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Research Horizons

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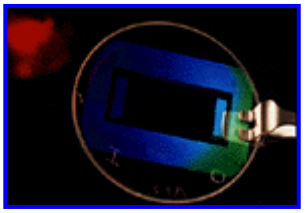
Food Processing for Tomorrow



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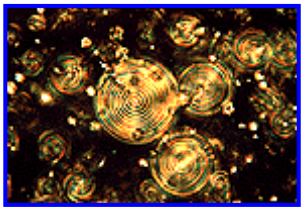

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Research Horizons
Georgia Institute of Technology

Food Processing for Tomorrow

FoodPAC promises safety, better quality for processors ... and consumers

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By Dara O'Neil

"FOOD IS AMERICA'S TOP BUSINESS -- largest of all the country's manufacturing industries." So says a 1993 special report published by the Institute of Food Technologists. In 1990 alone, Americans spent $546 billion on food.

In Georgia, the thriving food processing industry makes shipments of food products valued at more than $12 billion. In 1990, almost one in four employed persons in Georgia worked in the food industry. The food processing industry's impact is felt in nearly every corner of the state.

Despite the food industry's success, public concerns about food safety, nutritional value, worker safety and environmental impacts can overwhelm even the most conscientious company. Changing market conditions also pose challenges to companies seeking to introduce products, control costs and establish new markets in an expanding world economy.

To help Georgia meet these challenges, Gov. Zell Miller initiated the Food Processing Advisory Council (FoodPAC) in 1993 to enhance the competitiveness of Georgia's food processing industry. FoodPAC is part of the governor's new economic development thrust for Georgia's traditional industries -- food, textiles and paper. It is a public-private partnership of university, government and industry participants.

RELATED STORIES:

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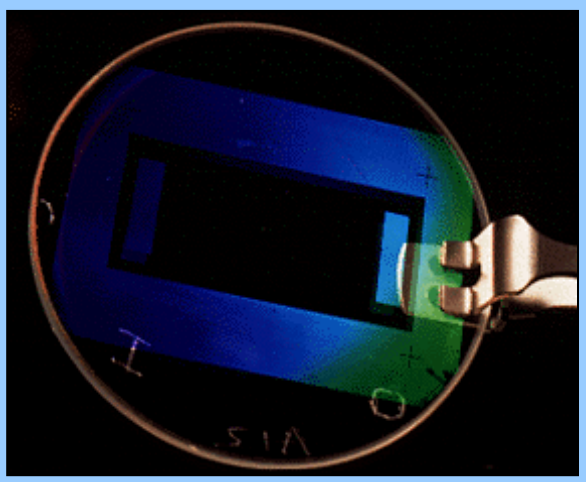


This sensor uses laser-based technology to detect salmonella bacteria in a fraction of the time that other methods require.

FoodPAC's goal is to make Georgia the national and international leader in food processing by the 21st century, by enhancing the competitiveness of the state's food processing and allied industries. While its primary focus is on helping existing industries grow, it hopes to attract new companies, as well.

One of FoodPAC's primary objectives is to move developments out of university laboratories and into the workplace, says Randy Powers of the Governor's Office of Planning and Budget.

"We are forming working alliances both between industry and the university system and between units of the university system," Powers explains. "Early results are showing that collaborative team development is working well."

A biosensor being developed at Georgia Tech, for example, will be tested by food safety experts at the University of Georgia's (UGA) Center for Food Safety and Quality Enhancement. Working together, these schools are moving toward a product that will help Georgia's food processors in their efforts to deliver safe, wholesome products.

Craig Wyvill of the Georgia Tech Research Institute (GTRI), chairman of the FoodPAC Process and Products Competitiveness Technical Subcommittee and coordinator of FoodPAC at Tech, says the initiative is built on a solid foundation that, to a large extent, already exists in

Georgia. "Our food industry and university research programs are very progressive."

Coordination and collaboration, however, have not always been what they could or should be, he says. This initiative can propel Georgia to the forefront of the international food sector.

"Cutting-edge food support activities for industry promote economic expansion, and attract new food processors and allied companies to Georgia," he explains.

Public forums addressing critical issues that affect industry competitiveness helped insure that FoodPAC was focused on the needs of state processors, says Jimmy Hill, FoodPAC chairperson.

"FoodPAC held fact-finding meetings, talked to industry associations, and held one-on-one sessions with key industry owners and leaders to fine tune action plans," Hill says.

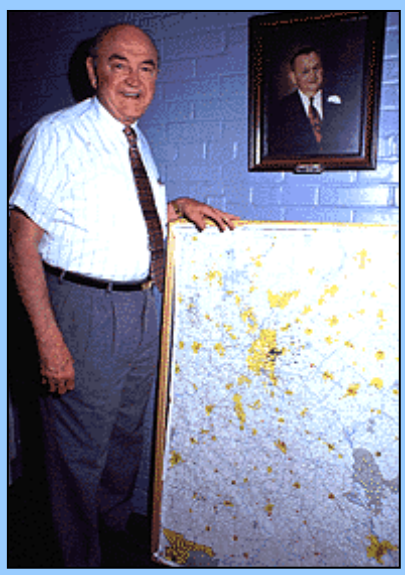
The initiative's planning committee identified four areas of critical importance to Georgia's food industry: process and product improvement; food safety; environmental management; and human resource development. The committee recently integrated human resource development into each of the other three areas.

