Georgia Tech Research Horizons

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High-Tech Therapy

Virtual technology From Georgia Tech and Emory may help in reducing acrophobia

"This study is important in establishing that there is real potential for the use of virtual reality in exposure therapy."-- Dr. Larry F. Hodges

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By John Toon

AN EXPERIMENTAL THERAPY based on virtual reality (VR) computer simulations has helped persons with acrophobia reduce their fear of heights, a team of computer scientists and clinical psychologists reports.

The work, published in the April issue of the *American Journal of Psychiatry*, is believed to be the first controlled study on the use of VR for treating a behavioral disorder.

The research may open new possibilities for dealing with a broad range of phobic conditions whose treatment now relies on exposure to real anxiety-producing situations. It also demonstrates a promising new application for VR, which has been popularized through games and entertainment.

Graduate student Drew Kessler (standing) tests the virtual reality headgear used in the phobia project with help from Dr. Barbara Rothbaum (left) and Dr. Larry Hodges.

"This study is important in establishing that there is real potential for the use of virtual reality in exposure therapy," says Dr. Larry F. Hodges, associate professor in the College of Computing at the Georgia Institute of Technology. "There are a range of conditions for which you might one day use virtual reality systems in a clinician's office to provide therapy."

A research team led by Hodges and Dr. Barbara O. Rothbaum, assistant professor in the Department of Psychiatry in Emory University's School of Medicine, studied the effects of VR-based therapy on a group of college students who displayed clear clinical signs of acrophobia.

After two months of weekly treatments, the students were evaluated for their anxiety, avoidance, attitudes and distress when confronted

with height situations. They were then compared to students with acrophobia who did not receive treatment.

"Significant differences between the students who completed the virtual reality treatment and those on the (control) waiting list were found on all measures," the authors say. "The treatment group was significantly improved after eight weeks, but the comparison group was unchanged."

In a series of sessions conducted by a clinical therapist, the treatment group used head-mounted VR displays to view a series of anxiety-producing scenes from bridges, balconies and an open glass hotel atrium elevator. In each case, the subjects began at ground level and moved gradually higher in the simulated scenes until they showed or reported signs of distress. The subjects then remained at that level until their anxiety levels dropped.

During 35- to 45-minute sessions held in Georgia Tech's Graphics, Visualization and Usability Center, nearly all of the students felt the sweaty palms, rubbery knees and dizziness that are among the signs of acrophobia. Ultimately, all test subjects mastered the three environments, including what became known as the "Indiana Jones" bridge suspended a simulated 80 meters above a river. In addition to the treatment, seven of the 10 students in the treatment group chose to expose themselves to height situations between sessions, even though they were not specifically instructed to do so.

"We had a subject who actually went to a large Atlanta hotel and got on an open glass elevator," notes Hodges. "He came back and told us that although he was scared, he could now deal with the situation. Before the treatment, it would have taken several people to carry him onto the elevator."

Hodges said that although the virtual situation created real anxiety and distress in the test subjects, the levels may not have been as intense as if the subjects had been on a real bridge, balcony or elevator.

"They experienced the same feelings of anxiety and the same emotions that they would in real height situations, and that seemed to be true throughout all the eight weeks of the therapy," he explains. "But people were willing to place themselves into situations in VR that they would never do in the real world. It's not as real as real-life, but it's real enough that you experience the same kind of emotions."

Though the researchers demonstrated that their VR technique could lessen the subjects' fear of heights, they did not directly compare the results to those of traditional therapy techniques. Even if the VR technique turns out to be no more effective than conventional methods, however, it may still offer significant advantages.

"Virtual reality graded exposure may turn out to be much more time- and cost-effective than traditional exposure therapy, which requires the therapist to leave the office setting and work with patients in anxiety-producing height situations," notes Rothbaum. VR treatment in a therapist's office would also protect the confidentiality of the subjects.

In addition to demonstrating the effectiveness of VR in treating psychological conditions, the study also provided information on the amount of visual data required to make subjects feel that they are really in the situation they fear. Reducing the amount of visual information could allow the VR to be done on less costly equipment, making it possible for therapists to purchase the computers and helmet-mount display for as little as $20,000, Hodges believes.

"This study allowed us to get some experimental data on the experience of what we call 'presence,' and what it is that makes you feel you are in any environment," he explains. "It will help us learn what kinds of details we can abstract away and what details are important."

Other authors of the study included Rob Kooper, a visiting researcher from Delft University of Technology in the Netherlands; Dan Opdyke from the Department of Psychology at Georgia State University; Dr. James S. Williford of the 101st Airborne Division at Fort Campbell, Ky.; and Dr. Max North of the Department of Computer Science at Clark Atlanta University.

The research was supported in part by a grant from the Emory/Georgia Tech Biotechnology Research Center, by an equipment grant from the Georgia Tech Foundation, and by a Research Experiences for Undergraduates Site Grant from the National Science Foundation.

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Marketing on the World Wide Web:

Provide information now, expect on-line sales later

Responses to a questionnaire indicate that Web users have household incomes approaching $60,000; expect to buy electronics, computers, software and other high-priced items; and are willing to pay for quality information at a reasonable price.

By John Toon

COMPUTER HARDWARE and software vendors -- as well as companies offering travel, investing and similar services -- should use the World Wide Web to provide information to the growing number of potential customers seeking on-line product information there, says a researcher who has studied consumer attitudes of more than 4,500 Web users.

