Georgia Tech and Saint Joseph's Health System to Collaborate

Officials of Georgia Tech, Saint Joseph's Health System and Saint Joseph's Translational Research Institute (SJTRI) – a division of Saint Joseph's Health System – have signed agreements designed to more rapidly move new treatments, therapies and products into clinical use with patients.

The agreements call for the $18.5 million relocation and expansion of the SJTRI research facilities to Technology Enterprise Park (TEP), a new bio-business park located adjacent to the Georgia Tech campus, and collaboration between physicians and researchers at Saint Joseph's Hospital and Georgia Tech faculty and students.

"The greatest roadblock to getting new therapies or devices from the research lab to patients has been the silo approach to research," says Nicolas Chronos, M.D., president of the Saint Joseph's Translational Research Institute. "This relationship between Saint Joseph's and Georgia Tech brings all the forces together – clinicians, patient care, biotechnology, bioengineering, bioscience and entrepreneurial business – for cross collaboration and innovation that will move the process ahead much faster for the benefit of patient care."

Phase one involves the expanded SJTRI facility in Technology Enterprise Park (TEP), a 32,000-square-foot facility that will include catheterization labs, expanded vascular physiology lab, surgical suites and additional research capabilities. Georgia Tech researchers will have access to the research facility for clinical trial activities.

"Collaboration between the engineer/scientist and clinician is key to new discoveries, so we welcome this opportunity to collaborate with Saint Joseph's to help accelerate the development and application of advances being made across a broad range of medical specialties," said Mark Allen, Georgia Tech's senior vice provost for research and innovation. "Working with the physicians and researchers of Saint Joseph's will give our faculty and students new opportunities to combine what they learn in our classrooms and research laboratories with clinical experience."

One area of potential collaboration between Georgia Tech and Saint Joseph's is in robotic surgery.

Phase one of the new facility is expected to be completed by early 2009.

The collaborative agreements include reciprocal faculty and research appointments for Saint Joseph's clinicians and Georgia Tech academic faculty. Initial areas of scientific collaboration include:

- Orthopedics
- Bioengineering
- Cardiovascular surgery and cardiology
- Genomics
- Systems biology and informatics
- Advanced diagnostic and therapeutic technologies
- Robotics and surgical education
- Facilities design and process improvement.

– Lynn Peterson
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Sensor-based Vest Helps Understand Causes of Asthma

Scientists at the Georgia Tech Research Institute (GTRI) have developed a sensor system that continuously monitors the air around persons prone to asthma attacks. Worn in the pockets of a vest, the new system could help researchers understand the causes of asthma attacks.

"We are investigating whether we can go back after an asthma attack and see what was going on environmentally when the attack started," says Charlene Bayer, a GTRI principal research scientist. The research was supported by the U.S. Department of Housing and Urban Development with initial funding from the GTRI Independent Research and Development (IRAD) program.

Although no one fully understands why certain people get asthma, doctors know that once a person has it, his or her lungs can overreact to environmental stimuli, causing chest tightness or breathlessness known as an asthma attack.

The new sensor system measures airborne exposure to formaldehyde, carbon dioxide, ozone, nitrogen dioxide, temperature, relative humidity and total volatile organic compounds (VOCs). VOCs are emitted as gases from products such as paints, cleaning supplies, pesticide formulations, building materials and furnishings, office equipment and craft materials.

In addition to detecting these seven environmental stimuli, a special mesh filter in the system collects particles. A pump pulls air through the filter so the quantity of particles can be measured at the end of the sampling period. The composition of the collected particulate can also be analyzed in the laboratory.

The battery-powered

Photo: Gary Meek

A sensor system worn in the pockets of a vest may help pinpoint triggers for asthma attacks.

system fits into the pocket of a vest and contains commercially available sensors that were integrated into a single system by Mark Jones, chief executive officer of Keehi Technologies.

"The device weighs less than one pound including batteries, and it takes a measurement of air every two minutes, stores the data in onboard memory and then sleeps to conserve battery power," Jones explains.

Bayer and GTRI research scientist Robert Hendry calibrated and tested the sensors in a room-sized chamber that simulates real-world environmental conditions inside buildings. Coupled with sensitive mass spectrometers, the chamber allows indoor air chemistry to be studied in detail.