The technologies developed through FoodPAC -- while designed specifically for Georgia's food processing needs -- will help food processors outside the state, as well.

Process and Product Improvement

Food processors in Georgia and elsewhere are always searching for ways to meet changing consumer demands while delivering products that meet expanding markets for healthy, convenient foods. The food industry thrives on process techniques that take environmental constraints into account, meet food safety requirements and produce high quality products for consumers.

Process efficiency in the food industry can be achieved by incorporating advanced technologies that lower unit costs and improve overall product quality, contributing to higher profits. Finding ways to reduce the number of unskilled human links in automatic materials handling systems could be an important breakthrough in reducing workplace injuries resulting from highly repetitive activities. Developing better methods of producing food and enhancing the nutritional value of foods are important, as well. FoodPAC has sponsored projects at GTRI and UGA to enhance the food industry in these areas. These include:



Billy Thomas, president of Thomas Packing in Griffin, Ga., says FoodPAC environmental outreach and technical programs help business people decipher regulations affecting their industries.

- Field assessments are crucial to understanding industry needs. Senior research engineer Mike Burrow of GTRI's Electro-Optics, Environment and Materials Laboratory is part of a team conducting field assessments of Georgia's food processing plants. Often one plant's needs are the same as those of others in an industry, Burrow says, so several plants usually benefit from suggested improvements. Burrow and his colleagues identify existing technologies such as robotics and automation that can help food processing plants.

- Senior research engineer Wayne Daley of GTRI is directing an effort aimed at developing advanced sensor technologies to help automate quality grading, with the goal of improved productivity for Georgia's food processors.

- Daley's colleague, GTRI research engineer Chris Thompson, is investigating opportunities to improve informational linkages for Georgia's food industry. He is evaluating an advanced communications infrastructure that would connect Georgia's food processors and researchers through computer interlinks.

- At UGA's Department of Food Science, Dr. Romeo Toledo is developing a Food Processing Center to provide prototyping, and scale-up process assistance and technology transfer to Georgia's food processing industries. Process scale-up involves studying a process and designing a continuous, large-scale processing operation to replace the single batch test operation. Georgia Tech researchers and members of the public and private sectors will be able to use the facility to test process and product innovations under simulated industrial processing plant conditions.

- Faculty from Georgia Southern and Valdosta State universities are working to define the reasons why some sectors of the food industry in Georgia are struggling.

Food Safety

Food safety and quality are among the most important issues for American consumers and the food industry. Innovative methods that detect and control harmful bacteria in foods reduce human illness and the cost of product recalls. Arresting microbial and chemical hazards in foods during processing is the most effective way to prevent costly food- poisoning outbreaks or product recalls mandated by regulatory agencies.

- UGA's Center for Food Safety and Quality Enhancement has received support from FoodPAC to upgrade its facilities and undertake a number of studies to enhance ways of reducing pathogens in food products.

- A device being developed at Georgia Tech promises to revolutionize how food safety is tested. Principal research engineer Nile Hartman, research scientist Dr. Dan Campbell and Dr. Paul Edmonds, an associate professor in the biology department, are developing a rapid-response biosensor that detects dangerous food-borne pathogens in a fraction of the time normally required. They will test the biosensor in conjunction with UGA's Center for Food Safety and Quality Enhancement in Griffin, Ga.

Environmental Management

Each step in food processing affects the environment. Practical and economically justified processing modifications are imperative to minimize the number of natural resources used and amount of waste products generated in processing. To reduce adverse environmental effects and the economic burdens of complying with laws and regulations, researchers at Tech and UGA are analyzing food processing techniques. They use environmental testing facilities at GTRI and at UGA's Biological and Agricultural Engineering Department to address waste problems and assess the environmental impacts of new processes.

- Outreach programs make advanced technologies known to and effective for the food processing industry. Senior research engineer Jim Walsh conducts workshops and provides technical assistance on food processing environmental topics. Programs such as his half- day seminars, funded through FoodPAC, provide a wealth of information that many food processors otherwise would have difficulty obtaining. FoodPAC environmental outreach and technical assistance programs like these have helped Billy Thomas, president of Thomas Packing in Griffin, Ga., to better understand how environmental regulations affect his business. "The average small-business man does not have time to decipher the environmental regulations," Thomas explains. "If he did, he wouldn't have time to run his business."

Poised for Success

Georgia's food processing research and development infrastructure has benefitted greatly since FoodPAC's initiation. Major upgrades in university food processing research facilities are allowing research projects to be accelerated. FoodPAC's steering committee is encouraging broad participation by Georgia's more than 700 food processors. Working alliances are forming among researchers, equipment manufacturers and food processors that promise to bring exciting new advances to plant floor operations.

Georgia's food industry certainly appears to be poised to achieve the vision of this initiative.

Further information is available from Craig Wyvill, Electro-optics, Environment and Materials Laboratory, Georgia Tech Research Institute, Georgia Institute of Technology, Atlanta, GA 30332-0823. (Telephone: 404/894-3412) (E-mail: craig.wyvill@gtri.gatech.edu)

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Research Horizons
Georgia Institute of Technology

Managing the Nile

A Tech-designed system will help planner more effectively manage the mother of rivers

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By Amanda Crowell

THE SPECTACULAR WATERS of the Nile River flow like blood through the veins as they move north from the Equatorial Lakes to the Mediterranean Sea. For the people of eastern Africa, the river is life itself. It feeds their soil, growing crops and sustaining livestock. It fuels their economic development. It is the source of religious traditions and rituals that give their lives meaning.

