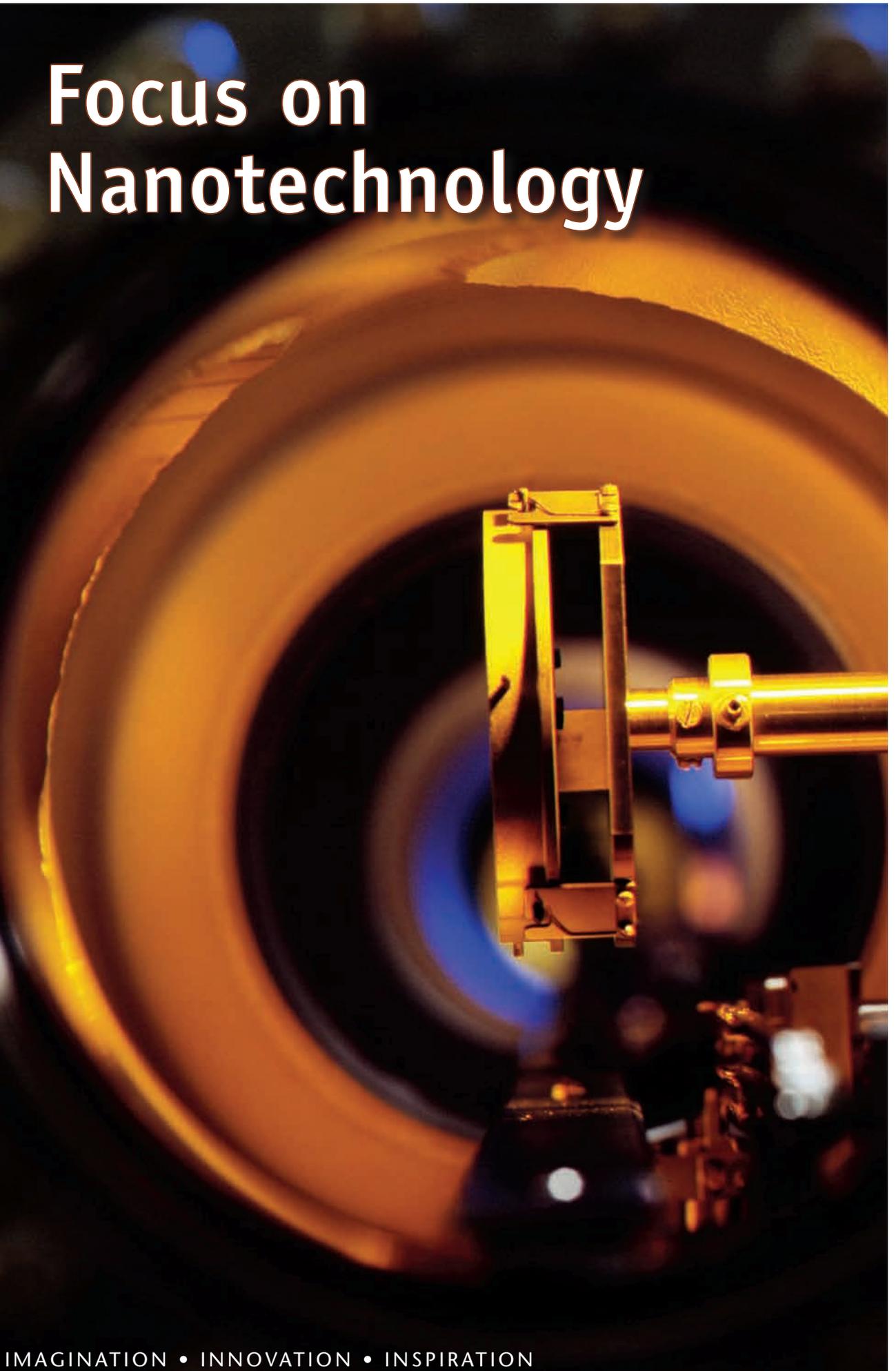


ARKANSAS INGENUITY

FROM THE COLLEGE OF ENGINEERING AT THE UNIVERSITY OF ARKANSAS • FALL 2007



Focus on Nanotechnology



IMAGINATION • INNOVATION • INSPIRATION

There is a lot going on at the College of Engineering at the University of Arkansas! We continue to make giant strides in supporting the relationships between research and engineering innovation, industry relevance and the economic development of the region and the state. Our renowned researchers are working on projects that will lead to a brighter future in Arkansas, our country and our world.

In particular, our nanotechnology research and the homeland security mission of the Mack-Blackwell Center for Rural Transportation are making important contributions to science and the security of our nation.

Nanotechnology researchers at the University of Arkansas are working on new ways to help medicine target diseased cells, and the use of smart fabric that can monitor vital health signs such as body temperature, respiration and heart rate. These discoveries will potentially benefit people from backgrounds as diverse as soldiers, elderly cancer patients and young football players.

It is imperative that undergraduate and graduate students receive a thorough exposure to the field of nanoscience and engineering as part of their education. The University of Arkansas is prepared to offer just that.

We have recently established the Institute for Nanoscience and Engineering that cuts across several colleges and schools to promote, coordinate, and facilitate interdisciplinary research, education, industrial outreach and entrepreneurial opportunities in the emerging field of nanoscience and engineering.

Last year, the College of Engineering booked new research projects worth over \$10 million in the area of nanotechnology. Seventeen permanent faculty in seven departments are intimately involved in exploring the potential of nanotechnology. The applications being explored involve chemical and biological sensors, medicine, energy, electronics, wear-resistant coatings for machine tool industry, corrosion-resistant coatings for aircraft and more. Engineering faculty are also engaged in commercializing their research innovations through several startup companies. This allows our students to benefit from the unique experience of working in our first-rate facilities.

Our Mack-Blackwell Rural Transportation Center was recently chosen by the federal government to be among six centers selected nationally to address homeland security issues. This five-year program will broaden the scope of activities for the center beyond pavement and concrete materials, highways and bridge designs and transportation engineering. MBTC's designation as a National Transportation Security Center of Excellence demonstrates the transformation of the center into a major resource of ideas for the world as we try to protect vital infrastructure from acts of terrorism.

In other news, we are very proud of our solar boat team that took second place in the Solar Splash World Championship held in June at Lake Fayetteville. This second place finish follows our winning the championship last year. Congratulations to the Cedarville University team that narrowly edged our team out of first place. In addition, two of our young faculty were selected by NSF for the CAREER award.

Please read more about these and other exciting College of Engineering activities in this publication!



Ashok Saxena
Dean of Engineering
Irma F. and Raymond F.
Giffels Endowed Chair in
Engineering
College of Engineering



Senator Mark Pryor visits with Jack Buffington, Associate Director of Mack-Blackwell Rural Transportation Center, and University of Arkansas administrators to discuss the center's new homeland security mission. See story on page 4.

Arkansas Ingenuity is published twice a year by the College of Engineering at the University of Arkansas. Questions or comments should be sent to Editor, 4180 Bell Engineering Center, University of Arkansas, Fayetteville, AR, 72701 or sent by e-mail to llannutt@uark.edu.

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4 Securing our Future

Mack-Blackwell Rural Transportation Center has been granted an additional mission to find ways to improve the security of America's rural transportation systems.