The research suggests companies should be using the Web to provide detailed and comprehensive information to encourage the sale of products and services at traditional locations such as retail outlets. Companies expecting consumers to make extensive on-line purchases may be disappointed -- at least for now.

"Currently, people are more interested in using the Web as an information resource than in using it to actually make purchases," says James Pitkow, a Georgia Institute of Technology researcher who analyzed responses to a set of questionnaires posted on the Web last fall. "Web users want to gather information about new computer hardware and software, music, books, the weather and available travel resources on-line. For them, the Web is an information retrieval tool for up-to-date data."

Companies should therefore pay close attention to the quality of the information they make available electronically. Providing valuable and current information provides a "hook" that draws users to Web sites, notes Dr. Laurie Hodges, a research scientist in the Georgia Tech Research Institute (GTRI).

"The people who will be commercially successful on the Web will be those who can put up the best information," explains Hodges, who is collaborating with Pitkow to study Web usage and trends. "It is important for companies to update and change the information at their Web sites frequently to keep people coming back."

Though heavily weighted toward persons whose occupations give them easy access to the Internet, users of the World Wide Web have household incomes approaching $60,000, expect to buy electronics, computers, software and other high-priced items, and are willing to pay for quality information at a reasonable price. That makes them prime prospects for many types of businesses.

These conclusions are based on detailed demographic information gathered from a widely advertised questionnaire posted on the World Wide Web between October 10 and November 16, 1994. Because the respondents were not randomly selected from the population of Web users, the information lacks the rigor of a true scientific survey.

However, the data collected by Pitkow and Mimi Recker in Georgia Tech's Graphics, Visualization and Usability (GVU) Center provides one of the best available pictures of who is using the rapidly growing hypermedia system that provides hypertext, graphics, photographs and movies to users throughout the world.

The data and an experimental set of questions, collected in "GVU's 2nd WWW User Survey," was analyzed with help from Sunil Gupta at the University of Michigan School of Business.

A third survey made available April 10 through May 10 solicited responses from Web users about additional consumer areas. Results of the third survey will be available after June 10 at .

Among the key results of the second survey:

- Nearly 80 percent of respondents said they would be willing to pay for information on the Web if the quality and price were right. Only 20 percent said they would not pay for services under any conditions.

- Noncommercial World Wide Web sources were deemed more important than direct mail advertising and brochures for obtaining product information. Only traditional print media was used more by the respondents.

- More than two-thirds of the respondents said they had sought information about higher-priced computer software and hardware through the Web during the past six months. More than a third of the respondents reported using the Web to find on-line information about home electronics, movies and videos, music and books.

- Though 70 percent of the respondents obtained information about higher-priced computer hardware on line, only 13 percent made purchases there. Traditional retail outlets are still where Web users said they ultimately purchased the products they chose.

- Browsing, entertainment and education are the top three reasons the respondents cited for using the Web. Next in order were work-related uses, academic research and business research. Just 8 percent said they used the Web for shopping.

- Seventy percent of the respondents have college degrees, more than a third at the master's or doctoral level.

- Estimated average household income is $59,600, though 13 percent of the respondents said their household income was greater than $100,000. North American users were more affluent than their European counterparts.

- The average age of respondents was 31, though the number in higher age groups was significant.

- Technical specialist, university student and researcher are the top three occupations cited by respondents.

GVU's World Wide Web survey relies on an adaptive questioning technique that uses responses to select future questions. For instance, a response to a question about the type of computer owned by respondents determines the following questions about the software used to browse the Web, since some programs run only on certain computers.

The "decision tree" technique allows the researchers to gather more information with fewer questions, since respondents see only the questions that apply to them. Pitkow hopes the questionnaires will serve as prototypes for the surveying techniques, which may be more widely applied as Web use grows and more companies establish a presence there.

Information about the adaptive questioning techniques and results from GVU's 2nd WWW User Survey were presented at the Third International World Wide Web Conference at Darmstadt, Germany April 10 through 13.

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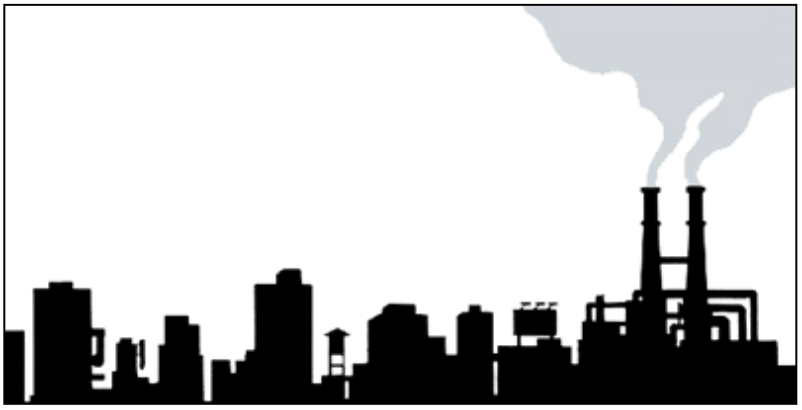
Pollution Prevention: People Are the Key

Integration of pollution prevention programs with organization management, communication and culture-related assistance is needed, this study shows.

By Lea McLees

IMAGINE THAT YOU WORK for one of the approximately 100 programs in the United States that provides pollution prevention assistance to small and mid-size companies. Among the contacts you have made are some companies who call you regularly -- perhaps more often than they really need to -- to solve problems. You also see their representatives at all your seminars -- even the seminars the representatives do not particularly need to attend.