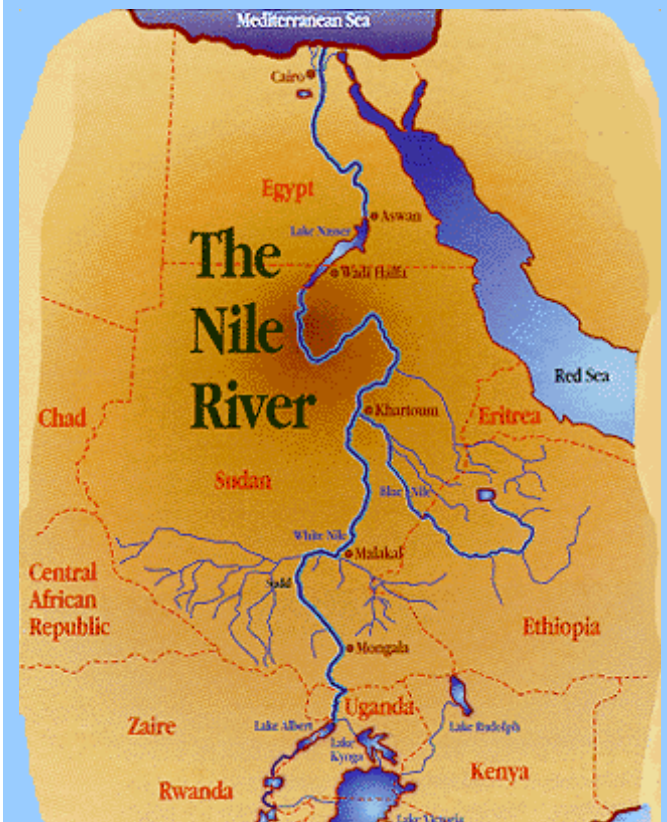
Little wonder, then, that any changes proposed along the river's 4,000-mile path, which touches the lives of 250 million people, can lead to conflicts and must be agreed upon by everyone involved.

RELATED STORY:

Water Resources Management: Challenges and Opportunities

"I think it was Mark Twain who said, 'Whiskey is for drinking and water is for fighting'," recalls Dr. Aris Georgakakos, a Georgia Institute of Technology professor who specializes in water resources. "Today and in the years to come, in many parts of the world, water is and will continue to be a serious reason for conflict ... especially when many countries are sharing a limited resource."

But Georgakakos also hopes work done here at Georgia Tech will help lessen and resolve such conflicts. Currently, he is overseeing a project to design an integrated decision support system to manage the Nile River in a sustainable way.



That means developing a system based on sound scientific research that examines the many complex factors of water management, from weather dynamics to river hydraulics to human demand. The system then becomes a valuable tool for helping policy makers and river basin planners agree on how best to manage the Nile fairly for years to come.

"To do that realistically and on a factual basis, they need to have models like the ones we developed, to quantify the impacts of alternative operational scenarios on the various water uses," says Georgakakos, head of the Environmental Hydraulics and Water Resources Group in Georgia Tech's School of Civil and Environmental Engineering, and the school's associate chair for research.

"If they have a system that they all agree upon and trust, to assess what the river can do for them, I think that they have a solid basis for communication and a good chance to resolve their differences peacefully," he continues.

The more than $10 million Nile River project is being sponsored by the United States Agency for International Development, through a contractual services agreement with the Food and Agriculture Organization (FAO) of the United Nations. A collaborative effort between Georgia Tech and the U.S. National Weather Service, it is being carried out for the Egyptian government.

Part of the system already is operating at the Nile Forecast and Control Center at the Ministry of Public Works and Water Resources in Egypt. Several Egyptian engineers and senior officials have been trained to understand and operate it. In addition, these engineers have spent time at Georgia Tech and the National Weather Service, helping to design the river forecasting and decision models.

The decision system also was discussed in October 1995 when senior officials from seven Nilotic countries--Egypt, Ethiopia, Kenya, Sudan, Tanzania, Uganda and Zaire--met in Rome, under the auspices of the FAO. Other countries affected by the Nile or its tributaries include Burundi, Eritrea and Rwanda.

Representatives who attended the meeting took stock of Egypt's progress in developing a model for monitoring, forecasting, simulation and control of the Nile. Several of them said their people need to develop more technical expertise in water resources management, an area where Georgia Tech can provide effective assistance.

Georgia Tech's educational program in water resources includes training, technology transfer activities, regular courses at the undergraduate, graduate and doctoral levels, and short courses and seminars for the continuing education of engineering professionals.

Decision support systems are used to design and operate water resources systems efficiently. They rely on hydrometeorological data, including satellite images, river flow and stage hydrographs, rainfall observations, and soil moisture distribution and changes.

Such data, gathered from satellites, radars and on-site sensors, are valuable for understanding how water resources systems work, and are much more accessible to management authorities today than in the past.