COVER

8 Focus on Nanotechnology

College of Engineering researchers develop nanotechnologies that promise to increase consumer product reliability and the quality of healthcare.

IN EVERY ISSUE

- 2 In the Lead
- 16 On the Move
- 18 Alumni in Action
- 21 Engineering Matters
- 22 Face to Face

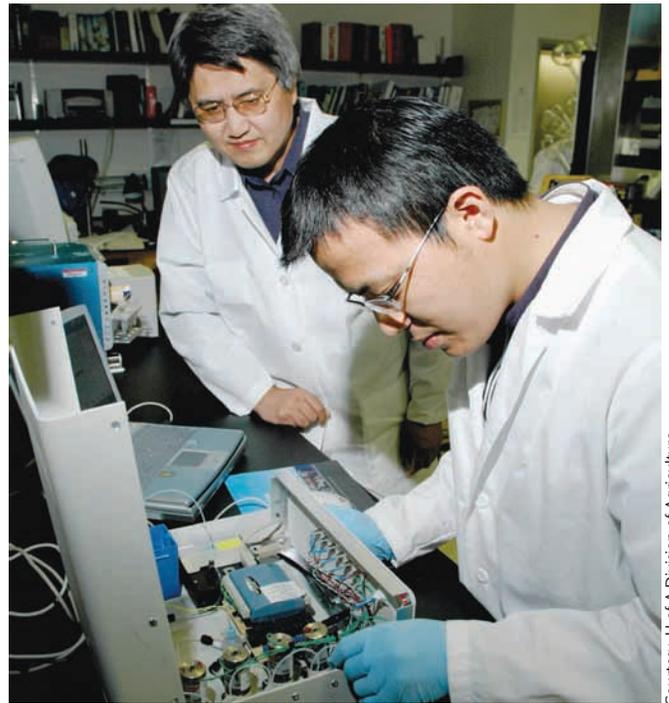
Professor Named to Tyson Chair in Biosensing

Yanbin Li, one of the world's leading scientists in the development of biosensing technology for food safety and quality applications, has been named to hold the Tyson Endowed Chair in Biosensing Engineering.

A \$1.5 million endowment for the new chair was provided by the Tyson Foods Foundation from a gift announced in May 2005. Matching funds were provided through the University of Arkansas Matching Gift Program, previously endowed by the Walton Family Charitable Support Foundation. Investment earnings from the endowment will help support Li's research in the department of biological and agricultural engineering and the Center of Excellence for Poultry Science, which is a unit of the University of Arkansas System's Division of Agriculture.

Li has developed a prototype portable biosensor system that can detect the H5N1 avian influenza virus in poultry samples in less than one hour at an estimated cost of less than \$10 per sample. H5N1 is the "bird flu" virus that has been transmitted from poultry to humans in more than 300 cases in Asia, Africa and Europe.

Li is principal investigator on a recent grant of \$375,000



Courtesy, U of A Division of Agriculture

Dr. Yanbin Li, professor of biological and agricultural engineering, and Dr. Zunzhong Ye, assistant professor, use a biosensor they developed at the University of Arkansas to test samples of poultry processing chill water for the presence of harmful bacteria.

from the U.S. Department of Agriculture's National Research Initiative to refine and test the H5N1 biosensor system. Co-investigators are Billy Hargis, Steve Tung and Ronghui Wang at University of Arkansas and Luc Burghman at Texas A&M University.

Two Faculty in Mechanical Engineering Honored with NSF Awards

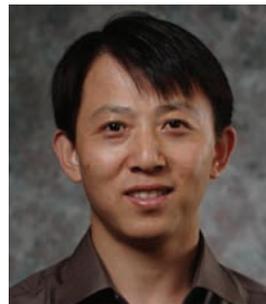
Two assistant professors in the mechanical engineering department at the University of Arkansas have been awarded individual Faculty Early Career Development awards for 2007 by the National Science Foundation. Min Zou and Sulin Zhang will each receive approximately \$400,000 over five years to fund their research projects.

"It is uncommon for a department of our size to have two professors receive the NSF Career award in one year," said Joseph J. Rencis, professor and head of the mechanical engineering department.

The foundation offers its most prestigious awards in support of the early career-development activities of those teacher-scholars who most effectively integrate research and education within the context of the mission of their



Min Zou



Sulin Zhang

organization.

"This is just another indication of the momentum for academic excellence that is building in the mechanical engineering department and in the UA College of Engineering," Rencis added.

Zou's research into nanoscale surface-engineering promises to improve the performance of products with micro-electro-mechanical systems, known as MEMS and ranging from the automotive to biomedical fields. The research focuses on the use of nanoscale bumps and surface chemistry to reduce adhesion and friction forces between two surfaces that come into contact. These products should not fail catastrophically or wear as quickly if adhesion and friction forces are reduced.

Zhang will continue his research career at Penn State.

Arkansas Sprints to Second Place in 2007 Solar Splash World Competition

The University of Arkansas solar boat team came up short in its bid to repeat as world champions at Solar Splash 2007, held June 13-17 at Lake Fayetteville.

The Arkansas team, composed of electrical- and mechanical-engineering students, placed second behind Cedarville University this year. Last year, Arkansas placed first and Cedarville placed second.

The 2007 competition featured 16 teams, including one from Istanbul and one from Canada.

“The overall competition gets stronger each year,” said Alan Mantooth, professor of electrical engineering and one of three team advisers. “But we have quite a perennial battle for supremacy between our team and Cedarville. Overall, we’re proud of how hard our students worked, and it’s great to see them have so much fun in this event.”

Each team was responsible for designing its own boat and power system. Boats were scored on appearance, how well they were built and how well they operated, in addition to their performance on the lake. Each boat was required to operate on a combination of natural and stored solar power.

Roy McCann, associate professor of electrical engineering and a team adviser, said this year’s competition was more competitive. For example, Arkansas won the championship last year with 867 total points and placed second this year



Solar Splash 2007

with 895 points. This year, for the first time in eight Solar Splash competitions, the University of Arkansas team won first place in the 300-meter sprint. Arkansas also won this year’s endurance competition.

“This was an important goal for the team,” McCann said.

During the five-day event, teams participated in five on-the-water competitive events. On-site competitions also included visual displays and workmanship. On-the-water competition included qualifying boats in low- and high-speed configurations, a 300-meter sprint double elimination event, and a 4-hour endurance event. The Solar Slalom, another part of the on-the-water competition, involved a combination of speed and maneuverability.

In its 14th year, Solar Splash is the world’s only international, intercollegiate solar electric boat design and race competition.

Center for Engineering Logistics and Distribution Receives Renewed NSF Funding

The Center for Engineering Logistics and Distribution was recently awarded NSF funding for the next five years. The renewal grant will provide \$470,000 over five years to cover the base operations at the University of Arkansas.

CELDi, a cooperative research center, is comprised of eight universities and led by the industrial engineering department in the College of Engineering at the University of Arkansas. Partners include the University of Louisville, University of Oklahoma, Oklahoma State University, Lehigh University, University of Nebraska, Texas Tech University and Clemson University.

