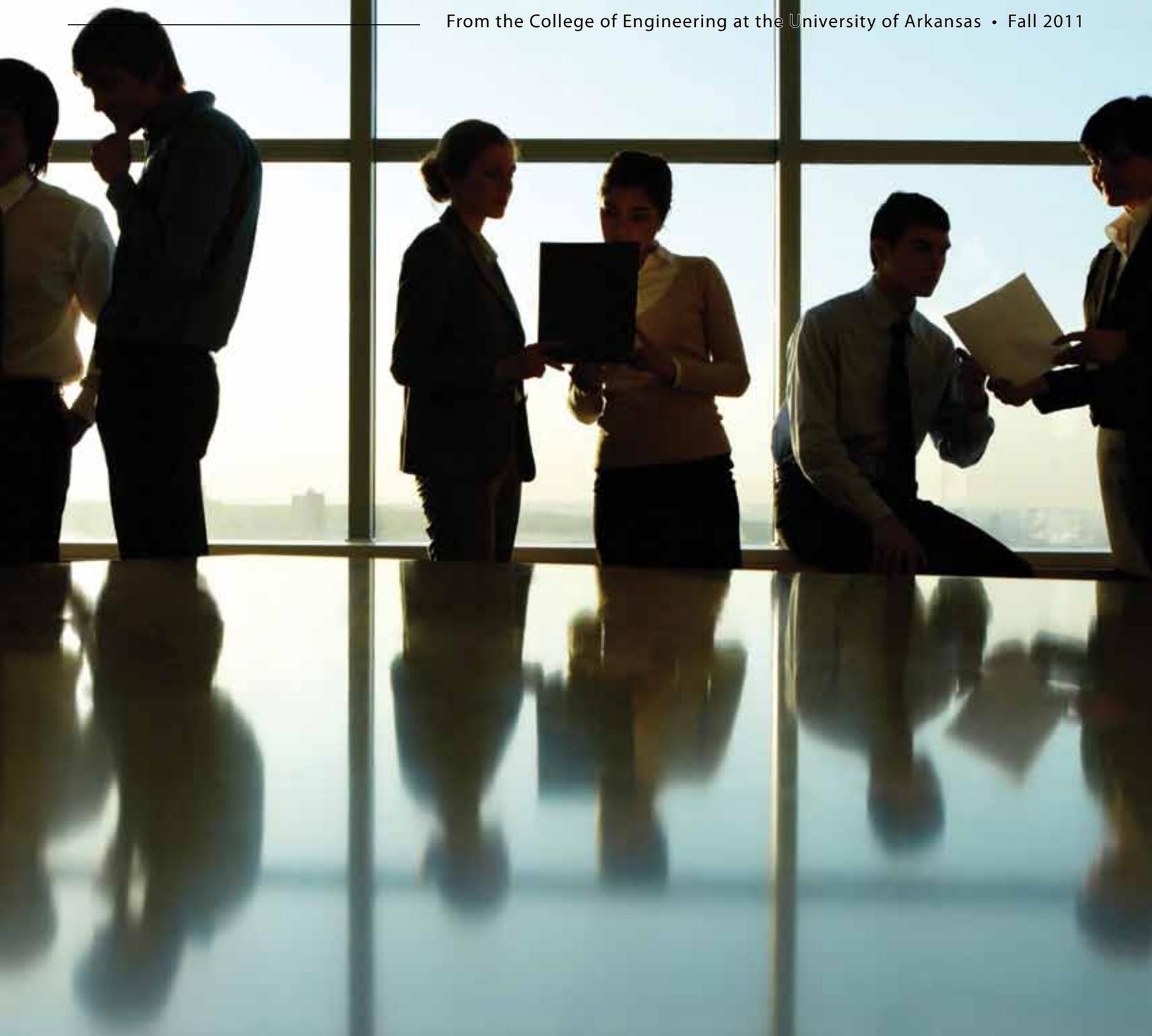


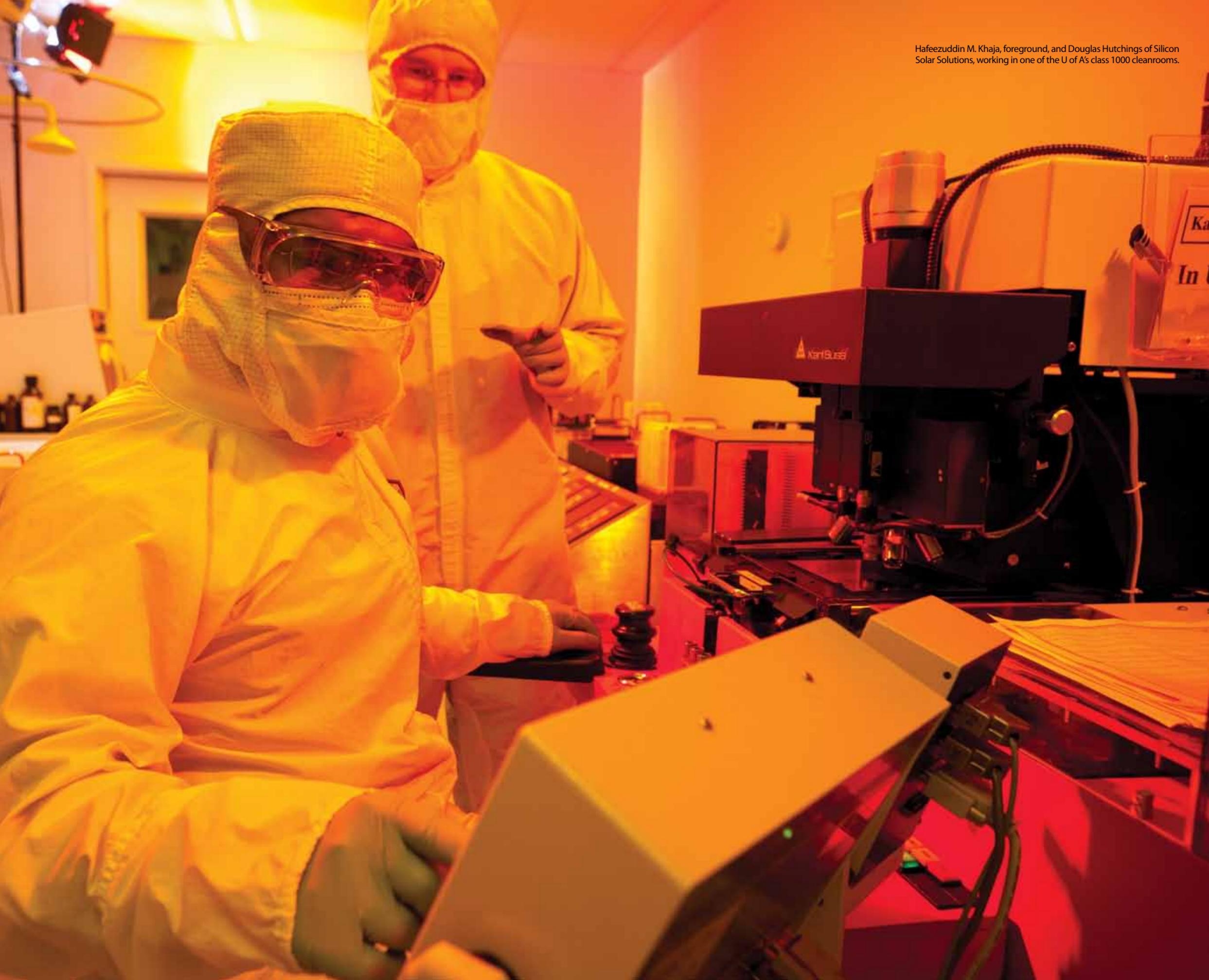
arkansas @ s E N G I N E E R

From the College of Engineering at the University of Arkansas • Fall 2011



UNIVERSITY OF
ARKANSAS
COLLEGE OF
ENGINEERING

the Business
of Engineering



Hafeezuddin M. Khaja, foreground, and Douglas Hutchings of Silicon Solar Solutions, working in one of the U of A's class 1000 cleanrooms.

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We all know how important engineering research and innovation are, for our nation and for the world. But in order for these breakthroughs to have a real impact, they must move out of the “ivory tower” of academia and become available for use in the real world. At the University of Arkansas College of Engineering, professors and students are putting their ideas to work through high-tech start-up companies. These businesses are developing and commercializing technologies that can improve the health of our planet and its people, while providing jobs in Northwest Arkansas.

In this issue, you can learn about some of the businesses that have developed on our campus, and find out how the university supports their efforts. Some of these companies, like NanoMech, have worked for years to get to where they are, while others, like Silicon Solar Solutions, are busy creating the solid foundations of a successful business.