Once set up, a decision support system offers the capability to simulate the response of watersheds, rivers and reservoirs to different climatic inputs and decision policies; to predict water and power demands; and to quantify the tradeoffs among different water uses. Components also may perform water quality and ecosystem simulations, study the conjunctive use of surface and ground waters, or assess the impacts of climate changes.

The system is not meant to replace the management authorities, only quantify the pros and cons of different operational and planning options, Georgakakos says. And it must be as fluid as the rivers it controls, able to relate well to all temporal and spatial scales of interest.

For the Nile, major issues include: hydroelectric development proposed in Ethiopia, which commands the source region of the Blue Nile; regulation and future development of the Equatorial Lakes--Lake Albert, Lake Kyoga and Lake Victoria; and various conservation projects proposed for the White Nile, including construction of the Jonglei Canal in Southern Sudan, to bypass a swamp that absorbs nearly 50 percent of the Nile water passing through that area.

"Changes can have serious consequences, especially for Sudan and Egypt, the downstream nations for which the Nile is the only source of water supply," Georgakakos says.

Georgia Tech's decision system also includes an operational module for the High Aswan Dam in Egypt, looking at the day-to-day management of this reservoir, as well as how it interacts with the Equatorial Lakes and other upstream storage facilities. Built in 1968, the dam is the cornerstone of Egypt's economy. It provides a stable water supply, countering the Nile River's historic hydrologic persistence, which yields high or low flows for several years at a time.

"Because of this river feature, Egypt could not exist as we know it today without the High Aswan Dam," Georgakakos says.

However, when a river's natural regime is altered, it may affect the surrounding environment and ecology. Today, assessing and mitigating these risks has become an important part of water resources management.

"We begin to understand that whatever we do has consequences," Georgakakos says. "So in planning the development and operation of water resources projects, we must not only consider traditional water uses like hydropower, flood control, water supply, navigation and recreation, but also look at the long-term sustainability of the resource, environmentally and ecologically."

The Nile River project is about a year away from completion, but already, it is being used as a prototype for other river basins.

Similar projects are in the works for the Yangtze River in China, the Iguacu in Brazil, the Achelloos in Greece and several rivers in Mexico.

In the United States, decision support systems also have been developed for the Upper Des Moines River in the Midwest and the Southeastern U.S. reservoir system, which includes the Savannah, Apalachicola- Chattahoochee-Flint and Alabama-Coosa-Tallapoosa Rivers.

Although a handful of other universities have strong water resources programs, Georgakakos says Tech offers a uniquely integrated team approach. By designing decision support systems that pull together all the complex factors of water management, researchers hope to lead the way in changing failed practices.

In this vein, Georgia Tech will continue ongoing partnerships with the FAO, the Hydrologic Research Center in San Diego, the Office of Hydrology of the National Weather Service in Washington, D.C., and the Oak Ridge National Laboratory's Environmental Sciences Division in Tennessee.

"There are many facets to water resources, and it is very important that decision makers understand their short- and long-term interactions before formulating management policies," Georgakakos says.

"Based on the research that Tech and other research organizations have done over the past 10 to 15 years, we have made great strides in many aspects of water management," he adds. "And what is more, we have learned how to package it all into a nice system like the one we developed for the Nile."

Further information is available from Dr. Aris Georgakakos, School of Civil and Environmental Engineering, Georgia Institute of Technology, Atlanta, GA 30332-0355. (Telephone: 404/894-2240) (E-mail: aris.georgakakos@ce.gatech.edu)

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Georgia Institute of Technology

Lighting Computer Storage

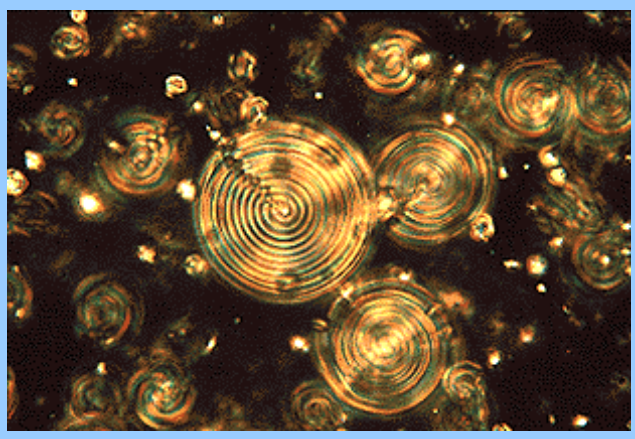
A new optical switch may revolutionize data storage

By John Toon

A LIGHT-ACTIVATED OPTICAL SWITCH under development at the Georgia Institute of Technology could be the basis for a new type of rewritable three-dimensional data storage system. By utilizing a small number of "trigger molecules" to induce a phase transition in liquid crystal materials, the system would write, read and erase information using different forms of polarized and unpolarized light.

Such an optical storage system would offer significant advantages over conventional computer floppy disks, magnetic tape and compact disks, which use two-dimensional media to store data. The optical switch materials could also be used in spatial light modulators, and in active coatings for optical fibers.

"The idea is that you would write to the liquid crystal with circularly-polarized light, read it with linearly-polarized light, and erase it with unpolarized light," explains Dr. Gary B. Schuster, professor of chemistry at Georgia Tech. "You can read, write and erase information in liquid crystal materials using this system."



A photomicrograph of liquid crystals suspended in glycerol helps provide information about the properties of the crystals.