The sensor system is designed to be comfortably worn in the pockets of a vest throughout the day and kept at the bedside while sleeping at night. Another vest pocket contains an electronic peak-flow meter to periodically measure pulmonary function. When experiencing an asthma attack, the vest wearer notes what time it occurred, allowing Bayer to examine the levels of the chemical compounds at that time.

Six adult volunteers have tested the vest for comfort and the effectiveness of the sensor system under actual use conditions. That has already brought benefits for one volunteer, whose vest detected higher volatile organic exposures in his home than anywhere else. The readings led researchers to discover a pollutant pathway from the volunteer's basement garage into the living areas that was allowing automobile exhaust and gasoline fumes to invade the house.

With future funding, Bayer hopes to develop a smaller and more sensitive sensor system, test the current vest in population studies of asthmatic children and develop software to process the population studies data as it is collected.

"With this system we can determine what children are exposed to at home, at school and outside where they play," says Bayer. "Chances are there are some overreaching compounds that seem to trigger asthma attacks more in children."

- Abby Vogel

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Mapping Tool Visually Tracks Emergency Resources

Photo: Gary Meek

GTRI senior research engineer Kirk Pennywitt with GTVC.

Tracking the location and availability of resources such as hospitals, transportation equipment and water during an emergency situation can be life-saving.

A collaborative mapping tool developed by the Georgia Tech Research Institute (GTRI) is helping emergency management officials better coordinate event and incident planning – and real-time response.

GTRI has teamed with Atlanta-based company Emergency Visions to provide mapping capabilities for a resource database the firm developed to identify, activate, track and coordinate response assets. The GTRI and Emergency Visions applications were selected by the Florida Division of Emergency Management in June 2007 as part of a solution that combines these comprehensive technology tools with the training and management expertise of a team led by the International City/County Management Association (ICMA).

"A lot of mapping systems are very complex to operate. Our system was deliberately designed to be easy to use for people who are not mapping experts," says Kirk Pennywitt, a GTRI senior research engineer.

Researchers began developing the Geographic Tool for Visualization and Collaboration (GTVC) in 2000 for military applications, but it has since been tailored to the needs of the emergency management community and first responders.

GTVC can track chemical or smoke plumes and help management personnel plan evacuation routes for emergencies such as hurricanes, fires or flooding. To do this, the system tracks resources including the locations of hospitals, fire stations, schools, nursing homes, sand bags, dump trucks, water, personnel and supplies in an affected region. The map can also indicate the status of those assets, such as the number of beds available in a specific hospital.

Emergency planners can immediately get a snapshot of what is going on without relying solely on traditional voice communications. During an event, electronic feeds can alert users to new incidents and display the location of the events live on the map.

The combined mapping and database system provides Florida with a robust networked emergency management system that it plans to implement in all 67 of the state's counties.

The Georgia Emergency Management Agency has been using the system since 2005 to track forest fires and hurricanes. Hillsborough County, Florida and Dakota County, Minnesota have also licensed the emergency management software for their incident preparedness plans.

"We've also had interest from more than 100 other cities, counties and local agencies," adds Pennywitt.