All of these companies are already contributing to the economy and culture of Northwest Arkansas. They provide our students with exposure to a real-world engineering environment, and when those students graduate, these local businesses can provide jobs that keep some of our best talent in the area. In addition, the culture of entrepreneurship and innovation created by these start-ups has the potential to bring more attention and investment to our part of the country.

I am so proud of these enterprising faculty and students, and I hope you enjoy reading about their success.

Ashok Saxena

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

Jamie Hestekin, Innovator of the Year

Jamie Hestekin and his team of engineering students have won Planet Forward’s Innovator of the Year contest. As one of two Innovators of the Year, Hestekin, associate professor



Jamie Hestekin

of chemical engineering and the Jim L. Turpin Professor in Chemical and Biochemical Separations, and his team will be featured on Planet Forward’s website for the next 12 months, as they work on a method of producing biofuel from algae. Professors Robert Beitle and Roy Penney are co-advisers of the team.

Professors Honored by the Institute of Industrial Engineers

IIE honored two University of Arkansas professors at its annual conference on May 21-25. Russell Meller, holder of the James M. Hefley and Marie G. Hefley Endowed Professorship in Logistics and Entrepreneurship received the David F. Baker Distinguished Research Award. This award is given to a researcher who has made broad contributions to the field of industrial engineering. Kim Needy, department head and Twenty-First Century Professor in Engineering,



Russell Meller



Kim Needy

was named an IIE Fellow. Meller is the director of the National Science Foundation Center for Excellence in Logistics and

Distribution. One of his recent accomplishments is the development of two aisle designs that increase efficiency in warehouses. Needy’s research interests include engineering management, sustainability and supply chain optimization. One of her current research projects focuses on product design with the supply chain in mind.

Ed Clausen Named Outstanding Teacher

The Midwest Section of the American Society of Engineering Educators has named Ed Clausen, professor of chemical engineering, as its 2011 Outstanding Teacher. Clausen, holder of the Ray C.



Ed Clausen

Adam Endowed Chair in Chemical Engineering, has been teaching in the Ralph E. Martin department of chemical engineering since 1981, and he is currently the director of the honors program in the College of Engineering.

Department Head Tom Spicer explained that Clausen’s generous nature and rapport with students make him an outstanding teacher.

Engineering Students Receive NSF Fellowships

Six College of Engineering students have won National Science Foundation Graduate Research Fellowships: Adam Barito, Brittany Bogle, Stephen Crain, Scott Geurin, Rachel Lee and Julius

Morehead. The graduate fellowship program is one of the National Science Foundation’s oldest and most highly competitive, offering support for graduate study in all scientific disciplines.

ASME Recognizes William Springer

William T. Springer, Twenty-First Century Professor in Mechanical Engineering, has received the S.Y. Zamrik PVP Medal from the American Society of Mechanical Engineers for significant contributions in the nondestructive evaluation arena and for his support and leadership within ASME’s Pressure Vessels and Piping Division.



William Springer

El-Ghazaly to Chair IEEE Periodicals Committee

The Institute of Electrical and Electronics Engineers Technical Activities Board has elected Samir El-Ghazaly, holder of the Twenty-First Century Leadership Chair in Engineering and head of the department of electrical engineering, as the chair of the IEEE Periodicals Committee.



Samir El-Ghazaly

IEEE publishes more than 140 academic journals and trade and technical magazines. The periodicals committee oversees these publications, sets the IEEE publication strategies and policies and evaluates and approves new journal proposals. El-Ghazaly was elected by IEEE presidents and directors.



Razor

University Acquires New Supercomputer

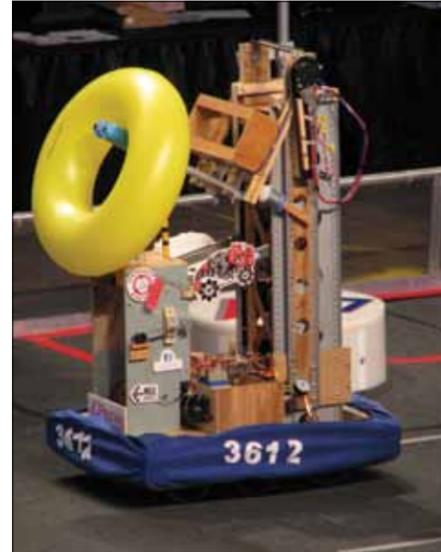
The University of Arkansas' newest computing resource, called Razor, is enabling researchers to solve large problems faster than ever. Razor more than doubles the amount of computing resources at the university's High Performance Computing Center. Faculty and students from several departments are using high-performance computers to explore the fundamental properties of chemicals and nanomaterials, develop new methods of detecting breast cancer and organize large sets of spatial data.