Information about the new optical switch was presented March 25 at the 211th national meeting of the American Chemical Society in New Orleans. The research is sponsored by the National Science Foundation.

Operation of the new optical switch is based on "chiral" molecules that Schuster and his co-workers use to trigger changes in the liquid crystal. Chiral molecules exist in right- handed and left-handed forms. Each form is affected differently by circularly-polarized light -- which also exists in right-handed and left-handed versions.

When right-handed trigger molecules are struck by left-handed light, for example, they may be converted preferentially to left-handed molecules. If the chiral molecules are dissolved in a liquid crystal material, this structural change can be used to prompt a phase transition in the crystal.

The phase transition alters the optical properties of the liquid crystal material, and one way that change can be detected is by passing linearly-polarized light through the crystals. Because the linearly-polarized light can be at a wavelength that does not affect the chiral trigger molecules, reading the stored information would not alter it.

Multiple phase transition "switches" could therefore be used together to store digital information.

When the information was no longer needed, it would be erased from the liquid crystal by shining unpolarized light through it, reversing the phase changes originally made by the circularly-polarized light. Returning the storage material to its original state would make the system

truly rewritable -- and of significant potential value as a computer data storage media, for example.

Schuster believes the system is an improvement over earlier optical switches not only because it is rewritable, but also because a small number of photons can trigger the phase transition. This makes the liquid crystals amplifiers for the photonic signal.

Schuster and graduate student Jennifer Galvin are developing trigger molecules made up of bicyclic ketones substituted with a styrene group. These materials appear to satisfy most criteria needed for a two-dimensional switch and have set a record for the magnitude of their response to circularly-polarized light.

Before the switches become useful for optical data storage, they must be converted from two-dimensional layers to a true three-dimensional system.

"There are a lot of people who have thought about ways of using light for memory applications," Schuster explains. "I think the reality is that it is only going to be useful if you can do it in three dimensions. "Furthermore, that would be useful only if you don't have to write information a bit at a time, which means writing it holographically. If you could write three-dimensional holograms optically and read them, you would really have something worthwhile."

To make a three-dimensional system, the liquid crystals and their dissolved trigger molecules would need to be dispersed in a polymeric material. Microdroplets of the liquid crystal, perhaps less than a micron in size, could then be addressed individually or as groups.

Because the system would be optically-based, multiple beams of light could be used to simultaneously write information to the data storage media without interference. That optical advantage would permit large amounts of information to be packed into a relatively small space, facilitating the further miniaturization of computer systems.

Development of practical optical switches has long been frustrated by the lack of suitable materials. Optical materials studied earlier used irreversible photochemical changes to store information. That meant data could be written to them only once, limiting their practical value for computer information storage.

Though the Georgia Tech system shows promise, Schuster emphasizes that much work remains to be done before it could reach practical application.

"From a scientific point of view, looking into the future, this is what we hope to do with these materials," he says. "Our grandchildren might see the first computers based on this system."

Further information is available from Dr. Gary Schuster, College of Sciences, Georgia Institute of Technology, Atlanta, GA 30332-0365. (Telephone: 404/894-3300) (FAX: 404/894-7466).

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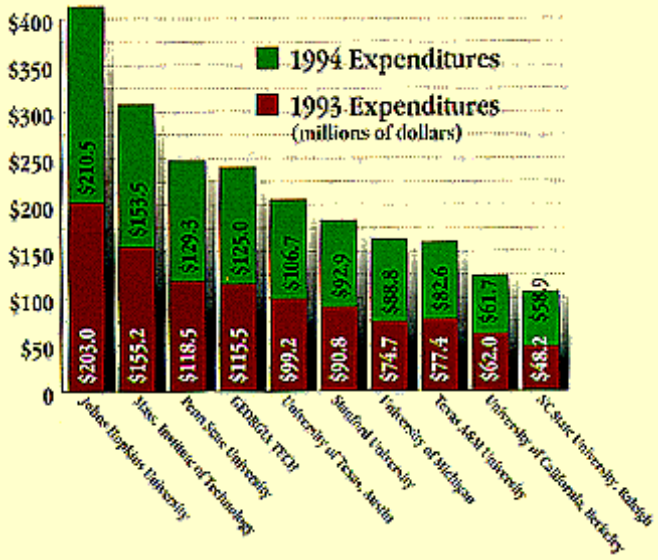
Research Horizons

Georgia Institute of Technology

RESEARCH NOTES

Georgia Tech Ranks High in Research R&D

The Georgia Institute of Technology continues to rank among the nation's top universities in the volume of research it conducts, statistics compiled by the National Science Foundation show.



For fiscal year 1994 -- the latest year for which comparison statistics are available -- Georgia Tech ranked fourth among all U.S. colleges and universities in the dollar volume of research conducted in two key categories: engineering and computer science. While the federal government provides the largest portion of its research support, Georgia Tech ranked sixth among all U. S. colleges and universities in the amount of industry-sponsored research received.

Within specific engineering disciplines, Georgia Tech ranked second nationally in amount of electrical engineering research, fourth in aerospace engineering, sixth in mechanical engineering, ninth in metallurgical and materials engineering, and 14th in civil engineering.

Among the physical sciences, Georgia Tech ranked 14th in the amount of physics research.