If the main goal was to have a regular dialogue with clients, the answer is yes, says research scientist Carol Foley of the Georgia Tech Research Institute (GTRI). If the main goal was to see clients succeed on their own at pollution prevention, then you may need to provide some different solutions -- solutions that integrate organizational assistance with technical aid.



"The days of a separate pollution prevention program are coming to an end, " Foley says. "Pollution prevention had to be separate early on to raise awareness. By focusing on a particular problem, we discovered that technical assistance programs can become surrogates for multi-departmental decision-making within companies."

Foley, who also is a visiting fellow at the Army Environmental Policy Institute, bases her conclusions on a study funded by the U.S. Environmental Protection Agency (EPA) and the Georgia Pollution Prevention Assistance Division. She and three colleagues surveyed pollution prevention efforts among 1,529 mid-size firms in Florida, Georgia, Louisiana, North Carolina, Tennessee and Texas, obtaining a 40 percent response rate. Each firm had two to 30 facilities nationwide and was potentially eligible for the U.S. EPA 33/50 program, a voluntary emission reduction program focusing on 17 toxic chemicals.

The researchers' findings support the need for integrating pollution prevention programs with organization management, communication and culture-related assistance. Among their findings:

- ✔ Pollution prevention is not as integrated across the entire facility in mid-sized firms as it is in larger organizations. One person, perhaps a manager, is responsible for environmental compliance and, in most cases, does not involve people throughout the organization in decision making.

- ✔ Mid-size firms rely on external sources for identifying pollution prevention options more than large firms do. They tend to look to published literature, trade associations, vendors and technical assistance programs for ideas and impetus.

- ✔ Mid-size firms are less likely than large firms to use quality teams, facility assessments, employee recommendations -- all internal sources -- for gathering information on pollution prevention options.

Case Study Findings

The researchers also developed detailed case studies of four of the firms surveyed that have successfully prevented significant amounts of pollution over the last four to five years. Among the organizational characteristics they examined in the case studies were corporate culture, values and attitudes, internal and external organizational factors, and decision making styles, trying to find commonalities among the successful companies.

One site was committed to Total Quality Management (TQM) concepts, said research associate Leigh McElvaney, who has an interest in corporate communications. Such concepts encourage employee input into company decision making at all levels, and rely on internally generated solutions to problems.

"They had touch-screen computers dedicated to communicating with employees because the typical computer keyboards intimidated their employees; they had video monitors everywhere, broadcasting information such as safety and health tips; and all employees had access to production data at anytime," McElvaney notes.

Another company also successful at pollution prevention was run in a more autocratic style, was not as clean and neat, and did not seem to have formal TQM programs in place.

"However, this company had decentralized decision making processes , as did the TQM-oriented company," McElvaney says. "Some of the floor managers had worked there for a long time and their opinions were respected. The decisions didn't all come from the top down."

A participatory management style that encourages pollution prevention input from all employees is vital, says senior research associate Claudia Huff, a student of organization development.

"The way to solve a lot of environmental problems is to begin by talking to the employees on the floor and getting their ideas," she says. "Companies must encourage the employees on the line to feel confident enough to talk to the manager, and of course the manager must respect those ideas and follow through."

In fact, many technical assistance programs are based on collecting input from employees at different levels of the company. This feedback is used to determine whether the solution to a problem lies within the company, or whether a university's engineering assistance is needed, Foley notes. Encouraging a company to develop management and organizational styles welcoming employee pollution prevention suggestions is just as important as actually implementing a pollution prevention program, the researchers say -- and will encourage the company to solve some problems on its own.

Other organizational characteristics of mid-size firms successful at pollution prevention include:

- **A significant emotional event** -- having had, or knowing colleagues who have had, experiences with environmental clean-up or regulatory problems, such as disasters followed by bad publicity and adverse media relations.

- **Focus on product quality** -- with lots of direct input from customers on environmental issues, as well as on the product or service they buy.

- **Respect for the company's environmental manager** -- colleagues perceive this person as knowledgeable and effective.

- **An opportunity for change** -- such as a decision to replace old equipment, or advice gained from an outside source.

Management-Based Approaches

The importance of organizational determinants of pollution prevention activities is increasingly recognized among public policy makers, as well.

Management-based approaches to promoting waste minimization are becoming more popular among environmental agencies. That is a big change: Initially, most pollution management measures promulgated in the United States were regulatory and focused primarily on pollution control technologies, says Dr. Michael Elliott, associate professor of city planning and public policy. He is interested in pollution prevention decision making within companies, and the impact of political and economic system constraints on that decision making.

According to Dr. Elliott, much of environmental pollution control policy seeks to constrain managerial prerogative by requiring specific technology-based solutions. These technologies have been seen by both regulatory agencies and by corporate management as technology add-

ons. These technologies frequently did little more than remove pollutants from air or water and transfer them to landfills.

Pollution prevention, on the other hand, requires more basic changes in modes of production, materials purchasing, operation and maintenance systems. Such systems are too specialized to be effectively regulated. Rather, they require fine-tuned decision making within each facility. As such, public policy to promote pollution prevention will work best when policy enhances the likelihood that corporate managers will actively seek to prevent pollution. Fine tuning public policy to address the concerns of corporate managers in various industries is essential to this effort.