The high-performance computers can be accessed by any faculty member or student at the University of Arkansas, and by the faculty and students from other Arkansas universities that are members of the Arkansas Research and Educational Optical Network.

Razor features 126 dual hex-core processors for a total of 1512 processing cores running at 2.93GHz, with 2 gigabytes of memory per core and more than 200 terabytes of disk storage. Its processing speed is 17.75 teraflops.

FIRST Robotics Team Named Rookie All-Stars

The Springdale High School GearHogs, whose mentors include industrial engineering assistant professor Chase Rainwater and College of Engineering graduate Scott Turley, were awarded the Rookie All-Star



The GearHogs' robot, carrying a game piece.

Award for the Midwest Regional FIRST Robotics Competition.

To prepare for the competition, the team designed and built a robot according to the competition standards. At the three-day competition, the robot played a game called Logo Motion, which involved securing game pieces on a 10 foot scoring grid. In the three different phases of the game, the robot performed autonomously and was controlled remotely by the students.

As a result of winning the Rookie All-Star award, the team was invited to attend the FIRST World Championships. This event, which involved teams from all over the world, including the U.S., Israel, Australia, Turkey and France, was the subject of an ABC special featuring Will.i.am of the Black Eyed Peas. Rainwater reported that the team learned a lot at the competition, and that he hopes to start a regional FIRST competition at the U of A.

New Nanoscale Material Science and Engineering Building

The Nanoscale Material Science and Engineering Building is an exciting addition to campus with many innovative characteristics. Because of the atomic-level research that takes place in the building, it was built with special specifications such as vibration isolation, electromagnetic wave isolation, ultra-sensitive temperature control and a class 100 cleanroom. The facility has 20 different instruments, some of them world-class, available to campus faculty and students and to industries



in Arkansas and the surrounding area. The building also includes special rooms where student researchers can brainstorm ideas, develop technology and business plans and create and test new nanostructures.



Middle school students build a volcano in the Explore Engineering I program.

Engineering Summer Camps Promote STEM Education

In four different week-long summer camps, students in grades six through 12 learned about science and engineering from professors and students at the University of Arkansas. In June and July, middle and junior high school students got exposure to different STEM topics in Explore Engineering I and Explore Engineering II, and high school students got hands-on experience with specific engineering disciplines in the Engineering Summer Academy. During the first week of August, female students from Northwest Arkansas took part in Engineering Girl Camp.



This is the second year the College of Engineering has offered all of these summer programs. This year, the number of students taking part in Explore Engineering I and II and the Engineering Summer Academy more than doubled.

New Mechanical Engineering Department Head

The College of Engineering has selected James Leylek to head the department of mechanical engineering. Before coming to Arkansas, Leylek was a professor of mechanical engineering at Clemson University and the executive director of the



James Leylek

Clemson University Computational Center for Mobility Systems. Leylek's research focuses on computational aerodynamics and heat transfer. He develops mathematical models that can predict how changes in engine design will affect air flow and temperatures inside the engine. Leylek holds the Twenty-First Century Leadership Chair in Engineering.

University Helps Middle and Junior High School Math Teachers

In order to facilitate the shift to Common Core State Standards curricula, a program called the University of Arkansas Engineering & Mathematics Partnership will provide curriculum workshops and evaluations for 6th-8th grade math teachers in the Northwest Arkansas area.

The two year program, which is funded by a \$283,000 per year grant from the Arkansas Department of Education, will specifically target teachers who serve student populations with high levels of poverty or a large number of English language learners or teachers who work in schools designated by No Child Left Behind as "in need of improvement." Fourteen middle and junior high public schools are participating, as well as one private school.

Improvements for the Research Center

The Engineering Research Center is getting a \$2.5 million renovation over the next 18 months. The College of Engineering will pay for the project over the next four years with research incentive funds. Twenty percent of the funds designated for the renovation will be used to reallocate lab and office space to make room for three new faculty labs. The rest will be used to improve the electrical systems in the building, add more safety features and increase security.

