3515 or PROFS HROSS. ❑

Personal Notes

Proud to be an American

On June 15, **Paolo Chiappina** (EDL—Augusta Regional Office) obtained his U.S. citizenship.

Wedding Bells

Rachel Sluss (RIDL) and **Luther Ward** (TSDL) were married on July 4.

Also having a Fourth of July wedding was Capt. **Mike Matheus** (adjunct RIDL—sponsored through the Air Force Education with Industry Program).

Debbie Powers (RIDL) was married July 25 to David Shenning.

In MSTL, **Geoving Gerard** was married in May to Aileen Jaca in the Philippines, and **Rozlynn Sullivan** was married June 20 to Sims Gordon.

Cradle Roll

Elizabeth and **Andre Lovas** (TSDL) had a baby daughter, Nancy Ann, July 2.

Our Sympathy

... to **Paulette Clark**, whose father died in early June, closely following the death of her mother in late April.

... and to **Rozlynn Sullivan Gordon**, who lost her grandfather June 28. ❑