Overall, Georgia Tech ranked 29th nationally in total research and development expenditures with $193 million in 1994, up slightly more than 10 percent from the $175 million reported in fiscal 1993. The growth moved Georgia Tech up two notches, from 31st place in 1993.

"In an era of uncertainty for research and development funding, Georgia Tech continues to gain market share," says Dr. Jean-Lou Chameau, Georgia Tech's vice-provost for research and dean of graduate studies.

"This says a lot about the quality of our work, faculty, researchers and students. We are very pleased with our continued historic strengths in engineering, but also with the rapid improvements we are making in the sciences."

Pointing to Georgia Tech's expanding relationships with industry, he adds: "We are indebted to our industry partners, who are critical to our success, and plan to increase our interaction and research activities with industry."

Because they are collected in a consistent manner, the National Science Foundation statistics are considered the most reliable indicator of research volume at U.S. colleges and universities.

R&D Center Serves Electric Power Industry

A new research and development center at Georgia Tech is pursuing a variety of research, development, test and education programs to serve the electric utility industry, its customers and suppliers.

The National Electric Testing, Research and Application Center (NEETRAC) merges the Georgia Power Research Center's extensive human and technological resources with Tech's electric power research and instructional programs.

"NEETRAC is emblematic of the broad coalitions which must be created between industry and academia to sustain the development of innovative technologies and services," says Tech President Dr. Wayne Clough. "The convergence of interests between a large corporation, such as Georgia Power Company, and a large research university, such as Georgia Tech, has allowed for a truly unique initiative."

NEETRAC's creation is particularly timely in light of deregulation and intensified competition among utilities. As competition often leads large, vertically integrated utilities to shed their internal R&D capabilities, centers such as NEETRAC help utilities, manufacturers and end-users engage in long-term research and short-term application projects, including technology transfers.

Georgia Power will donate the equipment, buildings and land previously dedicated to its Research Center to Georgia Tech for the continued use of NEETRAC. The replacement value of the test and research equipment, buildings and land to be donated is in excess of $7 million.

NEETRAC is organized as a research and development center of Georgia Tech's School of Electrical and Computer Engineering. At least 10 corporations representing electric utilities, equipment manufacturers and utility coalitions are center members. An advisory board of executives from member companies will be established. Dr. Hans B. Puettgen, professor and vice chair in the School of Electrical and Computer Engineering, is NEETRAC's acting chair and director.

Further information is available from Dr. Hans B. Puettgen, 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)

Look Out Kids, It's "Fish-Cam" On Line

Students in Georgia soon will be making "splashes" across the Internet, thanks to a unique program that uses a marine ecosystem to teach science.

The program stems from a popular class in Georgia Tech's School of Chemistry and Biochemistry, where students conduct experiments on a 350-gallon salt water ecosystem.

Now it's set to go on line in June, thanks to support from the National Science Foundation and Georgia Tech's Center for Education Integrating Science, Mathematics and Computing (CEISMC), Center for Enhancement of Teaching and Learning (CETL), and Office of Information Technology (OIT).

Assistant Professor Kenneth D. Hughes, who teaches the Georgia Tech class, designed the new program with John Pratte, a natural sciences professor at Clayton State College. The idea arose last year during the University System of Georgia Board of Regents' Faculty Development Workshop, conducted by Kris A. Biesinger of the Office of Information and Instructional Technology (OIIT).

Once on line, K-12 schools and other colleges and universities can explore the ecosystem instead of setting up their own. Electronic probes and sensors will let students download data and conduct real-time experiments.

Participants will take turns controlling where test probes are set, and an underwater camera will give a "fish-eye" view of life in the tank.

Georgia Tech students use their test results to keep the aquarium life forms -- including fish, soft coral, sea anemones and coralline algae -- healthy. They draw water samples to examine factors like dissolved oxygen, pH levels, salinity and metal-ions, learning quantitative chemical analysis and interdisciplinary environmental themes.

The Internet project is part of ongoing work to "hardwire" Georgia Tech for high- quality, advanced telecommunications.

"This is, I think, the next level of remote or distance learning, where students are actually exploring and investigating a site and

downloading real chemical data," Dr. Hughes says.

Further information is available from Dr. Kenneth Hughes, School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, GA 30332-0400. (Telephone: 404/894-4090) (E-mail: kenneth.hughes@chemistry.gatech.edu)

Researchers Recognized for Achievements

- Dr. Richard D. Teach, a professor in the School of Management, has been elected a Fellow of the Association for Business Simulation and Experimental Learning.

- Dr. Yves Berthelot, a professor in the School of Mechanical Engineering, was named a Fellow of the Acoustical Society of America.

- Dr. Charles E.S. Ueng was recently elevated to the Fellow grade by the American Society of Civil Engineers. Ueng is a professor in the School of Civil and Environmental Engineering and is director of the Composites Education and Research Center.

- Dr. Bruce Sinclair, a professor in the School of History, Technology, and Society, was recently awarded the Society for the History of Technology's "Leonardo Da Vinci Medal." The award recognizes one scholar yearly for "outstanding contributions to the history of technology through research, teaching, publication or other activities."

- Drs. William Ditto and Uzi Landman of the School of Physics are among 50 people "shaping the future of our industrial culture and America's technological policy," according to Industry Week magazine. Ditto, an assistant professor, and colleagues developed a new understanding of how chaos theory can be used to treat certain human diseases. Landman, a professor and the director of Tech's Center for Computational Materials Science, investigated changes in the properties of microscopic wires with his colleagues -- their findings help engineers miniaturize electrical devices.

