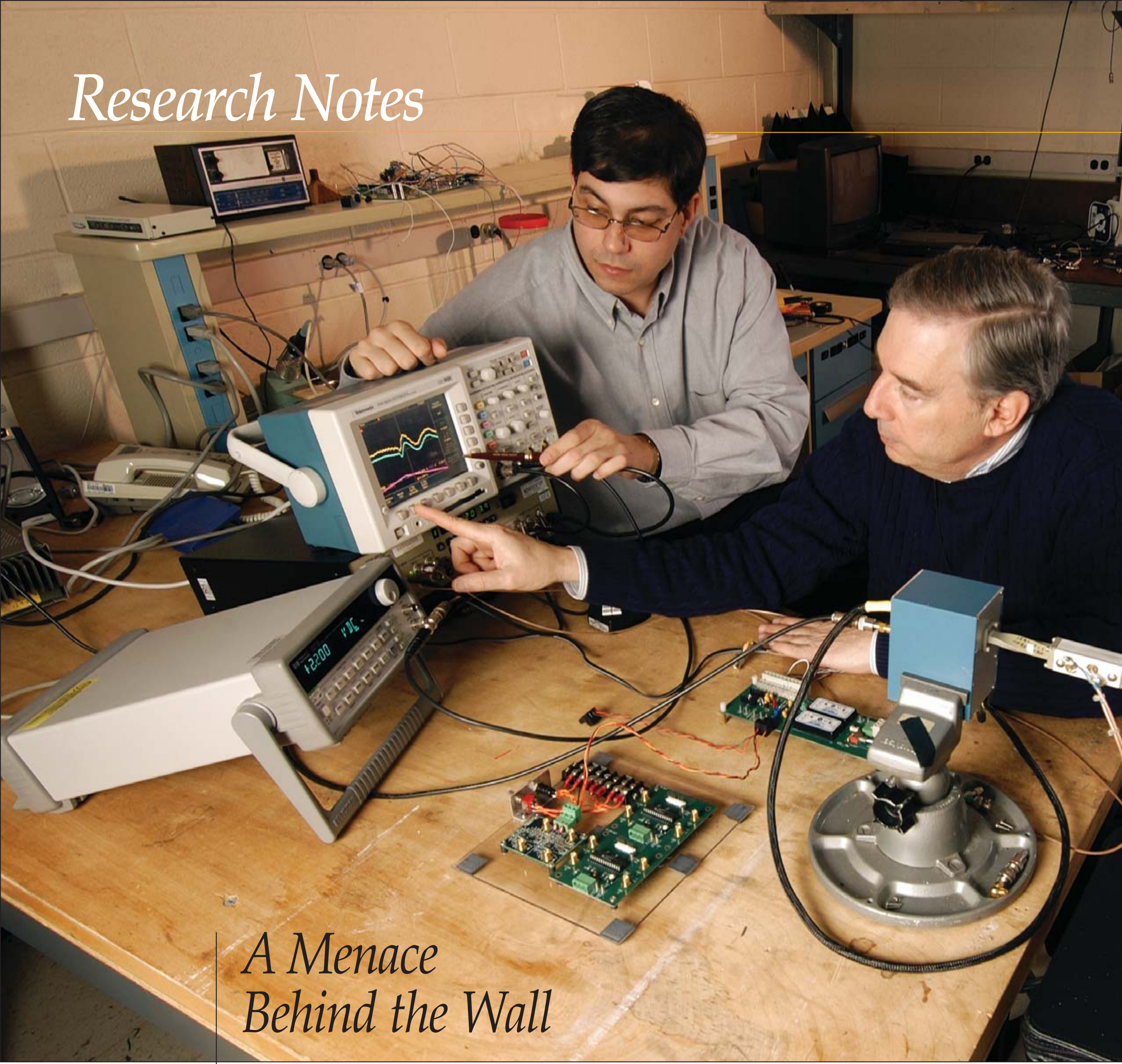

A Menace Behind the Wall

PHOTO BY GARY MEEK

Researchers are developing technology to detect hidden mold.

Researchers are testing the feasibility of using radar technology to detect mold behind gypsum wallboard. A common problem, hidden mold can cause serious structural damage and health problems before homeowners discover it.