The EPA and many states are experimenting with pollution prevention programs. One of the earliest programs was the EPA's 33/50 program. This program targeted 17 chemicals for reduction. Companies that volunteered for the program committed to reducing their release of these chemicals. Across all corporate volunteers, EPA sought a 33 percent reduction in toxic releases by 1992 and a 50 percent reduction by 1995. In return, EPA's program provided an opportunity for the companies to be publicly acknowledged for their pollution prevention programs.

The program proved popular. Following its apparent success at marshalling corporate support for pollution prevention, EPA and state agencies developed other voluntary programs. What these programs have in common are efforts to increase corporate incentives to voluntarily reduce pollution. Publicity for pollution prevention activities, technical assistance to promote awareness, and changes in liability associated with toxic releases are all examples of policy aimed at corporate management.

"These programs have not been evaluated extensively, but what has come out suggests that in fact they can work reasonably well," Elliott says. "The focus on managerial solutions and organizational determinants of pollution prevention is a growing trend. We are going to see a lot more environmental improvement through efforts to flexibly alter corporate decision making."

These researchers' findings mean that pollution prevention is more than technology application -- a company's success is often linked to its organizational culture and how it approaches the problem as a result of that culture, Foley says.

"Pollution prevention programs that are really doing their jobs would be invisible within other programs at a company -- we would become part and parcel of that whole organizational process," she explains. "And that's what pollution prevention is supposed to be: Instilling an ethic or attitude change, such that people adopt a pollution prevention stance in everything they do."

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HyperTech:

Meeting the challenges of the Information Age

HyperTech's improvements make large map, database, photo and text files accessible to all computer platforms -- even when users are on location away from their offices.

By Lea McLees

ACCESSING LARGE AMOUNTS of different types of data -- map, database, aerial photo and text files -- can be difficult using a conventional database interface like the one on your home or office computer. Now imagine trying to access such data at a remote location in Asia, or via a laptop computer during a business flight to Europe. How do you access all the information you need?

HyperTech, a graphical hypertext interface being developed at the Georgia Institute of Technology with funding from the U.S. Air Force's Rome Laboratory, may put the information right at the user's fingertips. HyperTech accesses large amounts of diverse information -- but unlike many of its predecessors, it uses a standard, commercial relational database system called Sybase. Not only is Sybase the Air Force standard, it also is heavily relied upon in the business world, says senior research engineer Kirk Pennywitt of the Georgia Tech Research Institute (GTRI).

Susan Liebeskind (left), the technical director on the HyperTech project, leads programming design. She and Kirk Pennywitt, a principal investigator on the project, discuss their work.

"Although our system is based on a Sun UNIX platform, the data can be exported to HTML [Hypertext Markup Language], the language of the World Wide Web," says Pennywitt, who is HyperTech's project director and works in GTRI's Information Technology and Telecommunications Laboratory. "HyperTech can be read by people on other computers using World Wide Web browsers available for PCs, Macintoshes, Unix and every other major type of computer platform."

Hypertext is a way of displaying information differently from the usual word processing methods. Instead of writing and reading page by page, as one does with a book, hypertext allows a computer user to display and traverse information as logically related pieces. Dr. Jay David Bolter, a professor in Georgia Tech's School of Literature, Communication and Culture, provided most of the input on how the

hypertext interface should work.

"Electronic links in a hypertext can deliver information to a user according to his or her immediate needs and interests," says Bolter, a principal investigator on the project. "Let's say the hypertext contains a political map of the United States and that demographic information is linked to the coordinates of each state or city on the map. By clicking on a particular city or state, the user receives exactly the information that he or she is seeking."

Working with Pennywitt and Bolter on the project are Susan Liebeskind, the technical director, who is leading programming design; Maria Hybinette and Phillip Hutto, automated linking coding; Janis Roberts and Eric Ayers, user interface coding; Stephen Arnold, database coding; and Kelly Johnson and Susan Hatcher, user documentation and usability testing.

THE RESEARCHERS DEVELOPED HyperTech to work with the Air Force's "Electronic Footlocker" concept of storing information digitally, ready for deployment to remote locations, Pennywitt says.

"So, for example, you have information on a foreign country and a situation arises there -- you extract all the pieces of relevant information from the Electronic Footlocker, put it on tape or CD-ROM, and ship it off with people when they head for the field," Pennywitt explains. "You might have information consisting of message traffic, maps, photographs, reference information and other items to store in that digital format."

HyperTech lets users create links between pieces of information where an association might not be obvious. A link, familiar to hypertext and World Wide Web users, is an underlined or highlighted word or symbol -- and by clicking on it using a mouse, the user is transported to a related document.

"You could have an article talking about the economics of certain products and that could relate back to the strategic importance of a certain country," Pennywitt said. "Basically the operator can traverse the information in non-linear fashion."

HyperTech will allow users to update databases while they are on location or in the field, so they are acting on the most current information possible. In addition, this particular interface avoids one of the main problems hypertext users encounter frequently: following so many paths within the information that they become lost.

"Our system provides a navigable map of all the data elements of the system," Pennywitt explains. "Pieces of information are represented as boxes, and the links are presented as arrows going in and out of them, so you can see which elements are linked to others, and how."

HyperTech also provides multi-user support so more than one person can access information at one time. Multimedia support for text, graphics, video and sound are standard features. The researchers are using off-the-shelf products whenever possible, Pennywitt says.

"That's easier for users to maintain, and is generally a more economical way of developing things," he explains. "Because it's based on a relational database system, we have a theoretical capacity of about two billion data elements. That is considerably greater than most other hypertext systems."

If those two billion data elements each consisted of a half-page of text, this would equal over a trillion characters, enough to fill 1,500 encyclopedias.