The center provides research and solutions for logistics and distribution problems encountered by organizational partners. These partners, who range from government to commercial backgrounds, join the center for a minimum \$50,000 contribution each year.

Increasing global competition, customer requirements

and the evolution of the Internet are dramatically and continually changing the way companies operate. These challenges are forcing companies to rethink the way they do business, the products and services they offer, and the transportation modes they use to bring these products to market.

“CELDi is uniquely positioned to be the one-stop source for logistics and distribution problem-solving that looks at system design by considering operational impact,” said Russell D. Meller, director of the center and the Hefley Professor of Logistics and Entrepreneurship. “We are excited that the center’s funding has been renewed by the National Science Foundation, and we look forward to continuing to lead the largest NSF sponsored industry/university research center to an even higher level of support for our member organizations.”



Securing the Future of America's Transportation System

Mack-Blackwell Rural Transportation Center researchers and staff members found August to be full of surprises. Midway through the month, the center's executive director, Kevin Hall, was notified that the center had been selected to participate as a member of the National Transportation Security Center of Excellence.

Perhaps the most fulfilling part of this news was that the researchers were being granted a new responsibility by the federal government. For the next four years, MBTC will share a mission to protect America's critical infrastructure.

The center will work in conjunction with five other transportation research centers that will split \$18 million annually to study ways to protect the security of America's transportation system.

The partner centers include Long Island University's Homeland Security Management Institute in New York, State University of New Jersey's National Transit Institute at Rutgers, Texas Southern University, Tougaloo College in Mississippi and the University of Connecticut Transportation Institute.

This homeland security funding is part of the Improving America's Security Act of 2007, which President Bush signed on Aug. 3.

"We are thrilled to be included in this very important effort. The recent bridge collapse in Minnesota shows that there is a need to ensure the safety of existing infrastructure. We feel that we will be able to make significant contributions towards this goal," said Hall.

In the beginning, the focus of MBTC was the improvement of the quality of rural life through transportation. In particular, the center focused on improving the movement of people, goods and services into, out of and through rural areas of the United States. With terrorism and aging infrastructure in the headlines now, the new safety and security mission will open many other doors for the center's researchers.

Studies funded by this new mission will cover areas of concern as recommended by the 9/11 Commission Report issued in 2004. The areas of focus include the protection of rural bridges, highways, riverways, railways and other vital transportation infrastructure.



Kevin Hall

"The Mack-Blackwell center is uniquely situated to address key transportation issues — particularly those in rural locations," said Hall. "Our past studies have encompassed an array of systems, including highways, airfields, waterways, rail, trucking and logistics. We are fortunate that we can draw on a wealth of expertise here at the University of Arkansas and partner with other universities, agencies and companies to provide real solutions to infrastructure-related needs."

MBTC works with a diverse population of researchers. Each year, the center seeks the input of researchers from the University of Arkansas and other academic institutions in order to obtain problem statements that form the basis of future research projects. These problem statements come from researchers based in colleges of engineering, agriculture, business administration, and arts and sciences.

Over the past 15 years, the center has sponsored 143 researchers from 12 universities in 9 states. This number is expected to increase with this new mission.

Homeland Security: Researchers Focus on Rural Transportation Networks

The University of Arkansas' Mack-Blackwell Rural Transportation Center was making strides towards becoming a leader in homeland security before its federal designation as a National Transportation Security Center of Excellence was even a dream.

Professors who are involved with MBTC recently completed a study that has led to new ways to assess risks to roadways, bridges and other vital pieces of rural infrastructure. The three industrial engineering researchers, Heather Nachtmann and Edward Pohl, associate professors, and Richard Cassady, associate professor and holder of the John L. Imhoff Chair in Industrial Engineering, submitted the study titled "Homeland Security for Rural Transportation Networks."

This study was different from most transportation studies, because it focused on the protection of rural infrastructure. Federal money has traditionally gone to study the protection of urban infrastructure. The center's emphasis on rural transportation allows researchers to break from the mold to find ways to make transportation systems safer for Arkansans and other people throughout the country who live in or travel through rural areas.

"Studying the security of rural transportation networks is important because most of the existing knowledge is based on transportation networks in urban areas," Nachtmann said.

Although most existing transportation knowledge is based on urban areas, a majority of America's infrastructure is not urban. In fact, roughly 83 percent of America's land mass is classified as rural. Even major highways cross many miles through rural areas. According to the study, 3.1 million miles of roads cut through rural areas. This shows that there are large rural areas that require evaluation and protection.

The geographic size of rural land is enormous, yet rural counties and towns are less likely to have employees dedicated to road maintenance and security. This lack of manpower leaves vital transportation links vulnerable to disaster—whether from structural failure or terrorist attacks.

The researchers started with existing plans for evaluating risks to urban infrastructure. They attempted—and succeeded—in modifying a U.S. Department of Transportation urban risk assessment tool for use in evaluating risks to rural infrastructure.

"One goal of our research is to evaluate the scalability and adaptability of existing urban-based tools to the security of rural transportation networks," Nachtmann said.

One key to success was finding a way for rural infrastructure supervisors to assess risks by using as few employee hours and public dollars as possible because the local transportation departments often lack the manpower and money that is available to transportation departments in metro areas.

"We hope to provide county and city emergency planners with effective and cost-efficient tools to assess the vulnerability of their transportation assets and develop preparedness plans," Nachtmann said.

While rural transportation officials cannot plan for every possible contingency, the new assessment method allows them to get an idea of the most likely risks.

One difference that the researchers found was that urban areas are better suited to risk scenarios, while rural areas are



Heather Nachtmann

better suited to analysis based on critical assets. This lets those rural transportation departments focus their limited amount of manpower and dollars in areas where the most risk exists.

For instance, if a county has a bridge that serves in a critical area of interstate, transportation officials can conduct a risk assessment based upon that particular asset. If the officials want to know what might occur should that critical bridge go out, the risk assessment tool guides them through steps that allow them to evaluate important data such as the amount of traffic that travels over the bridge, whether or not there is an alternate



“We hope to provide county and city emergency planners with effective and cost-efficient tools to assess the vulnerability of their transportation assets and develop preparedness plans.”

route and likely casualty rates.

These risk assessments cover all forms of rural infrastructure from bridges, highways, riverways, railways and airways.

“Arkansas is a natural laboratory for studying the security of rural transportation networks. In addition to the typical transportation assets, the state provides access to inland waterways, major interstates and the Mississippi River,” Nachtmann said.

This new assessment method will allow county emergency responders and planners to develop customized emergency response plans based on the critical transportation assets in their communities. Counties that primarily have river crossings and rail crossings to protect will be able to use information from the matrix that relates to those specific areas of infrastructure. On the other hand, counties that have several bridges that are

part of a major interstate will be able to assess the potential damage that could be done if one or more of those bridges were to fail.

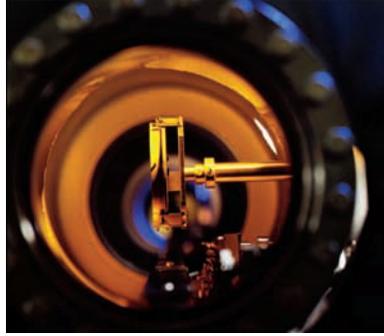
At this time, the researchers believe the risk assessment material will include a handbook that explains the method and a spreadsheet based tool that will help transportation officials track vulnerable transportation assets in their communities. MBTC has provided grant funding to underwrite the distribution costs.