Hoping to develop a non-destructive and less expensive method than is now available to detect mold behind walls, Georgia Tech Research Institute (GTRI) scientists are collaborating with humidity control expert Lew Harriman of Mason-Grant Consulting in a two-year feasibility study primarily funded by the U.S. Department of Housing and Urban Development (HUD) through its Healthy Homes Initiative. The Air-Conditioning and Refrigeration Technology Institute in Washington, D.C., and Munters

Corporation in Norcross, Ga., are also providing funds for the study.

"Mold is a common problem, especially in humid, southern climates, but people are often not aware of it because it's occurring behind a painted or wallpapered wall," says GTRI research scientist Victor DeJesus. "Then it's too late when they realize it. The wallboard must be replaced."

In addition to degrading structures, mold can emit smelly and potentially harmful compounds into the air, DeJesus adds.

Researchers are conducting experiments on damp, mold-infested wallboard panels. Initially, they are using a signal processing algorithm and high-sensitivity, laboratory-size radar system recently developed by GTRI principal research scientist Gene Greneker and senior research scientist Otto Rausch.

They will determine the feasibility of using millimeter-wave, extremely high-resolution radar to detect mold in these panels based on unique characteristics of the mold backscatter signature, extracted by unique signal processing techniques. Also, Harriman will investigate the possibility that X-ray and gamma-ray technologies might work. And later, the researchers will examine the effectiveness of these techniques in detecting mold in other indoor building materials, including ceiling tiles typically used in commercial structures.

Ultimately, the researchers hope to produce a small, handheld prototype unit – something akin to a stud finder – to lay the technical foundation for a commercial product that contractors could purchase for about $1,000 to $2,000 and easily learn to use. They would then test that prototype in actual houses.

Radar expert Greneker envisions a system that would map mold behind a wall. If dampness is indicated by the radar-based device, then a contractor could know more precisely where to probe for damage, he explains.

"We think this technology is on the cutting edge for detecting mold behind walls," Greneker says. "Its potential is immense."

In an initial experiment that began in January 2004, researchers used a small panel of wallboard — which is very porous — soaked in water and injected with non-toxic fungal spores. In one month's time, those spores germinated as the wallboard was kept in a high-humidity environment. Mold thrives in damp wallboard because of its paper-based encasing, DeJesus explains.

Researchers then used the radar system to scan the wallboard panel, and they were encouraged by the early results. Now, they are tweaking the algorithm to enable the radar system to discriminate between the mold backscatter signature and nails, boards and wiring that would be found in and behind wallboard, Greneker says. They must also find ways to reduce the system's cost, while retaining its sensitivity, he adds.

This experiment and a larger-scale one that began this spring simulate what might happen to wallboard dampened by a home's leaking pipe or roof, or from condensation formed by a HVAC system, or even from high-humidity conditions, DeJesus says.

If left unattended, mold can destroy structures and cause serious health problems. The researchers cite a well-known case in which a jury awarded $32 million in damages to plaintiffs in Texas who sued over a neurological condition and asthma their doctors attributed to mold in the home they purchased.

In less serious cases, the consequences can still entail a lengthy and costly repair process, the researchers say. A contractor must pinpoint the damaged area by drilling holes in the wall. Rotting wallboard, insulation and, perhaps, studs must be removed, the area dried and then decontaminated before new wallboard can be installed.

— Jane M. Sanders

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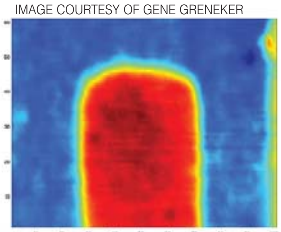
IMAGE COURTESY OF GENE GRENEKER

Researchers are scanning mold-infested, gypsum wallboard with a high-resolution radar system to determine the feasibility of the technology to detect this smelly and destructive problem behind walls.

IMAGE COURTESY OF GENE GRENEKER



This computer-generated image depicts radar detection of mold in an infested sample of gypsum wallboard.

Opposite page: Researchers are testing the feasibility of using radar technology to detect mold behind gypsum wallboard. They are using a signal processing algorithm and high-sensitivity, laboratory-size radar system recently developed by the Georgia Tech Research Institute.