Improving Computer Hardware Security

What if the circuits in your computer had their own agenda? As Jia Di, associate professor of computer science and computer engineering, explained, hardware designers could easily insert malicious functionalities into their designs, and these could steal information or modify incoming data.



Jia Di

A type of code called hardware descriptive language, or HDL, is used to describe the design of a piece of hardware. Often, companies that make the hardware buy certain designs from third parties, and have no way of knowing if the HDL contains code that could present a security threat. "It would be exhaustively hard to test for these," said Di.

In spite of this challenge, the U.S. Department of Defense is making hardware security a priority, and Di has received a \$250,000 grant from the Defense Advanced Research Projects Agency to develop a way to test hardware designs for malicious elements.

Currently, Di and his students are creating a tool that can look at HDL code and determine all the functionalities it is capable of performing. In the next phase of the project, they will find a way to figure out if any of those functionalities are malicious.



Christophe Bobda, far right, speaks to African journalists about his project.

Professor Helps Fight Pollution in Cameroon

On a trip to Yaoundé, Cameroon in 2009, Christophe Bobda, associate professor of computer science and computer engineering, noticed that the roads were crowded with old cars. The emissions from these vehicles were filling the air with pollution, and Bobda became concerned about the health of the people living in this environment.

Bobda also recognized that, in order to convince the government that pollution was a problem, he needed scientific evidence. "Everyone can see that there is a problem, but nobody really cares about doing something until you provide them with data," he explained.

In order to get this data, Bobda led a team that designed and built a set of devices that can monitor air quality. Each seven-inch by three-inch device contains three sensors, which can detect carbon dioxide, carbon monoxide and liquefied petroleum gases. It also incorporates a processing board, which prepares data from these readings, and a modem, which can send that data to a central server.

In June 2011, Bobda, who is

a guest professor at the Ecole Nationale Supérieure Polytechnique in Yaoundé, traveled to Cameroon with the 25 sensors built by his group. After teaching a course in which he demonstrated the technology involved in the sensors, Bobda presented them to the university. Researchers there will install the devices around the city, rotating them among 60 intersections to collect data about pollution levels.

This data will be incorporated in a geographical information system designed by Emmanuel Toyne, a professor at Ecole Nationale Supérieure Polytechnique. Researchers can then use the data to study the correlation between air pollution and pulmonary diseases, which are a growing problem in Yaoundé. "We intend to show to the government that these pollution levels are not safe, and we hope that this is going to make them implement legislation to solve this problem," explained Bobda.

This project was funded by the German Organization for International Cooperation and Afriscience, an African science and technology organization.

Going Green at Home Made Easier with iPhone App

Technology just made being "green" easier. Computer science researchers at the University of Arkansas and University of San Francisco have developed an automated energy-management system that monitors energy generation and consumption in off-grid and grid-tied homes that use solar energy or wind power. As part of the system, an iPhone application warns homeowners of critical battery situations, suggests appliances to turn on or off, recommends ideal times to execute tasks that require greater power and adjusts power states of devices to reduce energy consumption.

"Our system alerts the homeowner of critical situations and then suggests which appliances to turn off. From anywhere, as

long as they have their smart phone, homeowners can then use the software to direct the system to shut off the suggested appliance or a different one," said Nilanjan Banerjee, assistant professor of computer science and computer engineering at the University of Arkansas.

Banerjee, Pat Parkerson, associate professor of computer science and computer engineering at the University of Arkansas, and Sami Rollins, professor at the University of San Francisco, installed a suite of monitoring tools in an off-grid, solar-powered home in Fayetteville. The researchers collected generation and consumption data during the summer of 2010 and in

November and December of 2010.

In addition to monitoring power-generation devices of the photovoltaic system, their system also tracked individual appliances, including a refrigerator, washer and dryer, hot-water heater and television.

Data collected by the monitoring



An iPhone-based recommendation system, bottom, uses information collected by the measurement system, top, to provide users with advice regarding energy consumption.

system demonstrated important findings. First, energy harvested from the solar panels and energy consumed by the house varied greatly but in a predictable manner. Second, the study demonstrated that traditional energy-management techniques are insufficient in off-grid homes. Finally, the data showed that manual and reactive techniques do not prevent critical battery situations. The homeowner in the study was conservative with energy consumption and carefully monitored battery voltage. Still, he had to rely on a backup generator approximately 25 percent of the time because he could not predict times in which harvesting solar energy was low.