AMONG THE CHALLENGES the researchers faced in developing the interface was a lack of commercial tools for developing hypertext Unix-based programs. For example, they had to develop many components for the text editor to support embedded graphics, different fonts and style characteristics.

By March 1996, the researchers hope to make HyperTech capable of automatic link generation, solving the problem many users face -- time to create all the links they need between databases. They also plan to develop customizable views of the data. The user can filter the information presented to fit individual needs; for example, the user can limit the number of links presented by limiting linked documents to those "related to Somalia," "containing digitized photographs," or "larger than 32K," for example.

The researchers also plan to optimize the HyperTech's interface's performance based on user feedback and additional usability testing.

"Hypertext is a constantly evolving research area," Pennywitt says. "We would like to incorporate as many exciting and useful new developments into the program as possible."

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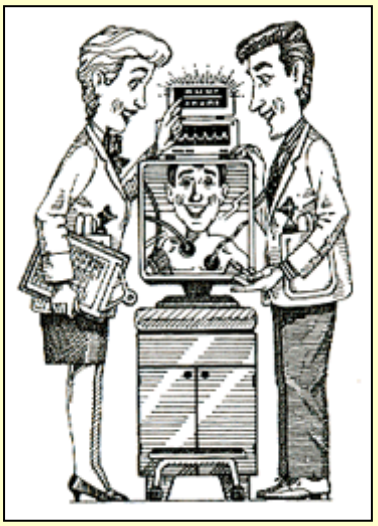
Research Notes

Future Vision: Electronic House Calls by Doctors



The same co-axial wiring that now brings cable television programming into our homes may soon link us with our doctors when we are sick.

Georgia Tech researchers are teaming with colleagues at the Medical College of Georgia's Telemedicine Center to develop "proof-of-concept" capability for delivering medical care to patients at home via telemedicine.

With funding from the Army Medical Research and Development Command, researchers will develop and install telemedicine units in the homes of 25 patients and in one nursing home. These units will be linked to medical communication hubs at the Medical College of Georgia and Eisenhower Army Medical Center. These hubs will be staffed 24 hours a day by medical professionals who can be in contact with the patients by two-way audio, video and data links.

Patients for this project will be selected by doctors, and will be persons who frequently need to see their doctors for relatively minor illnesses. The telemedicine units in the home will be equipped with an array of diagnostic devices tailored to the medical needs of the patients selected by the doctors. Output from these diagnostic devices will be forwarded to the medical hubs using the cable television coaxial cable.

Under this concept doctors will be able to "see" their patients electronically, without requiring the patients to physically travel to a hospital or doctor's office.

"It's quite probable that this type of patient diagnosis will prove successful and cost-effective," said Jim Toler, Co-director of Georgia Tech's Bioengineering Research Center. "If that happens, the way medical care has historically been delivered will be drastically changed in the future."

Researchers on this project are aware of only one project similar to this one, and it involves three patients.

Southeastern Telemedicine Alliance Formed

An alliance of six major Georgia medical and technology organizations has joined together to further the development of telemedicine.

The Southeast Telemedicine Alliance (STA) is made up of the Georgia Institute of Technology, the Medical College of Georgia, Georgia Baptist Medical Center, Emory University School of Medicine, the Morehouse School of Medicine, and the Eisenhower Army Medical Center. Via these organizations the Alliance represents the telemedicine interests of civilian, military, public, private, university-based, non-university-based, medical and technical entities. Members currently are identifying telemedicine organizations in other southeastern states so they can be invited to join, says Jim Toler, co-director of Georgia Tech's Bioengineering Research Center.

"With the formation of the Alliance, telemedicine information and plans across the Southeast can be exchanged in ways beneficial to all," Toler says.

Current members are sharing information on existing telemedicine programs, discussing technical approaches appropriate for future telemedicine efforts, seeking joint support from telecommunications companies, and responding collaboratively to federal solicitations for telemedicine-related research proposals.

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Georgia Tech Awarded $9.5M for Molecular Design Institute

Georgia Tech heads a group awarded almost $9.5 million by The Office of Naval Research (ONR) and the Georgia Research Alliance (GRA) to create a Molecular Design Institute (MDI) for the study and synthesis of new materials. The group includes partners at Clark Atlanta University, Emory University, the University of Tennessee, Oak Ridge National Laboratory, Naval Research Laboratories, TDA Research, Texaco and Exxon.

"I was pleased, but not surprised, to learn that the Office of Naval Research had selected Georgia Tech for the Molecular Design Institute," said Georgia Tech College of Sciences Dean Dr. Gary Schuster. "Our College of Sciences and College of Engineering are uniquely qualified to advance the discovery and development of new materials that will define progress in the 21st century."

The ONR selection was based on five criteria: overall scientific and technical merits; the candidates capabilities, related experience and facilities; the qualifications and experience of the principle investigators and key personnel; realism of the proposal costs; and the amount of matching funds.

Each MDI (one also was awarded to Lawrence Berkeley Laboratory in Berkeley, Calif.) is focused around a core institution. The institution must have strengths in all aspects of the related sciences (solid state physics, material science and inorganic and organic chemistry, biochemistry and molecular biology) along with demonstrated successful experience in coordinating multi-institutional programs and in participating in technology transfer with U.S. industry.

"Investigators at the institute will focus on discovering the insight that nature offers in making materials and then apply those methods to preparing new, superior materials," said Tech MDI Director Dr. William Rees.