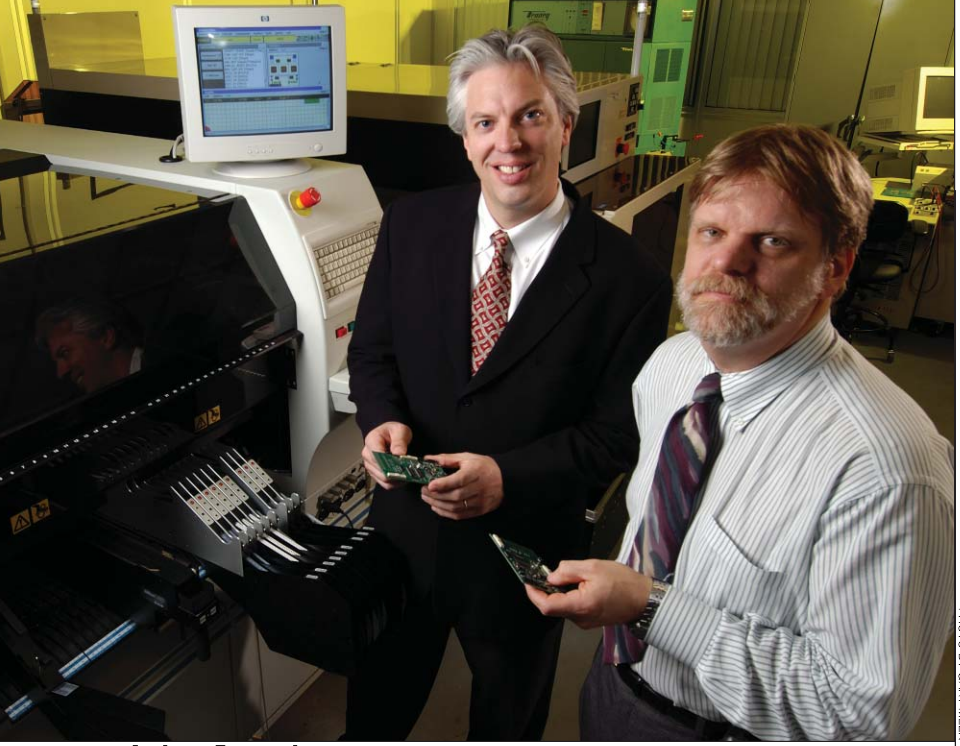


PHOTO BY GARY MEEK

Andrew Dugenske, left, and Jeff Gerth pose with a Universal GSM placement machine used to manufacture electronic assemblies. Georgia Tech led an effort that resulted in an international standard for communication among such machines on the factory floor.

Factory Floor Communication

Researchers help standardize information systems for "plug-and-play" power.

Electronics manufacturers use equipment and software from a variety of vendors, and this mix-and-match scenario causes a problem: Information systems must be modified whenever there's a change in assembly lines, which increases costs and delays production.

In response, researchers at Georgia Tech's Manufacturing Research Center (MARC) and the Georgia Tech Research Institute (GTRI) are working with the electronics-assembly industry to develop a family of international standards for interoperability.

Known as Computer-Aided Manufacturing using XML (CAMX), these specifications enable different machines and software on the factory floor to talk to each other in real-time.

The newest addition to the CAMX family is the IPC-2501, recently approved by the IPC, a trade association for the electronics interconnect industry. This standard provides a critical piece to the communications puzzle. Although earlier standards have dealt with the content of messages, the IPC-2501 provides a method for exchanging those messages.

The IPC-2501 features a centralized message broker, which uses an HTTP interface to pass XML (eXtensible Mark-up Language, a universal format for Web-based documents and data) messages.

"The message broker acts like a Web server and each piece of equipment or software application functions like a Web client," explains Andrew Dugenske, manager of research services at MARC and director of Georgia Tech's Framework Implementation Project.

In contrast to previous proprietary methods for message exchange, the IPC-2501 defines an open standard for routing information. "Now manufacturers can build their own systems and exchange messages seamlessly between different equipment and applications," Dugenske says.

Decreasing the complexity of communication yields significant benefits:

- *Lower programming costs*. According to industry statistics, for every $1 spent to purchase software, $4 is required to install and integrate it.
- *Faster production*. Speed is critical in today's competitive manufacturing arena, especially for electronics-assembly players. Time spent waiting for custom software to be written and integrated hurts manufacturers by delaying product introduction.
- *Greater flexibility*. Electronics manufacturers can use the best piece of equipment or software application for the job, regardless of vendor.