- Abby Vogel

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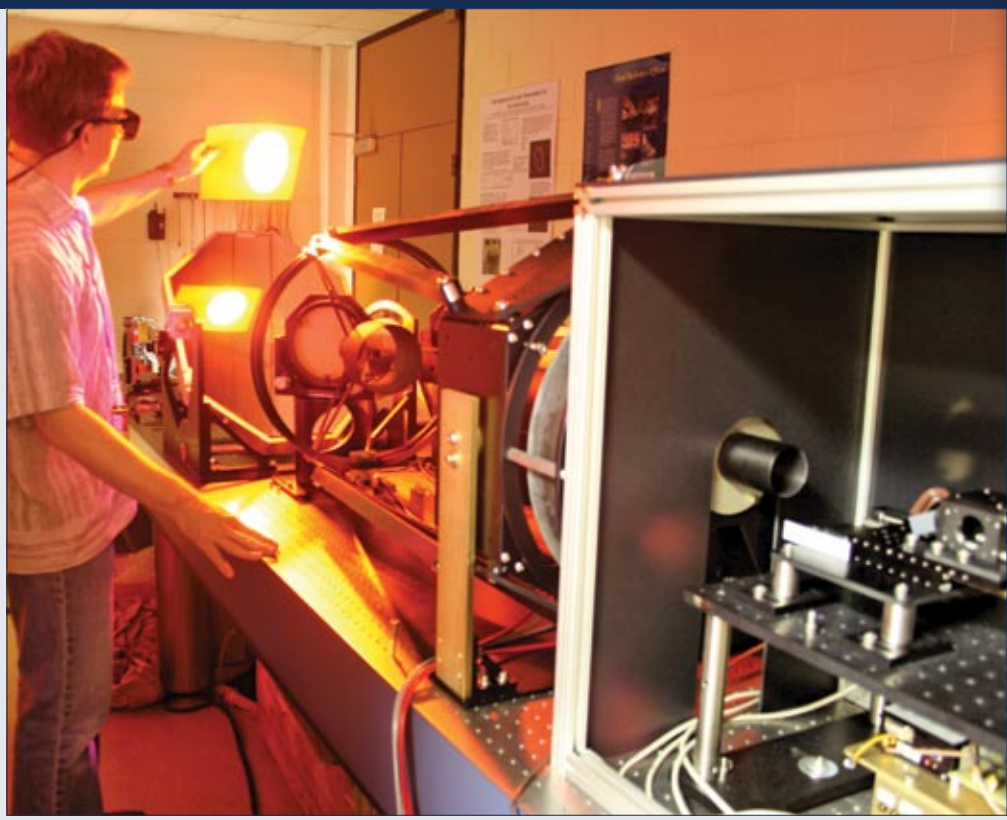
Laser Radar Measures Optical Turbulence

Photo: Sheree Colestock



GTRI researcher Dave Roberts examines output from a lidar system being used to measure atmospheric turbulence.

Scientists at the Georgia Tech Research Institute (GTRI) are laying the foundation for techniques that could do for ground-based imaging what the Hubble Space Telescope did for astronomy.

Optical turbulence is the distortion of light caused by its passage through the atmosphere. The phenomenon causes stars to twinkle and a desert horizon to shimmer – and makes accurate, detailed ground-based observation of distant objects all but impossible.

With a laser radar (lidar) developed at GTRI, "We can point that system in any direction in the sky and measure the strength of the turbulence effect," says Gary G. Gimmestad, GTRI's Glen Robinson Chair in Electro-Optics and senior faculty leader in remote sensing technology. "That has never been accomplished before."

The three-year Department of Defense-sponsored project represents a crucial step toward controlling the effects of optical turbulence, itself a separate, fast-growing field called adaptive optics. But first, turbulence "must be measured and characterized and monitored," Gimmestad notes.

The eventual development of algorithms or other techniques to compensate for optical turbulence could provide Earth-based telescopes with improved clarity and dramatically boost the quality of all kinds of long-distance imaging.

"Any kind of imaging you do on the ground is going to be affected by it," says Gimmestad. "With surveillance imaging, you tend to get waviness in the images. Certainly looking at space objects – stars, planets or whatever – your image quality is really degraded by turbulence."

Optical turbulence also inhibits long-range "free-space" laser applications; that is, laser light moving through the air rather than through a medium such as fiber optic cable.

One potential free-space laser application would facilitate high data-rate communication between a ground station and aircraft, particularly the unmanned aerial vehicles used for reconnaissance in military and natural disaster situations.

Another possibility attracting interest in scientific circles is the use of lasers to transfer power. Specifically, powerful ground-based lasers could recharge satellite batteries when their beams are trained upon a photovoltaic panel installed on the side of an orbiting satellite.

"The big problem is that turbulence is worse by the ground, right where your transmitter is, and it tends to spread the laser beam and make it wander all over the place," creating bright and dim spots on the receiving panel rather than the requisite uniform intense light, explains Gimmestad. Compensating for that "spread" at either the transmission point, the receiving point or both, could not only have an enormous impact on satellites, but also open the door to a number of laser-operated tasks.

Free-space optical communication, according to Gimmestad, is an existing technology that would be substantially enhanced if the problem of atmospheric interference can be solved. A commercially available system consisting of laser transmitters, modulators, encoders and receivers is typically used to set up a communications link between two buildings in an urban setting, where digging up streets to install fiber optic cable is neither practical nor cost effective. But the range of these systems is limited to a half-mile at best.

"At some point when you get enough optical turbulence, the whole thing becomes totally inoperative," he says. "So again, characterizing the level of turbulence out there becomes an issue."