In the past, materials were pulled from known stockpiles and elements were added to compensate for a determined weakness. By designing new materials for specific applications, scientists and engineers can eliminate a waste stream, increase overall efficiency and create presently unknown materials based on nature, the best known model available.

In submitting the proposal, Tech built in a strong educational component, Rees added. In all, Tech will be able to use ONR funds for 30 to 45 graduate positions across several academic units over the next five years.

"This institute allows us to educate a new generation of scientists and engineers who approach important problems from the perspective of the design of materials for specific applications," he said.

"The true beneficiaries of the Molecular Design Institute will be the students whose outlook will be broadened by participation, and the citizens of Georgia and the nation who will be rewarded by the discoveries that will certainly be forthcoming," added Schuster. "Tech is the right place at the right time for a forward looking agency like ONR to turn to for discovery. Support from the GRA and from Tech's central administration demonstrates again the commitment to excellence in learning and research."

GRA funds will be used in MDI to purchase equipment and to support eminent scholars (Tech will have two eminent scholars, and Emory will have one).

"The institute's focus on partering industry, university and government to promote the design of new bio-materials clearly set this initiative apart from the competition," said GRA President Bill Todd. "This outcome is precisely what the Georgia Research Alliance was formed to facilitate."

Initial funding from the ONR is $490,000, with $4 million committed to come later this year. The GRA funds for MDI are for $5 million over five years.

Further information is available from Dr. William S. Rees, Jr., Molecular Design Institute Georgia Institute of Technology, Atlanta, GA 30332-0400. (Telephone: 404/894-4049) (FAX: 404/894-1144) (E-mail: will.rees@chem-mail.gatech.edu)

Detector of Future Will Warn Motorists of Traffic Hazards

Radar detectors of the future will warn motorists of road construction, approaching emergency vehicles, wrecks ahead and other potential hazards, with the application of technology being developed by the Georgia Tech Research Institute.

"The next generation of radar detectors will have the capability to display safety warning messages to motorists," says principal research associate Gene Greneker. "We are developing a communications standard for the manufacturers sponsoring this study through the industry group RADAR. They will use the standard in manufacturing the next generation of radar detector warning systems."

RADAR is a trade association representing the radar detector industry with participation by Bel-Tronics, Sanyo-Tecnica, Uniden, Whistler and other radar system manufacturers.

Rob Pauley (left), Dr. Gene Greneker (center) and Bruce Warren (right) examine a radar detector. They are investigating how to send encoded signals that detectors would decode and convert into traffic hazard warnings for drivers.

Greneker and colleagues Rob Pauley and Bruce Warren are investigating the optimum way to send encoded signals to radar detectors so they not only pick up the signals, but also decode them and display a warning to the driver. The warning will correspond to the hazard the signals indicate, such as a wreck or road construction, Greneker says.

With the development of this technology, police and other traffic safety agencies could put portable transmitter systems along roads to transmit the necessary safety warning messages to radar detectors in approaching vehicles. One of numerous safety messages could be selected for transmission by the warning transmitter.

The technology is being developed so that it will cause the current generation of detectors to alarm, as well. An estimated 10 to 20 million detectors are in use now, Greneker says.

"We are depending on those existing radar receiver systems, too, to slow traffic approaching highway work zones, emergency vehicle right-of-ways, and rail crossings during a train's approach," Greneker says. "While motorists using a present generation detector and approaching a safety alert area will not know why their detectors are alarming, they will know to slow down a proceed with caution -- and this achieves our objective."

The project maintains liaison with the Federal Communications Commission regarding the authorization of the system to operate in the 24 GHz part of the radio spectrum.

In the future, the system may undergo testing by departments of transportation in several states.

Further information is available from Dr. Gene Greneker, Sensors and Electromagnetic Application Laboratory, Georgia Tech Research Institute, Georgia Institute of Technology, Atlanta, GA 30332-0857. (Telephone: 404/528-7744) (E-mail: gene.greneker@gtri.gatech.edu)

Georgia Tech's Research Link to European Community

Located in Metz, the capital of northeastern France's Lorraine Region in the heart of Europe, Georgia Tech Lorraine is the first full-fledged graduate engineering program offered by any American university in Europe. It was founded in 1989 to provide graduate education, sponsored research and continuing education to European and North American students. Georgia Tech Lorraine is organized as a nonprofit organization operating under French law.

Current degree programs are offered in electrical engineering, but later will be broadened to include management, as well as other engineering and scientific disciplines.

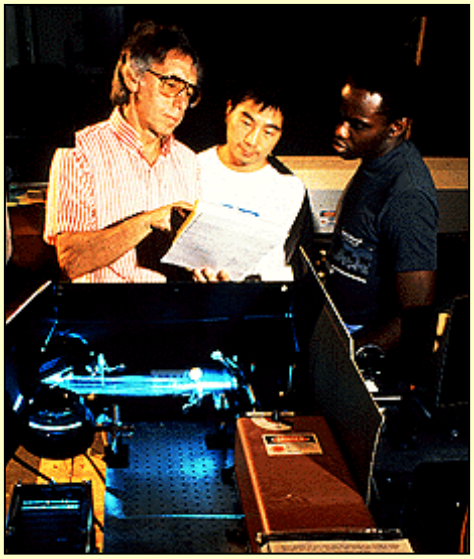
Sponsored research focuses on opportunities of special interest to the European community. Present research activities are oriented toward the telecommunication and related industries and involve digital signal processing, with special emphasis on image and speech processing; telecommunications systems and technology; and systems theory.