This new method of rural transportation risk assessment offers the ability for lay-people to effectively quantify the risks to their communities in terms of dollars and lives.

If you would like additional details, you can find the complete report at www.mackblackwell.org.



Large Steps



in a Small World

College of Engineering researchers explore the benefits of nanotechnology

Nanotechnology—it's the buzz word of the day in science and engineering fields. But what is nanotechnology?

"Nanotechnology is the science and engineering of manipulating matter at the length scale smaller than a micrometer" said Ashok Saxena, dean of the College of Engineering. "This has the potential for revolutionizing technology even more profoundly in several arenas than transistors did for consumer electronics during the period ranging from the 1950s through the 1990s."

The College of Engineering has 17 researchers in seven departments whose research primarily involves nanotechnology.

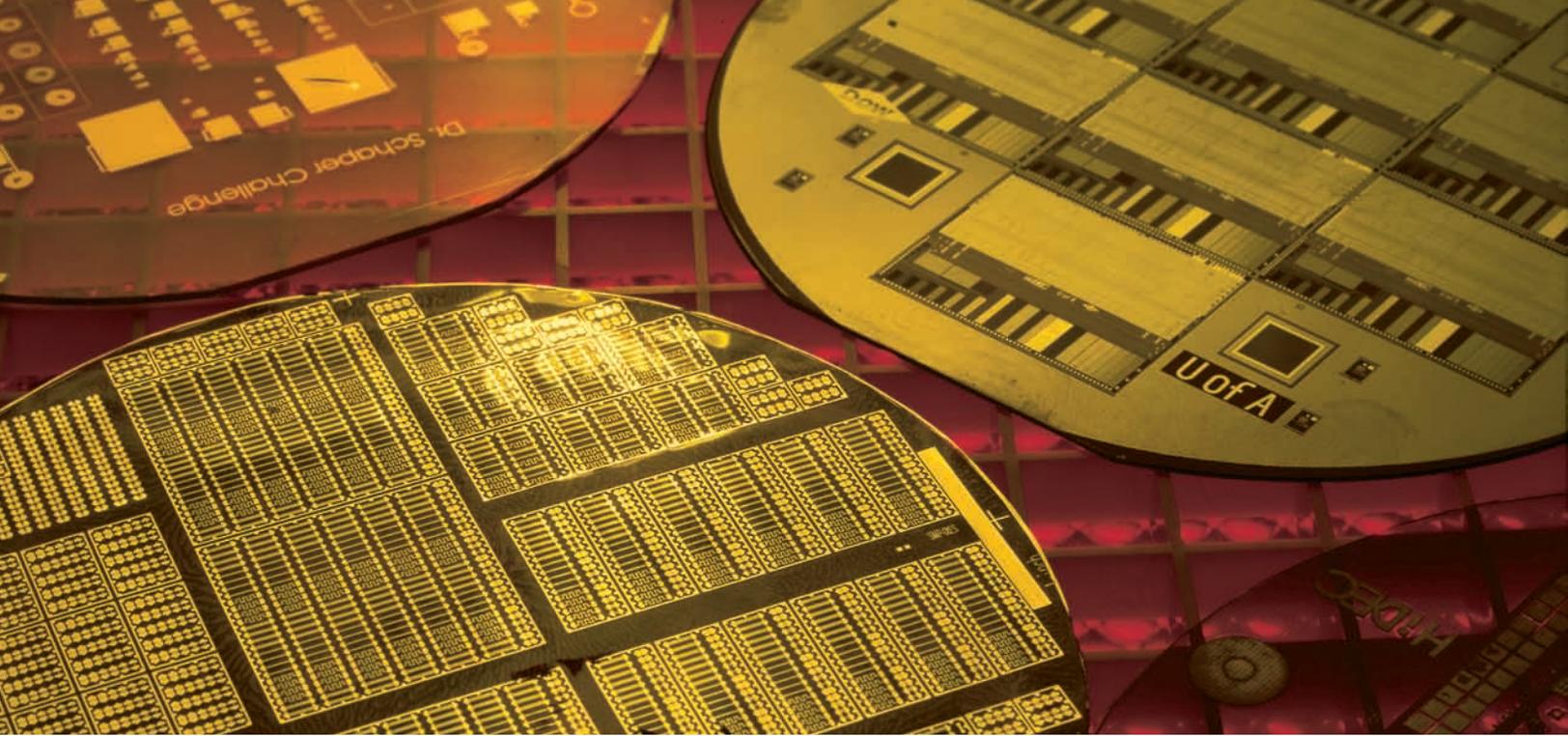
Nanotechnology holds the promise of improving the areas of consumer products, medicine, transportation, energy, defense and even agriculture. This represents a potential for more reliable products and services that will benefit consumers.

Even more importantly, improvements in these fields can help strengthen the industry base in our country, which benefits everyone.

Research in nanotechnology requires dedication of researchers, administrators and financial supporters. The University of Arkansas is proud to support their nanotechnology researchers through the development of the Institute for Nanoscience and Engineering.

This nanotechnology institute will function as an interdisciplinary unit that coordinates the efforts of various colleges and schools across campus to promote and facilitate interdisciplinary research, education, industrial outreach and entrepreneurial opportunities in the emerging field of nanoscience and engineering.

Our researchers are truly on the cutting edge.



Combating Friction and Stiction

By Matt McGowan

Micro-electro-mechanical systems, popularly referred to as MEMS, in small electronic devices often fail because of adhesion and stiction – the attractive force between the surfaces of interacting parts. University of Arkansas researchers have developed a surface-topography engineering method that reduces these forces and will help microscopic parts interact and function smoothly.

“There are two approaches to address adhesion and stiction issues in MEMS devices,” said Min Zou, assistant professor of mechanical engineering. “One is chemistry – applying chemicals on surfaces to weaken the forces. The other is topography engineering. Our approach was simple – we engineered nanoscale bumps to reduce the contact area between surfaces.”

The goal of the project was to create a hydrophobic surface. Determined by a popular engineering benchmark known as the water-contact angle, hydrophobicity describes the process of water “beading up” or turning into a ball, such as rain does on an automobile windshield that has been treated with chemicals. The water-contact angle is the measurement used to describe the extent to which water beads. A water-contact angle greater than 90 degrees is considered hydrophobic, and any angle greater than 150 degrees is considered superhydrophobic. With a water-contact angle of approximately 180 degrees, beads represent a near-perfect sphere with only minimal contact on surfaces.

Using only topography-engineering methods, Zou’s team achieved a water-contact angle as high as 137 degrees on silicon. No other researcher has achieved a higher water-contact angle without the use of chemicals. Zou’s team also conducted a study that combined the surface-topography engineering method with chemicals. That study achieved a water-contact angle greater than 150 degrees, and thus produced a superhydrophobic surface.

Zou’s team started with amorphous silicon – silicon that does not exhibit any crystalline form or shape. The researchers used aluminum to induce crystallization, which manifested as nano- or microcrystallites to form the textured surfaces. The researchers induced crystallization by annealing – a process of heating and cooling – the amorphous silicon in a conventional furnace.