It's work that requires a lot of room. Light energy must be measured at numerous points along the entire path of the laser, from transmitter to target, to gauge how much of it is lost or scattered at certain points along the way.

– Gary Goettling

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GTRI Helps a Small Company Bring New Products to Market

When a local company's rolling walker couldn't be sold in Wal-Mart stores because the box wouldn't fit on the shelves, the company came to the Georgia Tech Research Institute (GTRI) for help. A group led by GTRI senior research scientist Brad Fain solved the problem, reducing the volume of the cardboard box by 51 percent.

"The carton became much smaller than we thought it could get," says Phil Willis, president of the durable medical division for Access Product Marketing (APM) in Alpharetta, Ga. "We were very impressed with the way GTRI researchers aggressively and professionally attacked the problem."

According to Fain, finding a new way of folding the walker to fit inside a smaller box was an engineering challenge.

"We added a few hinges to the frame that allowed the rear wheel assembly to be folded, and designed a new way of attaching the front wheels," explains Fain. "Then we suggested they move a few support structures to allow the walker to be folded more efficiently."

GTRI also kept the cost low with the changes, allowing APM to sell the rolling walker at discount chain Wal-Mart.

GTRI's assistance was instrumental in helping APM market its Hugo® rolling walker to seniors around the country.

When APM took the next step in elderly mobility devices from rolling walker to cane, it returned to GTRI for assistance. This time, APM asked Fain and his team to design a sturdy folding cane from scratch. Because many older persons perceive folding canes to be weak and unsafe, according to consumer research conducted by Willis, the new cane design needed to address these issues.

Fain pooled a group that included Tedd Toler, a mechanical engineer with GTRI, and Michelle Berryman, an industrial engineer with local design company Echo Visualization.

The group first focused on what material to use. They also studied what the inner and outer diameters of the cane shaft should be. Next, the group designed the tip of the cane, making sure it could bear heavy loads and be highly resistive to slipping.

The Hugo folding cane was successfully tested with 550 pounds of weight applied, while competitors broke at around 250 pounds, according to Willis.

Photo: Gary Meek

Researcher Brad Fain shows the folding cane designed for Access Product Marketing.

Once the basic structure of the cane shaft was designed, Fain's team moved its attention to the handle. Cane users feel a handle is the most personal and most intimate part of the cane, according to Willis. "It's the one part of cane that's unique to the user," he says.

For this reason, the Hugo folding cane was designed with a removable handle so that each user's personality could be on display, whether with a hook handle, a pink handle or a cushioned handle.

The personalized handle feature came to the attention of the producers of the FOX television show, *House, M.D.* The main character, Dr. Gregory House, used a Hugo folding cane with a customized handle in more than eight episodes last season.

"With all of GTRI's work for very large government agencies, we were concerned that our project would be so far under the radar that GTRI might not be able to pay attention to it," says Willis. "However, GTRI has been very welcoming to my small company. We received a tremendous amount of attention and some very deep thinking around our project, and we appreciated it."

– Abby Vogel

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Study Shows Microneedles Enhance Drug Delivery in Humans

In what is believed to be the first peer-reviewed study of its kind involving human subjects, researchers at Georgia Tech and the University of Kentucky demonstrated that patches coated on one side with microscopic needles can facilitate transdermal delivery of clinically relevant doses of a drug that normally cannot pass through the skin.

Reported in the journal *Proceedings of the National Academy of Sciences*, the study could help advance the use of microneedles as a painless method for delivering drugs, proteins, DNA and vaccines into the body. The research also found other advantages for the microneedles, including an ability to produce therapeutic drug levels with lower doses, and reduced production of drug metabolites that may cause side effects.

"This study represents an important landmark in the development of microneedles into drug delivery devices suitable for use in clinical medicine," says Mark Prausnitz, a professor in the Georgia Tech School of Chemical and Biomolecular Engineering. "This method may be useful for a broad range of drugs that cannot normally be delivered without a hypodermic needle."

The research was supported by the National Institutes of Health and the University of Kentucky Research Foundation.

Transdermal drug delivery has proven successful in a number of applications, including pain management, congestive heart failure and hormone replacement. Transdermal administration offers advantages over other delivery techniques, but existing systems can only be used for a narrow range of compounds that easily pass through the skin.