Further information is available from Dr. Hans B. Puttgen, School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, GA 30332-0250. (Telephone: 404/894-2927) (E-mail: hans.puttgen@ee.gatech.edu)

Aerospace Researcher Named to National Academy

Dr. Ben T. Zinn is Georgia Tech's most recent recipient of one of the highest professional distinctions accorded an engineer--election to membership in the National Academy of Engineering (NAE). Zinn is a Regents' Professor in the School of Aerospace Engineering, with a joint appointment in the George W. Woodruff School of Mechanical Engineering. He holds the David S. Lewis Jr. Chair.

NAE membership honors those who have made "important contributions to engineering theory and practice, including significant contributions to the literature of engineering theory and practice," and those who have demonstrated "unusual accomplishment in the pioneering of new and developing fields of technology," according to NAE. Zinn, the co-holder of seven patents in the field of pulse combustion, is recognized for contributions to understanding unsteady combustion processes.



Dr. Ben T. Zinn (left), recently named a member of the National Academy of Engineering is recognized for contributions to understanding unsteady combustion processes.

"I was surprised and thrilled to get this award," said Zinn. "It would not have been possible without the support of Georgia Tech and the contributions of my colleagues and students."

Zinn came to Tech in 1965 after completing his Ph.D. studies in aeronautical engineering and mechanical science at Princeton University. He attained the rank of Regents' Professor in 1973. His fields of research have included liquid and rocket combustion instabilities, ramjet and jet engine combustion instabilities, oscillatory flame phenomena reacting flows, soot formation, acoustics of complex geometries, wave propagation in nozzles and pulse combustion.

Zinn's election brings Georgia Tech's total of active NAE members to 12, giving the Institute "more active members than the University of Michigan, the University of Illinois, and Purdue University," said Tech Executive Vice President Mike Thomas.

The hallmark of the NAE's 1,800 members and foreign associates is personal engineering achievement. Members are elected by their peers and drawn from all engineering disciplines; they include leading engineers from industry, academia, government and other institutions.

The National Academy of Engineering was founded in 1964 to advance engineering and technology. It conducts its activities jointly with the National Academy of Sciences. The NAE is a private, independent nonprofit institution that serves the nation in two broad ways. It acts as adviser to the federal government, and, through its independent programs, it provides a channel for the advancement of engineering and technology as benefits humanity.

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Georgia Institute of Technology

A Vital Link

Breadth of knowledge has served Mike Rodgers -- and air quality -- well in a culture hallmarked by specialization.

By Lea McLees

UNCONVENTIONAL. UNUSUAL. A TRANSLATOR. The two adjectives might describe Dr. Mike Rodgers' approach to knowledge. The noun names what Rodgers does with what he learns.

"The majority of my career has been spent getting people with different disciplinary foci to work together," he says. "You can't assume that good things will happen just because you've put people together."

Rodgers trained as a physicist. His first full-time job was working as an engineer, and he earned his Ph.D. in an interdisciplinary field that combines meteorology with chemistry.

"As a consequence, I've been professionally exposed to many different fields and have worked to develop what I generally refer to as a 'Scientific American' understanding of a lot of different areas," he says.

In a society where scientists increasingly have been trained to develop depth of knowledge in specific areas -- a vertical orientation -- that makes Rodgers something of an exception.

"Depth of knowledge has substantial merit," he says. "A veneer of knowledge in many fields can be more dangerous than useful, because it can lead to insanely wrong conclusions at times. In my own case however, I felt it desirable to sacrifice some depth of knowledge to gain additional breadth."

Why? Because managing the air quality issues in which he is an expert requires more than just an understanding of molecular changes in the atmosphere. It demands interaction among people from policy, chemistry, transportation, industry and other backgrounds -- and in most cases, someone to help them relate to each other.

"It's important to have sufficient breadth to be able to serve as a linkage between disparate groups of more specialized individuals," Rodgers says.

Being a translator does have its drawbacks, though.

"You have to be prepared never to be the most knowledgeable in any area," Rodgers says of his work. "Somebody is always better than you at everything. I work with very good specialists."

A Broad Background

Rodgers' background and everyday duties encompass many of the fields of the specialists he brings together on large projects. His undergraduate and graduate training at Georgia Tech was in optics and lasers, his bachelor's and master's degrees in physics. He worked for many years developing laser-based instruments that detect atmospheric chemicals, and completed a doctorate in atmospheric sciences. His dissertation on detecting atmospheric nitrous acid in Atlanta won the Sigma Xi outstanding doctoral dissertation award at Georgia Tech. Gradually, his interest moved from lasers to atmospheric chemistry, and then to collecting data on the polluted environment.

Rodgers is jointly appointed to Georgia Tech's School of Earth and Atmospheric Sciences and School of Public Policy, and has taught in Georgia Tech's College of Engineering, College of Science and the Ivan Allen College of Management. His graduate students have majors ranging from civil or environmental engineering to public policy or earth and atmospheric sciences. In recognition of his work, he was among the first Institute Fellows named at Georgia Tech in 1994. The Fellows are outstanding scholars in the early to middle years of their professional development who show potential for major contributions as future leaders.

An Air Quality Laboratory

Among the challenges Rodgers is proudest of meeting -- one that paved the way for bringing diverse groups of researchers and other colleagues together -- was putting together Georgia Tech's Air Quality Laboratory (AQL). He began working toward that goal with two graduate students in 1987; this summer the lab will include 55 staff members and students, and it is still growing.