“We demonstrated that the surface area covered by nanotextures can be controlled by changing annealing temperature and duration,” Zou said.

In addition to electronic devices, the research applies to biomedical devices. It also advances the understanding of tribology, which is the study of friction, wear and lubrication of interacting surfaces in relative motion, such as gears, bearings and head-disk interfaces in computer hard drives.

Zou presented the research findings in January at the International Conference on Integration and Commercialization of Micro and Nano-systems organized by the American Society of Mechanical Engineers. The research was awarded the conference’s best paper award.

Point-of-Care Diagnostics

Integrated with “smart” fabrics, biosensors will monitor respiration rate and body temperature in real time

By Matt McGowan

Working with an organic semiconductor, electrical-engineering researchers at the University of Arkansas have fabricated and tested two similar but slightly different biosensors that can measure important physiological signs. Integrated into “smart” fabrics - garments with wireless technology - the sensors will be able to monitor a patient’s respiration rate and body temperature in real time and thus provide point-of-care diagnostics to health-care professionals and greater freedom for patients.

“We’re trying to move diagnostic testing out of the laboratory and directly to the patient,” said Taeksoo Ji, assistant professor of electrical engineering. “Although there has been some success at this effort over the past decade, traditional materials are not suitable for manufacturing low-cost, large-area sensor devices. The advantages of organic semiconductors will allow manufacturers to produce devices that are light, flexible and easily integrated into biomedical applications such as smart vests and fabrics.”

The researchers - Ji and Soyoun Jung, a graduate student in electrical engineering, under the direction of Vijay Varadan, Distinguished Professor of electrical engineering - worked with pentacene, a hydrocarbon molecule, and carbon nanotubes to develop the two types of sensors - a temperature sensor and a strain sensor. The addition of carbon nanotubes with pentacene increases sensor sensitivity. As an organic semiconductor, pentacene is efficient and easy to control. Both sensors were fabricated directly on flexible polymeric substrates.

The strain sensor, which would monitor respiration rate, consisted of a Wheatstone bridge, an instrument that measures unknown electrical resistance, and a thin pentacene film that acted as a sensing layer. The system would work when a physiological strain, such as breathing, creates a mechanical deformation of the sensor, which then affects the electrical current’s resistance. The researchers found that the smaller the sensor, the more sensitive it was to current

variations.

For the temperature sensor, the researchers used what is known as a thin-film transistor, which is a special kind of transistor that deposits thin film semiconductors on substrates. The thin-film transistor helped the researchers observe electrical current in linear response to temperature change. Most importantly, in low voltage areas, the current displayed the highest sensitivity to temperature changes.

The success of the research is promising for patients whose vital signs must be continuously monitored. Varadan said the sensors and wireless networks can fit on garments such as undershirts. With this technology, the smart fabric can monitor vital signs and collect and send data to an information hub in real time. The information can provide immediate detection of physiological abnormalities, which will allow physicians to begin treatment or prevent illness before problems reach an acute stage.

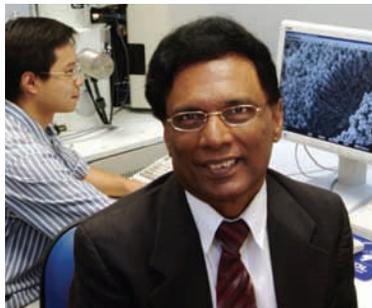
The research was done in the Organic Electronics and Devices Laboratory, which is part of the College of Engineering’s Center for Nano-, Bio-, and Info-Technology Sensors and Systems. Varadan is director of the center.

Varadan holds the College of Engineering’s Twenty-First Century Endowed Chair in Nano- and Bio-Technologies and Medicine and the college’s Chair in Microelectronics and High Density Electronics. In addition to his position as director of the above center, he directs the university’s High Density Electronics Center. Varadan is also a professor of neurosurgery in the College of Medicine at the University of Arkansas for Medical Sciences.



Taeksoo Ji and Soyoun Jung

Biosensor Center to Receive Part of Large NSF Grant



Vijay Varadan

The Center for Nano-, Bio-, and Info-Technology Sensors and Systems at the University of Arkansas will benefit from a recent \$9 million National Science Foundation grant to the Arkansas Science & Technology

Authority. The university portion of the grant will allow researchers to create collaborative infrastructure for the design of arrays of nanosensors that can be integrated with wireless systems and fabricated with a specialized, yet low-cost, nanofabrication technology.

“This grant will enable our center to develop wireless sensors and networking technologies that will have a major impact on people and the way they live,” said Vijay Varadan, Distinguished Professor of electrical engineering. “For example, we will develop wearable chemical and biological hazard sensors for firefighters, police and security personnel. In addition, we will develop biosensors for human physiological and ambulatory monitoring, and the detection of pathogens in clinical, food, agricultural and environmental samples. These are only a few examples of the kind of devices our center will create.”

Researchers at the University of Arkansas center have already developed and tested two similar but slightly different biosensors that can measure important physiological signs. Integrated into “smart” fabrics - garments with wireless technology - these sensors will monitor a patient’s respiration rate and body temperature in real time and thus provide point-of-care diagnostics to

health-care professionals and greater freedom for patients.

The \$9 million grant, made through the NSF Experimental Program to Stimulate Competitive Research, will establish the Arkansas ASSET Initiative (Advancing and Supporting Science, Engineering and Technology), which is designed to boost progress in two scientific research areas developing in Arkansas: plant-based bioproduction and wireless nano-, bio- and info-technology sensors. Both projects have potential for major economic development as well as regional and national commercial significance.

Each project has significant and integrated research on the campuses of Arkansas State University and the University of Arkansas at Little Rock, in addition to the University of Arkansas. As a co-principal investigator, Varadan will direct the wireless sensors project. Gail McClure, vice president of the Arkansas Science & Technology Authority, said that ASSET is the first strongly integrated, multi-university collaboration of three of the four graduate research institutions in Arkansas.

The Arkansas Science & Technology Authority was created by statute in 1983 with the mission to bring the benefits of science and advanced technology to the people and state of Arkansas. This mission is addressed by strategies to promote scientific research, technology development, business innovation, and math, science and engineering education.

Varadan holds the College of Engineering’s Twenty-First Century Endowed Chair in Nano- and Bio-Technologies and Medicine and the college’s Chair in Microelectronics and High Density Electronics. In addition to his position as director of the above center, he directs the university’s High Density Electronics Center. Varadan is also a professor of neurosurgery in the College of Medicine at the University of Arkansas for Medical Sciences.

National Notice for UA Nanotech Firms

Two University of Arkansas researchers and their nanotechnology companies were presented with Recognition of Excellence in Innovation certificates by the Under Secretary of Commerce for Technology Robert Cresanti on Aug. 7 at the University of Arkansas at Little Rock.

The certificates were awarded at a luncheon before a roundtable discussion on “Overcoming Barriers to Nanotechnology Commercialization,” hosted by Cresanti, in conjunction with U.S. Sen. Mark Pryor (D-Ark.), the

University of Arkansas System and the University of Illinois-Springfield.