By painlessly punching a series of microscopic holes in the outer layer of skin, microneedles promise to expand the range of drugs and vaccines that can be delivered transdermally. Until this study, however, the only published research demonstrating drug delivery using microneedles had involved studies in animals and on human cadaver skin.

Collaborating with Prausnitz and his Georgia Tech research team, University of Kentucky associate professor of pharmacology Daniel Wermeling and colleagues Stan Banks, David Hudson and Audra Stinchcomb set out to determine whether microneedle patches could indeed help deliver useful amounts of drug compounds that otherwise couldn't pass through the skin.

As a test compound, they chose the drug naltrexone, a skin-impermeable compound used to treat opiate and alcohol addiction.

Working with a small group of nonaddicted human test subjects, they first prepared a section of skin on each subject's arm by pressing and removing thumb-sized patches that contained 50 stainless steel microneedles each about 620 microns – about 1/40th of an inch – in length. Next, gel containing naltrexone was applied to the prepared area, which was then covered by a protective dressing.

The concentration of the drug in each subject's bloodstream was monitored for 72 hours. The researchers quickly saw levels of the drug reach pharmacologically active concentrations, and those levels remained steady for at least 48 hours in the six test subjects. None of the control subjects had detectable levels of the drug in his or her bloodstreams.

Beyond maintaining a steady level of the naltrexone, microneedle delivery may offer another advantage over oral administration: a reduction in the presence of compounds metabolized from the drug. The primary metabolite, known as naltrexol, is rapidly produced by the liver and intestines when the drug is administered orally, creating blood levels as much as 10 times that of the parent drug – which can cause undesirable side effects.

Microneedle administration also reduced the amount of drug required to produce therapeutic levels, replacing a 50-milligram tablet with 10 to 12 milligrams of drug in the gel.

The study represents a first step in demonstrating the broad range of potential uses for microneedles, says Prausnitz, who has been developing the devices for more than 10 years. In addition to Prausnitz, the Georgia Tech research team included Harvinder Gill and Jyoti Gupta.

"There are a number of ways in which microneedles can be used," Prausnitz notes. "This study addressed the simplest use of microneedles in which the needles are just inserted and removed from the skin and a drug patch applied. To understand how broadly microneedles can be used in medicine, we will also need to study delivery of other therapeutics, such as lidocaine, insulin and flu vaccine."

- John Toon

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Developing a Washable Robot for Poultry Processing

Even a hard-working robot needs a good bath at the end of the day. That was the issue facing researchers at the Georgia Tech Research Institute (GTRI) as they delved into one of the big challenges in food-processing automation.

Robots have begun to be deployed in many areas of food production, but their use for handling fresh meat has been hampered because such machines would also have to withstand cleaning with high-pressure water spray and corrosive sanitizing chemicals.

At GTRI's Food Processing Technology Division, research engineer Jonathan Holmes led a project to develop a robot that would pack fresh meat into trays, but with a design and construction able to withstand the harsh conditions created by routine washing in a way more consistent with how other equipment is cleaned.

Georgia Tech researchers have teamed with CAMotion, Inc. of Atlanta and are working in collaboration with Cargill Meat Solutions of Newnan, Ga.

The robot's job is to grasp raw meat products from a conveyor and place them onto foam packaging trays. The task requires considerable dexterity to pick up the products without causing damage, place them within the boundaries of the trays in an aesthetically pleasing manner, and provide one more visual inspection. And it has to be done fast – one per second.

But that was the easy part, relatively speaking.

"We're used to building automated machines, so the automation side was something we're accustomed to," Holmes explains. "The wash-down side of it was brand new for us – it's new for most people – and that was very challenging. We had to go through a lot of component testing initially just to find components we could use."

The current prototype uses special protective coatings and plating on its metal parts, shaft seals on its motors and other moving parts, and special watertight bearings that are little affected by the wash-down process.

Photo: Steve Thomas

Researcher engineer Jonathan Holmes watches the operation of a washable robot designed for use in the food processing industry.

The tray-filling stage of the poultry processing line may require up to a half-dozen human workers and often results in a bottleneck to the process. The hope is that automation of this type would result in increased throughput and lower costs for the industry. In addition, the wash-down technologies devised in this project could find their way into other areas untouched by automation because of cleaning requirements.

This project was funded in part by Georgia's Traditional Industries Program for Food Processing.