Starting the lab was difficult, he explains, because university atmospheric chemistry groups historically have been rather small and disciplinary-specific -- a professor and few graduate students, for example.

"The interdisciplinary nature of atmospheric chemistry and the very large number of chemicals that you have to measure, however, means that measurements in isolation are rarely very useful," Rodgers said. "Measuring many different things generally requires a lot of different capabilities, and historically that's not been the province of individual university research groups. The development of the Air Quality Lab to a substantial scale was necessary for being a full partner with the federal labs in major research projects."

Located within Georgia Tech's School of Earth and Atmospheric Sciences, the lab is now among the world's largest university research groups in air chemistry. AQL will be responsible for approximately $3 million in sponsored research during 1995. Rodgers has worked to develop a strong research infrastructure at Georgia Tech that has spawned several university based programs -- as well as collaboration and coordination with government labs, private industrial firms and others in which universities could be full partners.

Organizing large air quality programs and successfully executing them has become one of Rodgers' trademarks. One of the most influential of the programs he helped lead is the Southern Oxidants Study (SOS), an alliance of universities, state and federal agencies and industries conducting intensive research into the formation of ground level ozone air pollution in the United States. He was an original principal on the project. As mission scientist for the summer 1992 Atlanta Intensive portion of SOS, Rodgers led about 150 scientists in collecting data on ozone pollution issues. He was the program scientist for the Southeastern Regional Oxidant Network (SERON), which is part of SOS and manages network operations and data analysis. Now, he serves with colleague Jim Meagher of the Tennessee Valley Authority as chief scientist for SOS' chemical and meteorological measurements program.

Rodgers also is co-director, along with Mike Meyer of Environmental and Civil Engineering, of the Georgia Tech Research Partnership for Mobile Source Emissions Research. The program is the U.S. Environmental Protection Agency's (EPA) National University Center of Excellence in mobile source emissions research. Georgia Tech is participating with partners EPA, General Motors, Ford and Toyota, along with some engineering consulting firms.

"SOS and the mobile source research center are complex and integrated programs," Rodgers said. "I think that's something unusual for universities to do, and I think we've been successful at it."

In the Lab

Atmospheric chemists face one major problem every day, Rodgers says: Many things are going on at once in a constantly changing environment of wind and weather, humidity, and solar radiation.

"The experiments are difficult to perform, and concentrations of many important compounds are very low. This often requires the very best analytical methods available," he says. "Often the weaknesses of techniques and technologies that work well under laboratory conditions become strongly exposed when mounted on an airplane, or when you are sitting in the middle of a muddy field in a rainstorm in mid-summer in Baton Rouge. That's where the real challenge comes in."

The challenges of atmospheric chemistry are similar to those faced on a larger scale in managing the environment. Policy, legislation, regulation, scientific research and industrial production are evolving simultaneously, and at different speeds. As a result, Rodgers encourages his graduate students to cross-train themselves in different disciplines. Many are getting Ph.D.s in one area of expertise and master's degrees in different areas -- combining civil engineering and public policy, for example. The students will be naturals for attacking certain types of interdisciplinary problems, he maintains.

"A person who is professionally competent in both policy and air quality, or in economics and air quality, has many advantages in research on economic incentive controls as a replacement for regulation compared with two specialists who are trying to communicate with each other," he explains.

The Future of Air Quality

The most important change developing in air quality and other environmental areas is a switch from a problematic to a management viewpoint. Historically, air pollution and quality have been looked at as problems to be solved -- and some of the biggest have been deciphered, Rodgers notes.

"Now I think we recognize that the chronic problems are the most difficult -- the ones that are most closely related to our lifestyle," Rodgers explains. "I use the word 'manage' instead of 'address' or 'solve' because for the rest of our life on this planet, we will be 'managing' environmental problems. It requires re-thinking a lot of the ways we do things, from product development to engineering and production."

Managing environmental issues such as air quality also requires the recognition of scientists that their work is increasingly linked to policy. In fact, Rodgers believes that scientists doing air quality research are also doing air quality policy, whether they acknowledge it or not.

"The work that you do impacts public decision-making. I think it is very important for scientists to begin to recognize that, and to actively interpret their results for laymen and decision-makers, rather than depending on others to do that translation," he says. "My suggestion is not that scientists have to go the point of becoming policy analysts -- but very often, it just isn't enough to send a publication to a scientific journal and believe that we have discharged our social responsibilities. Trying to express the real issues of air quality in terms that non-specialists can understand is an extremely important part of what we do."

Scientists consume large chunks of public resources, Rodgers notes.

"In my own research this year the Air Quality Lab is receiving more than $3 million in sponsored funds," he says. "That's more than a dollar for every Atlantan. We need to give them news they can use, but not in some esoteric form."

To that end, Rodgers works with lay groups and policymakers to help them understand air quality research and its implications. He speaks to civic and professional groups that examine the role of scientists in society and managing air quality. And Georgia Tech's air quality laboratory maintains long-standing relationships with teachers and students in area junior and high schools -- going to the classroom, and bringing teachers and students to the lab.

Rodgers continues to be a translator of air quality research and related issues from the lab to students, policymakers, legislators, engineers, industry and colleagues in other disciplines. Ultimately, he predicts, experts in all scientific and technological fields must make a similar commitment to change -- and to interdisciplinary solutions -- thus adding some breadth to an extraordinary and admirable deep understanding of the ways things work.

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