Xiaogong Peng, who holds the Charles E. and Clydene Scharlau Endowed Professorship in Chemistry, and his company, Nanomaterials and Nanofabrication Laboratories (NN-Labs), were recognized for pioneering the manufacturing and application of high-quality, nanocrystals in solution that can be used in solid-state lighting, light-emitting diodes, solar cells, and biomedical detection. NN-Labs and the University of Arkansas received a joint U.S.

patent in 2006 for their specialized manufacturing process.

Ajay Malshe, a professor of mechanical engineering and the Twenty-First Century Professor of Materials, Manufacturing and Integrated Systems, and his company, NanoMech, were recognized for developing nanoparticle-based coatings and coating deposition systems that have unique properties such as extreme wear resistance, corrosion resistance, bio-compatibility and other attributes important for military and industrial products and for medical implants.

NN-Labs and NanoMech are both spin-off companies based on technology developed at the University of Arkansas. The companies are housed in the Genesis Technology Incubator.

The certificates recognized local and regional innovators who, within the last 12 months, have introduced a new product or service into the market, utilized a new manufacturing process, or received a patent from the U.S. Patent and Trademark Office.

The roundtable, the second of three meetings nationwide, featured founders of nanotechnology companies that have emerged from university research, as well as venture capitalists, state and local economic development agencies, and other experts who shared their insights and experiences in overcoming barriers to



Ajay Malshe

nanotechnology commercialization.

Other participants from the University of Arkansas included Greg Salamo, who holds the Joe N. Basore Professorship in Nanotechnology and Innovation; Vijay Varadan, who holds the Graduate Research Faculty Endowed Chair in Microelectronics and High Density Electronics; and Ashok Saxena, who holds the Irma F. and Raymond F. Giffels Endowed Chair in Engineering and is the dean of the College of Engineering.

Inventor's Corner: NanoGlide® – SMALL is SLIPPERY

Energy has become one of the most compelling sustainability challenges of the 21st century. A team led by Ajay Malshe, Twenty-First Century Professor of Materials, Manufacturing, and Integrated Systems, Professor of Mechanical Engineering and Director of Materials and Manufacturing Research Laboratories, in collaboration with a national team, is advancing breakthrough nanomaterials and nanomanufacturing methods to address this global challenge.

One example of these breakthroughs is NanoGlide®, a nanostructured lubricant. The objective of project NanoGlide® is to systematically design, synthesize, optimize and test this advanced lubricant using innovations at the U of A and by their collaborators. NanoGlide® encompasses active nanostructures of inorganic solid lubricant material encapsulated with organic molecules.

Friction, lubrication and wear can have powerful effects on energy use. The energy consuming

forces of these factors can be seen when two or more surfaces come into contact with each other.

In the United States, the annual cost of friction and wear-related energy and material losses is estimated to be 5 to 7% of their gross national products. For example, total frictional losses in a typical diesel engine may alone account for more than 10% of the total fuel energy depending on the engine size, driving conditions and other factors. Advanced lubricants, like NanoGlide®, offer potential savings of hundreds of millions of dollars from decreased fuel consumption, reduced vehicle exhaust emission and decreased down time caused by wear and tear on equipment.

Malshe's nanotechnology research labs are housed at the Genesis Technology Incubator located at the University of Arkansas' Engineering Research Center in Fayetteville, AR.

For more information about this project, contact Ajay Malshe at apm2@engr.uark.edu.



Instruments in Space

By Melissa Blouin

University of Arkansas researchers, in partnership with a local company will develop a probe for future planetary rovers that will help scientists study the history of the solar system by examining the properties of layers of material beneath the surface of the moon, Mars, comets and other planetary bodies.

Scientists at the Arkansas Center for Space and Planetary Sciences and officials of Space Photonics Inc. received a \$403,000 grant from the Planetary Instrumentation Development branch of NASA, which will allow them to create an optical probe that can be used to determine the composition and amount of ice beneath the surface of a planetary body.

“Our intention is to deliver to NASA hardware that is ready for a mission,” said Rick Ulrich, professor of chemical engineering and principal investigator for the project. This particular instrument will help researchers answer questions that have been around since planetary bodies were discovered.

“When we look out at these places, we only see the surface, and we wish we could see what lies beneath,” Ulrich said. “Those layers contain the timeline of the solar system’s history.”

To examine the layers, the researchers will build an Optical Probe for Regolith Analysis, an instrument they refer to as OPRA.

The instrument will operate at the base of a rover, driving a spike into the soil. The spike, which may be anywhere from one to four feet long, will contain several dozen

quartz windows along its length with fiber optic cables connected to an infrared spectrometer back in the rover, which will provide spectral analysis as a function of depth. Because all the electronics will be isolated in the rover, there will be no heat source to alter the possibly frigid interior of the planetary body.

“OPRA will analyze these layers without disturbing them,” Ulrich said. “We’ll get composition versus depth at every layer.” The infrared spectrum will provide information on the kind of rock, its chemical composition, the amount of water in the rock and how the molecules are arranged. By looking at the compositions of different layers, the researchers can peel back time and look at the geologic history of the planetary body.

“NASA wants simple, robust and effective hardware, and OPRA is all three of these,” Ulrich said. The public-private partnership with Space Photonics strengthens the university’s ability to attract major instrumentation funding.

Space Photonics has served as a research and development company for the Department of Defense and for NASA and has reported recent product sales to Honeywell, Lockheed-Martin and Orbital Sciences.

“The relationship with the University of Arkansas has been key for us,” said Matthew Leftwich, a senior development specialist and lead engineer at Space Photonics, a University-based start-up company. Space Photonics will develop the fiberoptic cable interface that will carry the infrared light signals to and from the alien soil, through the sub-surface probe. Infrared light sent to and reflected back from the alien soil into the probe’s fiber-coupled interconnect system will deliver the data to the



NASA, ESA, A. Aloisi (STScI/ESA), and The Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration

Fourier-transform infrared spectrometer for analysis.

“SPI will be collaborating with the OPRA design team to determine the optimal methods of fiber-to-quartz lens coupling and fiber routing throughout the OPRA probe,” he said.

To test the instrument, the researchers will build a large sandbox-like structure that will contain a Mars soil simulant, clay or other materials that might be found on planetary bodies. They will use this and other means to test the instrument, trying to determine the force necessary to penetrate the ground, how the windows should be positioned and how many times the probe can be used before the material begins to wear. They also will compile a library of spectral results from the different materials.

“We envision that this will work on Mars, the Moon, comets and asteroids,” Ulrich said. At the end of the project, the probe will be ready for NASA to consider for a mission, and it could be in space in 4 to 6 years.

Ulrich credits the work of the W.M. Keck Laboratory for Space Simulation and the multidisciplinary nature of the team for the success of the proposal - the researchers have expertise in materials science, geology, engineering, chemical engineering, fiber optics and space science. The team includes Ulrich; Larry Roe, professor of mechanical engineering; space center director Derek Sears, who holds the W.M. Keck Professor of Space and Planetary Sciences; Vincent Chevrier, a postdoctoral fellow in space and planetary sciences; and Leftwich with Space Photonics.

The Arkansas Center for Space and Planetary Sciences is a joint center in the J. William Fulbright College of Arts and Sciences and the College of Engineering.