Increasing General Aviation Security

U of A researchers have developed a statistical model of the typical operations at general



Justin Chimka

aviation airports. General aviation refers to civilian flying, including private and business flights, flight training and crop dusting.

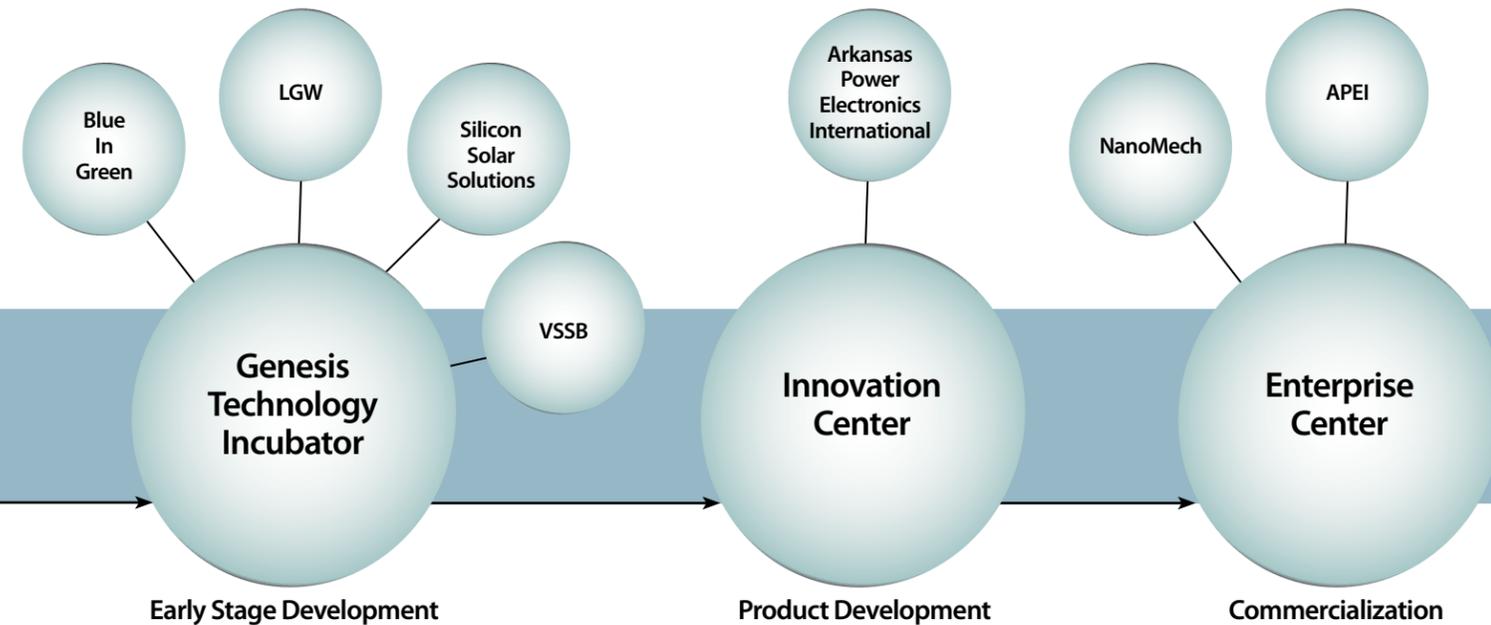
Supported by the U.S. Department of Homeland Security and the Mack-Blackwell Rural Transportation Center, the research could help officials detect unusual activity or behavior that might be associated with a security threat.

"We want to understand the variation associated with usual general-aviation activity and operations, so unusual activity can be detected, analyzed and resolved," said Justin Chimka, associate professor of industrial engineering and a researcher at the rural transportation center. "In other words, how big does a statistical error have to be for it to be considered a threat?"

Chimka and undergraduate student Ryan Black analyzed and recreated existing models used to predict growth at general aviation airports. After rendering the models more accurate and efficient, they systematically developed them for security purposes. The models relied on basic demographic information – annual number of landings and takeoffs, total number of planes based at an airport, whether an airport has a traffic-control tower, for example – and other detailed data.

the Business of Engineering

When academic research and innovation team up with entrepreneurship, the results can benefit the university, the region and even the world. The professors and students profiled in this issue of the magazine wanted to see their ideas go beyond the lab, and they decided to take on the challenge of commercializing their products themselves. With support from the university, help from their colleagues and a lot of hard work and creativity, these engineers are venturing into new territory: the world of hightech business.