- Drs. Donald Ratliff and Satya Atluri are Georgia Tech's newest members of the National Academy of Engineering. Atluri is an Institute professor and Regents' professor of Engineering and Aerospace Engineering. Ratliff is a Regents' professor in the School of Industrial and Systems Engineering.

Test and Evaluation Center Planned

To survive in the post-Cold War world, U.S. space and defense industry leaders will have to find cheaper, more efficient ways to test military products. Enter Georgia Tech's new Test and Evaluation Research and Education Center (TEREC).

"The Department of Defense actually has some of the most interesting test and evaluation problems," says Dr. Sam Blankenship, director of the center. "A commercial organization [has] the discipline of the market to tell it what's a good idea and what's not. But a peacetime military doesn't have that, so they have to test the products in something that simulates the operational environment.

However, civilian industrial product developers need better, cheaper ways to test their wares, as well. So TEREC's mission also will include civilian testing, from airplanes to cars to computer software.

The idea for the center arose is 1991 when Blankenship and senior research engineer Donald Wilmot were visiting the Air Force Operational Testing and Evaluation Center (AFOTEC) in New Mexico.

AFOTEC provided $100,000 for startup costs, but full funding is still in the works. The center won't have a central location, instead encompassing work done by researchers across campus.

A board of advisors made up of sponsor representatives will run the center, says Blankenship, who also is director of special projects for GTRI's Advanced Programs Office and a senior research scientist in the Electronics Systems Laboratory.

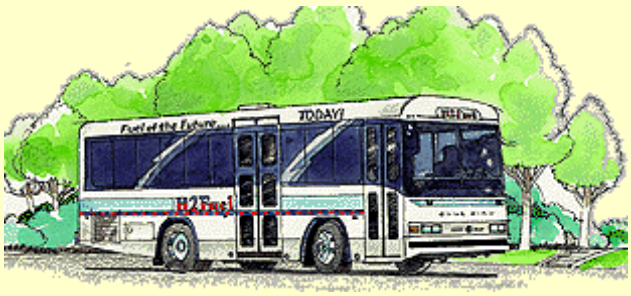
Research topics will be broad, such as the economic value of test and evaluation. A scholarly journal and a visiting professorship also are planned.

Georgia Tech also offers the country's only master's degree certificate in test and evaluation, from the School of Industrial and Systems Engineering (ISyE) or the School of Electrical and Computer Engineering (ECE). This program is overseen by Dr. Jerry Banks, ISyE, and Dr. George Vachtsevanos, ECE, and is separate from TEREC.

Further information is available from Dr. Sam Blankenship, Electronic Systems Laboratory, Georgia Tech Research Institute, Georgia Institute of Technology, Atlanta, GA 30332-0840. (Telephone: 404/894-7311) (E-mail: sam.blankenship@gtri.gatech.edu).

Hydrogen-Fueled Bus Offers Data, Olympics Transportation

When nearly two million people stream into Atlanta this summer for the Olympic Games, the city's transportation-related pollution is expected to surge as well.



But at least one group, which includes researchers in the GTRI Aerospace Sciences Laboratory, is working to counter these problems, by showcasing a prototype hydrogen-fueled, electric-powered bus for urban transportation.

The H2Fuel Bus Project is the result of combined efforts over several years by industry, government and research institutions, with primary funding from the U. S. Department of Energy.

Supporters say hydrogen, the universe's most abundant element, is an ideal replacement for fossil fuels, whose burning causes air pollution and global warming. It could be converted from water through renewable processes like wind power, producing a sustainable energy source and virtually no pollution.

GTRI researchers will integrate the 33-foot, transit-style bus's internal combustion engine, electrical generator and metal hydride fuel storage system. They'll test the bus during the Olympics, using it to transport Georgia Tech employees, to give the project maximum public exposure and to gather data on costs, reliability and the concept's commercial readiness.

The hybrid bus is expected to operate at double the efficiency of a comparable diesel bus, have twice the operating range (150 miles) of an all- electric, battery-powered bus and produce near-zero air emissions.

"Currently, we anticipate this unique combination of technologies to give the bus increased range and competitive efficiency," says Dr. John C. Handley, principal research engineer with GTRI's Aerospace Sciences Laboratory.

Partners on the H2Fuel Bus Project include the DOE's Savannah River Site near Augusta, Westinghouse Savannah River Company's HyTech Laboratory, the Southeastern Technology Center in Augusta, Blue Bird Body Company of Fort Valley, Ga., Northrop Grumman Automotive Systems of Maryland and Hydrogen Consultants, Inc. of Colorado.

Other partners include the Augusta-Richmond County Public Transit, which will own the bus and use it after the Olympics, and the Education, Research and Development Association of Georgia Universities.

The bus's fuel technology will use metal hydrides, which absorb and retain hydrogen in a solid form when cooled, then release it slowly when heated. Hydrogen in this solid form is much safer than when it is a compressed gas or liquid.

Supporters of the H2Fuel Bus Project hope that if it succeeds, it will bring new business development and manufacturing jobs to workers in the Savannah River area, in both Georgia and South Carolina.