NASA awards University of Arkansas researchers

CSCE Department Receives New ABET Accreditation and Moves into New Office Space

The Computer Science and Computer Engineering department had an exciting start to the school year. In August, the department was notified of its new ABET accreditation. At the same time, the department was completing the move into its office space at the newly constructed J.B. Hunt Transportation Services, Inc. Center for Academic Excellence.

“This is a major step for the department,” said Susan Gauch, newly appointed CSCE department head. “Not only does this reflect well on the CS degree program and the department, it also reflects the hard work by faculty, administration, and students involved in the process.”

Meanwhile, the new academic space was ready just in time for the start of the semester.

“The new building has state-of-the-art facilities and bright, open spaces. It is a great place to work and an asset when recruiting new students and faculty,” said Gauch. “There



are multiple open-use collaborative areas where students and faculty can work in impromptu sessions, reinforcing the importance of team efforts in modern computing. The available research lab space will also allow faculty to build and sustain active research programs.”

The J. B. Hunt Transportation Services, Inc. Center for Academic Excellence was dedicated on September 6.

Fond Farewell to Former Dean and Department Heads on the Move

Former dean Neil Schmitt and former department heads Jerry Yeargan and John English have left the University of Arkansas to open new chapters in their lives.

Schmitt, who joined the university in 1970, initially served as an assistant professor. He was promoted to university professor in 1996. Schmitt served as the dean of the College of Engineering from 1983 until 1996. During that time, the college’s teaching and research facilities were greatly expanded and renovated.

Yeargan joined the university in 1967 as an assistant professor. He was promoted to distinguished professor in 2001. Yeargan served as department head of electrical

engineering and the department of computer science and computer engineering.

English was with the university since 1991. Through the years, he served as an assistant professor, associate professor, professor, director of the Logistics Institute, economic development officer and director of GENESIS Technology Incubator, executive director for the Center for Engineering Logistics and Distribution, and most recently as the department head for industrial engineering. English is now the new dean of the College of Engineering at Kansas State University.

“I would like to wish Professors Yeargan and Schmidt happiness in their retirements and Dean English the very best in his future endeavors,” said Ashok Saxena, dean of the College of Engineering.

New Department Heads Named for Electrical Engineering and Computer Science and Computer Engineering

The electrical engineering and computer science and computer engineering departments have new department heads appointed as of August 2007.

Electrical Engineering

Dr. Samir El-Ghazaly, the new department head of the department of electrical engineering, is known internationally for his research involving microwave theories. El-Ghazaly began his position as head of the department of electrical engineering on August 6.

In addition to his role as department head, El-Ghazaly will also hold the 21st Century Leadership Chair in Engineering.

El-Ghazaly received his doctoral degree in electrical engineering in 1988 from the University of Texas at Austin. He joined Arizona State University as an assistant professor in the department of electrical engineering, where he became associate professor in 1993 and professor in 1998. El-Ghazaly served as professor and head of the department of electrical and computer engineering at the University of Tennessee-Knoxville since August 2002 and until joining University of Arkansas in August 2007.



Samir El-Ghazaly

Computer Science & Computer Engineering

Dr. Susan Gauch, the new computer science and computer engineering department head, is renowned for her work with Intelligent Information Agents. She began her position as head of the department on August 13.

In addition to her role as department head, Gauch also will hold the Rodger S. Kline Endowed Chair in Computer Science and Computer Engineering.



Susan Gauch

“I am very excited to be joining the University of Arkansas. With the new building and support from the university and local industry, I think that the CSCE department is well-positioned to make significant progress in the quality of its education, research and external reputation,” said Gauch. “There is a strong foundation on which to build nationally recognized programs, and I am very impressed with the friendliness and energy of my colleagues here.”

Her current research is focused on investigating personalized and conceptual information retrieval within the context of the Citeseer archive of computer science literature.

Gauch received her doctoral degree from the University of North Carolina-Chapel Hill in 1990. She has been a faculty member at the University of Kansas at Lawrence in its department of electrical engineering and computer science since 1993.

“I am extremely excited about turning over the leadership of the Electrical Engineering and the Computer Science and Computer Engineering departments to world-renowned scholars such as Drs. El-Ghazaly and Gauch, respectively,” said Ashok Saxena, dean of the College of Engineering. “I am confident that the two departments will flourish under their guidance and achieve new heights.”

In Memoriam

Loren Ray Heiple, retired dean and former head of civil engineering, died on August 2, 2007. Heiple served as dean of the College of Engineering from 1971 until 1979. He originally joined the College of Engineering as the head of the department of civil engineering in 1950. Heiple retired in May 1984, after 34 years as a faculty member in the College of Engineering.

2007 Engineering Alumni Awards Banquet

In April 2007, the College of Engineering hosted the annual Engineering Alumni Awards Banquet, drawing together alumni from around the country and celebrating the many achievements of our Arkansas engineers.

The evening event, hosted by Dean Ashok Saxena, was opened with welcoming remarks by Chancellor John White at the Embassy Suites in Rogers. Rodger Kline (BSEE `66), Chairman of the Dean's Advisory Council and Chief Administrative Leader of Acxiom Corporation, introduced the 2007 new Academy inductees.

The 2007 Engineering Hall of Fame award was presented to Tom Stephens, (BSIE `65, MSIE `66), Chairman and CEO of Boise Cascade, Inc. Stephens was introduced by University of Arkansas System Board of Trustees Chairman, Stanley Reed (BSAGE `73).

In the introduction, Reed highlighted Stephens' lifetime contributions to the competitive timber and paper industry in a career which has culminated in the leadership of one of the country's largest privately-held firms. "Tom, you are a shining example to our students of what can be achieved with the benefit of an engineering degree from the University of Arkansas," Reed said. "We thank you for the service you have rendered, and for the contributions you have made to our profession, to industry and to the University of Arkansas."

Dr. Bami Bastani (BSEE `76), President and CEO of Anadigics Inc., took the podium following dinner to introduce the 2007 Engineering Distinguished Alumni Award recipients. Bastani noted the long tradition of excellence that binds members of the Distinguished Alumni recipients and the renown they have brought to the University of Arkansas.

Bob Crafton, Alan Fortenberry, Jim Hefley, JR Jones, Jack King, Greg Reed, Lou Sheppard and Palmer Terrell were honored as the 2007 Distinguished Alumni of the College.

"We are deeply grateful to all of tonight's award recipients," Bastani said. "We are proud of the honor they bring to this College – to this extended family – by the many achievements and successes that have marked their careers."

Brock Hoskins (BSCE `89), Vice President and Senior Project Manager for Garver Engineers, introduced the 2007 Engineering Young Alumni Award recipients.



2007 Engineering Hall of Fame Award recipient Tom Stephens (BSIE `62, MSIE `63)

Before recognizing the awardees individually, Hoskins asked the audience to pause and applaud the College of Engineering faculty for the role our professors play in helping students achieve their professional goals.

Stan Andrews, Matt Connelly, Grant Ducote, Cyndie Frederick, Stacy Gunderman, Greg Langham and Shreenath Rao were honored as outstanding Young Alumni for 2007.