"Improving factory automation is critical because downsizing, consolidation and outsourcing of factories require that fewer workers manage more and sometimes unfamiliar manufacturing processes," says Jeffrey Gerth, a researcher from GTRI's Electronic Systems Laboratory who worked on the project. "CAMX provides the conduit to distribute manufacturing messages, so rapid intervention can be made with a minimum of human effort."

A specialist in human factors, Gerth helped design a portal for the message broker, which graphically displays information from machines so manufacturers can see what's happening on their factory floors.

"A standard isn't just about exchanging information, it's also about making decisions," he explains. "In the past, processes driven completely by technology often haven't provided the information individual decision makers need."

The IPC-2501 is a byproduct of Georgia Tech's Framework Implementation Project, a program that began in January 2000 and stemmed from a related project sponsored by the National Electronics Manufacturing Initiative.

An important hallmark of the Framework Implementation Project has been "coopetition," Dugenske says. A number of industry competitors joined forces to help Georgia Tech researchers define industry needs, along with security and scalability issues.

Now, Georgia Tech is working with NACOM Corp., a Griffin, Ga.-based manufacturer of automotive electronics, and several of NACOM's suppliers, to develop a CAMX application program interface. This software will make CAMX standards easier to implement and reduce costs for manufacturers.

"NACOM will be one of the first factories in the world to be CAMX compliant," Dugenske says. "It's great how a local manufacturer in Georgia is helping improve the international manufacturing scene."

— T.J. Becker

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CD4

New Center for Drug Design, Development and Delivery focuses interdisciplinary efforts on new pharmaceuticals

Researchers at the Georgia Institute of Technology have launched a new research and education initiative known as the Center for Drug Design, Development and Delivery (CD4).

The goals of the new center are to better integrate the multi-step process involved in creating new pharmaceuticals and to focus Georgia Tech's interdisciplinary efforts on helping industry bring new products to market. The effort involves more than 20 faculty members from six different academic areas at Georgia Tech.

"One of our goals in this center is to pull together these activities in a synergistic way so the process of bringing a drug to market will be more integrated," says Mark Prausnitz, director of the center. "By bringing together people from a variety of backgrounds in science and engineering, we can provide a broader perspective and understanding of the pharmaceutical development process."

Georgia Tech has long-standing strengths in drug development and design, as well as in the complex and demanding chemical engineering necessary for specialty chemicals. In recent years, it has built a research program in drug delivery techniques – and working with Emory University, has grown a large research and education activity in broad areas of biology and biomedical engineering, including genetics, bioinformatics and proteomics. The new center will emphasize industrial collaboration to ensure that its activities have real-world implications and that its students learn skills that will equip them to make contributions to the pharmaceutical industry.

"We want to work with industry on the most important problems that are going to meet critical needs," Prausnitz says. "To do that, we need to have strong interactions with industry to guide our research and education agendas."

With a background in technologies for delivering drugs through the skin, Prausnitz sees a need to focus on delivery concerns early in the drug design process. The growing complexity of drug compounds and rising importance of gene therapies will make drug delivery an increasingly important concern, he says.

Examples of faculty who are part of the initiative include:

- Andreas Bommarius, professor in the School of Chemical and Biomolecular Engineering. Bommarius focuses on improving biological catalysts to produce drugs such as anti-cancer agents and HIV protease inhibitors.
- Donald Doyle, assistant professor in the School of Chemistry and Biochemistry. Doyle is developing new drugs against diabetes and cancer using novel techniques to control gene expression by manipulating nuclear hormone receptors.
- Joseph LeDoux, assistant professor in the Wallace Coulter Department of Biomedical Engineering operated jointly by Georgia Tech and Emory University. LeDoux is designing new viruses that can be safely and efficiently used for gene therapy, especially for diseases of the lung, such as cystic fibrosis.

Beyond research, the center will focus on educational programs designed to help students at both the undergraduate and graduate levels understand the needs of pharmaceutical industry. With funding from the U.S. Department of Education's Graduate Assistance in Areas of National Need (GAANN) program, it has already launched a program of doctoral fellowships that supports 12 students.

— John Toon

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DHD MULTIMEDIA GALLERY

PHOTO BY ADAM HART-DAVIS,

We want to work with industry on the most important problems that are going to meet critical needs.

PHOTO BY NICOLE CAPPELLO

CD4 Director Mark Prausnitz