Building Businesses at the U of A

Taking a product or idea from the lab into the world is a complex process involving many steps and much collaboration. At the University of Arkansas, high tech companies have the advantage of the Technology Development Foundation (UATDF), which provides support for every stage of a company's development, including affordable lab space, office space and equipment, consultations over business strategies and funding sources, help with market research and referrals to potential investors.

During the first stage of establishing a business, researchers can take advantage of UATDF's Virtual Affiliate Client Agreement, which gives them access to meeting rooms and help with setting up a business plan and securing funding. At the Genesis Technology Incubator, startup companies receive affordable office and lab space to conduct proof-of-concept studies and product development. Companies graduate from Genesis to the Innovation Center, where they can conduct more advanced research and development and find investors. The Enterprise Center is designed to accommodate the needs of established businesses. Its flexible building layout allows high tech businesses to custom design offices, labs, cleanrooms and manufacturing areas.

NanoMech: The Big Business of Tiny Particles

Beginnings

In the early nineties, Ajay Malshe had a good life in India. "I had everything there," he said. "A nice house, a job at a premier university, a happy family." But Malshe wanted more than that. He had ideas about new materials and technologies, and at that time, India did not yet have the right economic climate for him to explore his ideas and take them to market. The best place, he decided, was the United States, so he moved his family here to start a materials business.

That didn't happen overnight. Malshe, who had been a professor in India, taught at Ohio State University, then moved to Arkansas to work in the U of A's High Density Electronics Center. In 1995, he accepted a tenure-track position teaching materials science and mechanical engineering. In this position, he found the freedom to work on his ideas, and he discovered a love of teaching. For several years, Malshe divided his time between teaching and research, developing his ideas through traditional academic methods, like publications and patents, as well as working closely with industry.

But Malshe didn't forget about his dream of starting

NanoMech continued on page 10

a business. A turning point for him occurred in the late nineties, when the NSF program director came to the university to talk about the Small Business Innovation Research program. "In the whole conference room, there were three people," he remembered. In the region at that time, the idea of combining academic research with business probably sounded strange. But for Malshe, it was an inspiration.

At the same time, entrepreneur Jim Phillips was exploring concepts that many people thought were absurd. Like instant messaging. His company, Skytel, was developing technology that would allow people to send written messages back and forth, rather than talking on the phone. "The whole world looked at me and said 'No one is going to want that'," Phillips said.

These days, the concept of instant and text messaging seems obvious. After all, the basic elements of this technology—pagers, cell phones and email—were mainstream products at the time. Phillips recognized that instant messaging was in what he called a "technology sweet spot," a new technology that works with existing platforms, but makes a huge impact on those platforms, changing them forever. After MCI bought Skytel for \$2.85 billion, Phillips was on the lookout for the next sweet spot.

Discovering Potential

In 1997, "nanotechnology was not a buzz word," Malshe explained, but he was already working on what he called "miniaturized systems." One day, he received a call from a tool company that was looking for a coating that would extend the life of cutting tool products.

In two days, Malshe designed a nano-sized composite version of a material called cubic boron nitride, or cBN. In a week, he had a contract with the company to develop the new technology. Working with other engineering professors, post-doctoral fellows and students, Malshe created a method to bind this super-hard material to the surface of cutting tools, extending their life and increasing their productivity significantly. This coating would eventually become NanoMech's first product platform.

Phillips became interested in nanotechnology when he heard author Michael Crichton talk about the tiny



Malshe, center, and Phillips, right, show U.S. Treasury Secretary Timothy Geithner, left, around NanoMech's manufacturing facility. The Secretary visited the company to promote changes to a federal tax credit that can be used for research and experimentation, and his visit highlighted NanoMech's success in this area.

particles he was researching for a book. Phillips recognized that the shift from micro to nanotechnology could have an impact similar to the shift from analog to digital. "Everything changed overnight," Phillips said of digital technology. "It changed industries. Companies came and went. I think the same revolution is happening right now in nanotechnology."

The Meeting of the Minds

Malshe founded NanoMech, Arkansas' first nano-manufacturing company, in 2002. Phillips heard about Malshe's innovations, and traveled to Fayetteville to meet Malshe and learn more. He was impressed by the fact that Malshe had designed and patented a product that, like text messaging, builds on an existing market.