"The many successes celebrated here tonight all started in the same place: in the classrooms of the College of Engineering. Without a doubt, the will to excel and go the extra mile is born in the many hours each of our former students spent wrestling with the challenge of a world-class engineering education," Hoskins said.

The College of Engineering Alumni Awards Banquet is held each year in April in Northwest Arkansas.



Left top, J.R. Jones, Distinguished Alumni Award Recipient, with his wife, Becky, and Lamar Pettus (BSME `68)

Left middle, Ralph Sandage (BSIE `78, MSE `84) with Bob Davidson (BSIE `70) and Bob's wife, Jo

Left, Gwen and Larry (BSIE `58) Stephens with Rodger Kline (BSEE `66)

Above top, Rodger Kline (BSEE `66) with Jack Giles (BSME `65)

Above, Professor Bob Crisp of Computer Science Computer Engineering, George Knight (BSCE `64), Marie Hefley, Jim Hefley (BSEE `61) and Vicki Knight



Above, Professor Craig Thompson of Computer Science Computer Engineering with Vice Chancellor for Finance and Administration Don Pederson and Associate Vice Chancellor for Facilities, Mike Johnson



Top right, Chancellor John White flanked by George Knight (BSCE '64), Vicki Knight, Buck Johns (BSIE '64), Distinguished Alumni Award Recipient Jack King (BSEE '62, MSEE '63), Professor Bob Crisp, and Rodger Kline (BSEE '66)

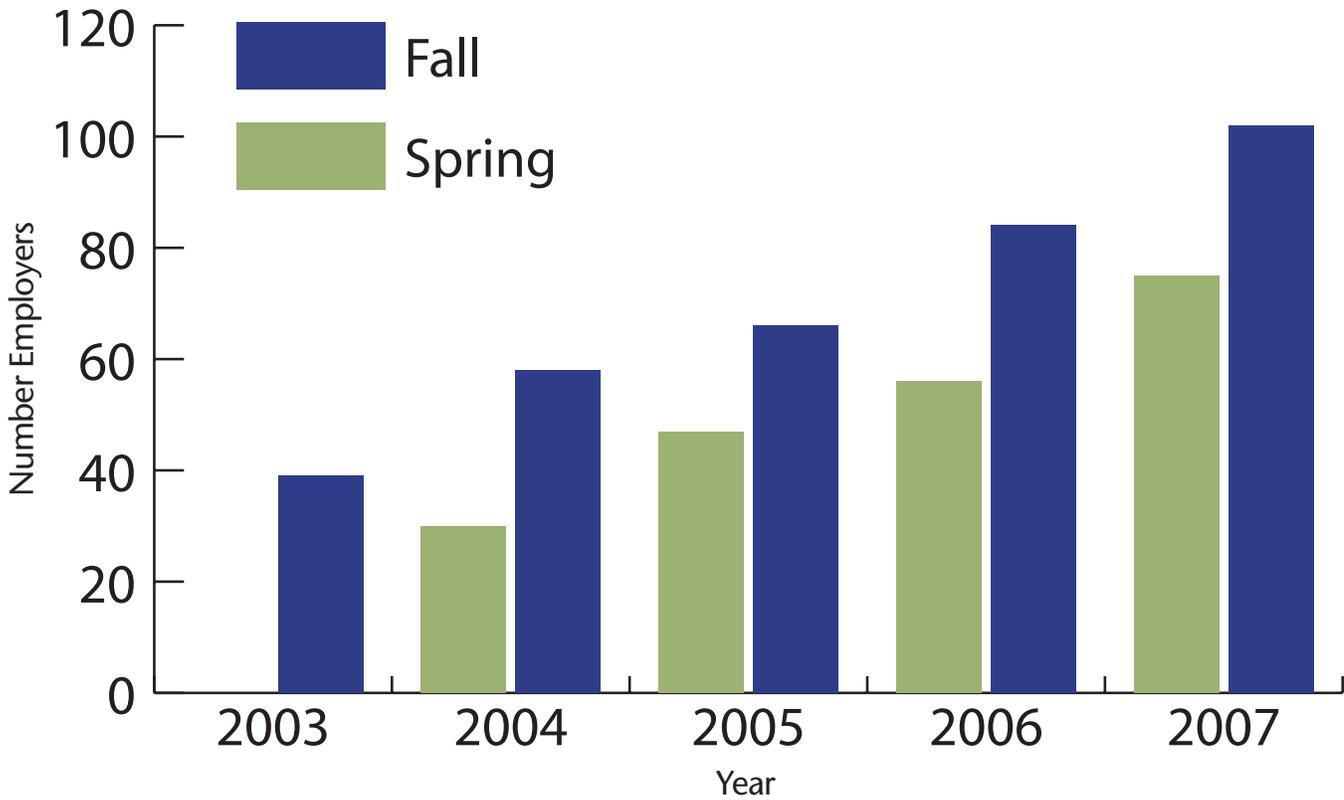


Middle right, Tom Stephens is welcomed into the Arkansas Engineering Hall of Fame by attending Hall of Fame members Jim White ('41 BSCE), Buck Johns (BSIE '64), Rodger Kline (BSEE '66) and Gus Vratsinas (BSCE '67, MSCE '68). John Michael Fohner, civil engineering class of 2009, looks on.



Right, Jon Keel (BSCHE '69, MSCE '70) and Carol Gattis (BSEE '80, MSEE '85, PhD '91) visit with Elmer Leisure (BSME '34).

Engineering Expo Attendance



Fill Us In

Tell us about your latest accomplishments, honors and awards.

By mail:

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Face to Face with the College of Engineering: Sarah Root, Ph.D.

Hometown: Port Clinton, OH; It is a small town on Lake Erie that is known as the Walleye Capital of the world.

Degrees: B.S. Industrial Engineering, University of Pittsburgh; M.S. Industrial and Operations Engineering, University of Michigan; Ph.D. Industrial and Operations Engineering, University of Michigan

What are your areas of research interest? My primary research interest is in the area of large-scale optimization: developing mathematical models of real-world systems. I have worked on applications in freight transportation and medical scheduling. I'm interested in continuing work in logistics and healthcare in the future.

How and why did you select engineering? My grandpa was an engineer. He really enjoyed his career. I liked solving problems and particularly enjoyed math and science, so it seemed like a good fit. Ironically, I also chose engineering because I thought it was one of the few majors I could select that I would be able to get a good job in without going to graduate or professional school!

Why did you choose to go to graduate school? I really enjoyed industrial engineering and I wanted to learn more



about operations research, a sub-discipline of industrial engineering. I also toyed with the idea of becoming a teacher when I was in college, so I thought that pursuing an advanced degree and entering academia would give me the opportunity to teach a subject I had come to love so much.

What do you like about teaching and research? I like the interaction with the students because they are really the future of the field. As a professor, I get the opportunity to showcase to them what a cool profession and relevant profession they have chosen. With my research, I enjoy figuring out new ways to solve interesting problems that people haven't been able to solve efficiently before. In both teaching and research, I love the "aha" moment when students understand something that had been confusing, or when we make a big discovery that will impact our research.

What do you think of Arkansas? This is my first year at the University of Arkansas. My first visit to Arkansas was on my interview. Three months later, I moved here for good. I love it! People are really friendly, and have helped to make this an easy transition.



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