Further information is available from Dr. John Handley, Aerospace Sciences Laboratory, Georgia Tech Research Institute, Georgia Institute of Technology, Atlanta,, GA 30332-O844. (Telephone: 770/528-7828) (E-mail: john.handley@gtri.gatech.edu)

-- "Notes" written by Amanda Crowell, Amy Fraser, David Kennedy, Hans Puttgen, Victor Rogers, John Toon.

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Research Horizons
Georgia Institute of Technology

Driver Safety

A Georgia Tech-designed intelligent traffic system uses radar detectors to alert drivers to highway hazards

By John Toon

TECHNOLOGY ALREADY WIDELY USED by American motorists is the basis for a low-cost safety warning system that would inform drivers of highway hazards such as traffic accidents, approaching emergency vehicles, construction delays or visibility problems.

With support from a consortium of consumer electronics companies, researchers at the Georgia Tech Research Institute (GTRI) have developed a transmitter and messaging system capable of sending a wide range of emergency warnings to motorists using advanced radar detectors. The Safety Warning SystemTM (SWS) will also provide a general warning to the estimated 20 million drivers using older radar detectors not capable of displaying text messages.

A SWS transmitter on the side of a highway transmits a warning to a dash-mounted advanced radar detector.

"Intelligent transportation systems planned for the future will improve highway safety by providing drivers with information about the hazards ahead of them, but it's going to be years before such systems are implemented," says Gene Greneker, a principal research associate in the Sensors and Electromagnetic Applications Laboratory at GTRI. "The Safety Warning System will provide a sophisticated warning capability today and serve as a steppingstone to the systems of the future."

GTRI researchers developed a transmitter and messaging system that can send a wide range of emergency warnings to motorists using advanced radar dectectors, as well as a general warning to older detectors don't offer text messages.

The key to development of the system was agreement by four leading radar detector manufacturers to use a common technique for sending emergency information and a standard set of warning messages compatible with National Highway Traffic Safety Administration guidelines.

The new generation of "smart" radar detectors includes a built-in liquid crystal display capable of displaying up to 64 characters. When such a detector receives a safety message, it first sounds a special tone to alert the driver before displaying the message. A second message can also be sent and displayed with the first, so the system could both warn of a hazard and tell the driver of a reduced speed limit.

Because the transmitter also sends out microwave signals on the K band, drivers using older radar detectors would still be alerted to a traffic hazard, but could not be told the specific nature of it.

The consortium of electronics companies, known as RADAR, has filed a patent application to protect the technology.

Transmitters would be located on police and other emergency vehicles, and on construction equipment, bridges, existing overhead sign warning systems and other fixed sites. Portable transmitters could also be moved to locations wherever needed.

"Every police car one day will have one of these," Greneker predicts. "When the police officer turns on the blue lights or siren to begin a pursuit or respond to an emergency, the transmitter would send out a message alerting motorists. At an accident site, the officer would use the transmitter to warn oncoming cars."

GTRI has built and tested one transmitter system, and will be building others as part of larger-scale testing. RADAR, which includes manufacturers B.E.L.-Tronics, Ltd.; Sanyo Technica USA, Inc.; Uniden America Corp.; and Whistler Corp., is pursuing efforts to commercialize the transmitter system.

Since 1991, the Federal Communications Commission (FCC) has allowed use of unattended radar transmitters to trigger radar detectors and thereby warn drivers of hazards. Though these "drone" systems cannot broadcast specific warnings, they have been useful for improving highway safety.

The Safety Warning System offers sophisticated warning capability today, and is a bridge to future systems, says Tech's Gene Greneker.

"At least two studies have shown that drone transmitters capable of setting off the current generation of radar detectors are effective at slowing traffic in construction zones," says Janice Lee, president of RADAR. "We believe this technology has much untapped potential. Enhanced transmitters, when coupled with 'smart' radar detectors, will let the driver differentiate between various types of road hazards."

The transmitter system -- developed by Greneker and Bruce Warren, with help from the engineering staffs of each of the participating industry members -- broadcasts the safety warning message using a binary encoded modulation technique that is received and displayed by the new K-band detectors.

Because the 64 standard warning messages are preprogrammed and stored in the detector's memory, the simple code is all the receiver needs to determine which message to display. The seven-bit code can be repeated as often as ten times a second, boosting reliability.

"You don't have to transmit every letter of the message, so there is plenty of opportunity to receive the warning," Greneker notes.

Customized warning messages can also be sent using a keyboard and simple computer- based menu system. Messages on unattended systems could be changed remotely through a dial-up system. Programming functions allow the system to broadcast during certain times of the day, to operate only when vehicles are approaching, or to turn themselves on only after sensing a hazard such as a bridge failure or low visibility.

RADAR has petitioned the FCC to allow higher transmitting power that would increase the range of the system and enhance the ability of moving emergency vehicles to broadcast warnings. With present power levels, the system will provide a warning at least one mile ahead of the highway hazard.

Greneker believes the technology developed for radar detectors could also be applied to other wireless communication needs, expanding the market for both transmitter and receiver manufacturers.

Further information is available from Gene Greneker, Sensors and Electromagnetic Applications Laboratory, Georgia Tech Research Institute, Georgia Institute of Technology, Atlanta, GA 30332-0856. (Telephone: 770/528-7744) (E-mail: gene.greneker@gtri.gatech.edu)

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