- Gary Goettling

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Shape-memory Polymers Developed for Biomedical Applications

Photo: Gary Meek

Professor Ken Gall reaches inside a test frame used to study shape-memory polymers.

Georgia Tech researchers are developing unique polymers that change shape upon heating to open blocked arteries, probe neurons in the brain and engineer a tougher spine.

These so-called shape-memory polymers can be temporarily stretched or compressed into forms several times smaller than their final shape. Then heat, light or the local chemical environment triggers a transformation into their permanent shape.

"My focus has been to optimize these polymers for many different biomedical applications," says Ken Gall, a professor in Georgia Tech's George W. Woodruff School of Mechanical Engineering and School of Materials Science and Engineering. "My lab studies how altering the chemistry and structure of the polymers affects their chemical, biological and mechanical properties."

The mechanical properties of these polymers make them attractive for many biomedical applications, according to Gall, who described his research in this area during two presentations at the Materials Research Society's fall meeting in November 2007.

Finding materials that display unconventional properties able to satisfy requirements for implantation in the body is a constant challenge for biomedical engineers. Particular attention must be paid to the biofunctionality, biostability and biocompatibility of these materials, which come into contact with the body's tissue and fluids.

With funding from the National Institute of Biomedical Imaging and Bioengineering of the National Institutes of Health (NIH), Gall proposed replacing metallic cardiovascular stents with plastic ones because polymers more closely resemble soft biological tissue. Plus, polymers can be designed to gradually dissolve in the body.

"Metal stents are frequently covered in plastic anyway, so we set out to remove the metal and leave just a polymer sheath," explains Gall. "Also, polymers are more flexible and do not stress the artery walls like the metals."

Gall's research group has designed a shape-memory polymer stent that can be compressed and fed through a tiny hole in the body into a blocked artery, just like a conventional stent. Then, the warmth of the body triggers the polymer's expansion into its permanent shape, resulting in natural deployment without auxiliary devices. This work was published in the journal *Biomaterials* earlier this year.

For another project, Gall and graduate student David Safranski have been investigating how altering a polymer's chemistry changes its properties, such as its ability to stretch. This project was funded by MedShape Solutions, an Atlanta company that Gall co-founded to develop medical devices primarily for use in minimally invasive surgery.

The researchers found that by changing the chemistry of the polymer backbone to include special side groups, they could increase of the amount of strain the polymer could withstand before failing – without sacrificing stiffness. Gall and graduate student Scott Kasprzak are exploring how these polymers might be used as a deployable neuronal probe, with funding from the National Institute of Neurological Disorders and Stroke of the NIH.

"We're looking for smart materials that can be synthesized in the size range of 100 microns – similar to the size of a strand of hair – and then be inserted into brain tissue," explains Gall. "This type of probe would need to slowly change shape inside the brain as to not disturb any surrounding tissue."

Another project in Gall's laboratory is examining the use of these polymers for the spine. Most spinal surgeries are currently not performed arthroscopically, so Gall sees benefits in using these shape-memory materials to enable minimally invasive spinal surgery.

- Abby Vogel

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Copper Improves Interconnects in Computer Systems

As computers become more complex, the demand increases for more connections between computer chips and external circuitry such as a motherboard or wireless card. And as the integrated circuits become more advanced, maximizing their performance requires better connections that operate at higher frequencies with less loss.

Improving these two types of connections will increase the amount and speed of information that can be sent throughout a computer, according to Paul Kohl, Thomas L. Gossage chair and Regents' professor in Georgia Tech's School of Chemical and Biomolecular Engineering. Kohl presented his work in these areas at the Materials Research Society fall meeting in November 2007.

The vertical connections between chips and boards are currently formed by melting tin solder between the two pieces. Research conducted by Kohl and graduate student Tyler Osborn shows that replacing the solder ball connections with copper pillars creates stronger connections and the ability to create more connections.

"Circuitry and computer chips are made with copper lines on them, so we thought we should make the connection between the two with copper also," Kohl says.

Solder and copper can both tolerate misalignment between two pieces being connected, according to Kohl, but copper is more conductive and creates a stronger bond.

With funding from the Semiconductor Research Corporation (SRC), the researchers developed a novel fabrication method to create all-copper connections between computer chips and external circuitry.

The researchers first electroplate a bump of copper onto the surface of both pieces, a process that uses electrical current to coat an electrically conductive

object with metal. Then, a solid copper connection between the two bumps is formed by electroless plating, which involves several simultaneous reactions that occur in an aqueous solution without the use of external electrical current.

Because the pillar, which is the same thickness as a dollar bill, is fragile at room temperature, the researchers anneal it, heating it in an oven to remove defects and create a strong solid-copper structure. Osborn found that strong bonds were formed at an annealing temperature of 180 degrees Celsius. He has also been investigating how misalignments between the two copper bumps affect pillar strength.

"I've also studied the optimal shape for the connections so that they're flexible and mechanically reliable, yet still have good electrical properties so that we can transmit these high-frequency signals without noise," says Osborn.

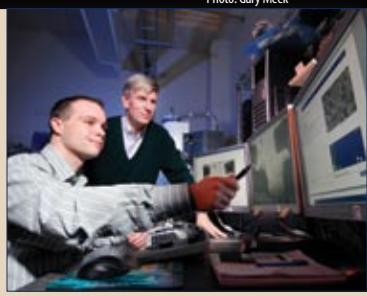
The researchers have been working with Texas Instruments, Intel and Applied Materials to perfect and test their technology. Jim Meindl, director of Georgia Tech's Microelectronics Research Center and Sue Ann Allen, a professor in the School of Chemical and Biomolecular Engineering, have also collaborated on the work.

In addition to this new method for making vertical connections between chips and external circuitry, Kohl is also developing an improved signal transmission line with the help of graduate student Todd Spencer.

"Several very long communication pathways exist inside a computer that require a very high performance electrical line that can transmit at higher frequencies over long distances," explains Spencer.

This is especially important in high-performance servers and routers where inter-chip distances can be large and signal strength may be significantly degraded. Kohl and Spencer have developed a new way to link high-speed signals between chips using an organic substrate, with funding from the Interconnect Focus Center, one of the Semiconductor Research Corporation/Defense Advanced Research Projects Agency (DARPA) Focus Center Research Programs.

Photo: Gary Meek



Graduate student Tyler Osborn, left, and Regents' Professor Paul Kohl study all-copper connections between computer chips and external circuitry.

- Abby Vogel

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Taking Aim at Preventing Worker Injuries

New technology is positioning an old injury-prevention program at the cutting edge of the poultry industry.

Nearly 10 years ago, scientists from the Georgia Tech Research Institute (GTRI) collaborated with Georgia Tech's School of Applied Physiology to create the Ergonomic Work Assessment System (EWAS) to track the positioning and arm movements of workers as they deboned poultry. The idea was to identify and then avoid the factors leading to repetitive-stress injuries.

The improved EWAS, developed in cooperation with the poultry industry, provides a more accurate and detailed assessment by taking advantage of technology that wasn't available in the '90s – namely position-tracking technology typically used to create computer animation.

"It measures arm position in three dimensions," says GTRI research engineer Jonathan Holmes. "You strap the system onto your arm and move your arm around, and you can watch it moving on a screen beside you."

The system measures forearm and wrist orientation as well as upper arm and shoulder activity. Separate modules provide a global reference for the position sensors. Muscle response is monitored through electromyography, a procedure for determining the level of electrical activity in muscles. Grip force on the knife is calculated by a technique developed by Liberty Mutual Research Institute for Safety, which is teaming up with the Georgia Tech design team for that part of the system development.

The aggregate data of shoulder and arm position, muscle response and grip force of a worker cutting poultry are transmitted wirelessly to a computer for analysis. EWAS will be used in field studies to assess the dynamics of muscle group interactions in job rotation schemes designed to reduce repetitive-motion disorders such as carpal tunnel syndrome.

Photo: Steven Thomas

Researchers Jonathan Holmes and Sergio Grullon demonstrate operation of the Ergonomic Work Assessment System.

"By monitoring these forces and positions, you can put numbers to physical motions and get a better idea of what is good and what is risky," says Holmes. "You can hopefully determine if someone is using certain muscles too often, or if they are bending their wrists too far. This opens the door for studies that can eventually help us determine which risk factors are more likely to lead to injuries."

The group is also investigating the development of a second system to monitor the back. They ultimately hope to pursue studies that can help reduce back injuries resulting from back-instability conditions.

- Gary Goettling

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