Phillips recognized that Malshe's cBN coating "would be in effect a plug-in that could change the entire industry." Phillips' business acumen helped Malshe get his products moving toward commercialization, and he accepted Malshe's offer to become CEO. Malshe's cBN coating, now called TuffTek, is currently on the market, along with the company's second product platform, nGlide. When added to oils, greases or coatings, nGlide, a macro molecular lubricant, increases their performance by 30 to 50 percent. Two more NanoMech product platforms are still in the early stages of productization. NGuard, a nano-materials product, has military applications, preventing the growth of fungus and bacteria on the gear of soldiers in the field, and can be used as an additive

to recycled wood-polymer composite to prevent fading. The Element-X platform includes a range of nano-metal powders. Using the unique properties of nano-sized elements like copper, aluminum, selenium, indium and others, Element-X can transform materials like cosmetics, electronic ink, fuel and fertilizers.

Malshe and Phillips agree that the success of NanoMech would not have been possible without the University of Arkansas. Phillips explained that one of the things that attracted him to Arkansas was the university's strong engineering program and commitment to investments like the new Institute for Nanoscience and Engineering.

This institute, he explained, "will attract scientists and engineers in a way that will provide what Silicon Valley and Research Triangle have: human intellectual capital that can assist companies that are growing in the area of nanotechnology."

"Today's universities are the knowledge creators," said Malshe, who values his position as a professor and entrepreneur, a vocation he has termed "profeneur." In this role, Malshe, a Distinguished Professor and holder of the Twenty-First Century Endowed Chair in Materials, Manufacturing and Integrated Systems, is able to create new technology and new jobs through his company, exchange ideas with other researchers and business leaders, and use his teaching skills to inspire the next generation of engineering innovators.

"When I came to this country, NanoMech was my dream," said Malshe. "I was blessed to add to that dream the ability to take that knowledge to the classroom."

The Future

Jim Phillips is excited about the future, in which he sees limitless possibilities. In his mind's eye, NanoMech's technology could keep getting bigger and better—paint that never fades, airplanes that don't break when they crash and propulsion systems for hovercraft are just a few of the products he can imagine—as it gets smaller and smaller. "Look up and you can feel infinity," he said. "You just keep multiplying. For nano, divide by two—that's also infinite."

For his part, Ajay Malshe is open-minded and optimistic. "People ask me where I will be ten years from now," he said. "I have no idea. I don't even know where I'll be tomorrow, but the point is this is not a destination, it's a process, and it is a fun process. I will have many stories to tell my grandkids."



Alex Lostetter holding a silicon-carbide charger that the company is developing for use in the Toyota Prius.

Arkansas Power Electronics International

"It's kind of a Cinderella story," said Sharmilla Mounce, business operations manager for Arkansas Power Electronics International, Inc. In 2002 she and Alex Lostetter, CEO, maxed out their credit cards to start the company with former colleague Jared Hornberger. Grant money appeared just a week before Lostetter left for a paying job, and today, APEI has 30 employees, many of them current or former U of A students, and \$3 million in revenue.

The company focuses on making silicon carbide power modules used in vehicles, geological exploration and the aerospace industry. Silicon carbide can operate at temperatures up to 600 degrees Celsius, unlike other currently used materials, which operate at about 125 degrees.

A joint development between APEI, the U of A, Rohm Company LTD., and Sandia National Laboratory, the APEI power module is the world's first commercial high-temperature silicon carbide-based power electronics module. With applications in hybrid and electric vehicles, renewable energy and electric aircraft, this module can greatly reduce the size and volume of power electronic systems. It also reduces energy loss by over 50 percent, which means significant potential energy savings.

LGW: An Unexpected Boost

The story of LGW begins in a rural village in China. Bob Winkleman, a lawyer-turned-battery-expert, had developed a battery-powered trike that could help Chinese farmers get from place to place, and he was testing a prototype. About two hours into his ride, the trike's battery died, and Winkleman thought he was stuck. After he let the battery rest for a while, however, Winkleman was surprised to see the reading on his volt meter rise all the way up to 14 volts, and he was able to start the trike up again and ride all the way back.

It is not unusual for seemingly dead batteries to come back to life, a phenomenon known as "battery bounce." But Winkleman began to wonder if he could use battery bounce to increase battery efficiency. Winkleman began what he calls "the process of eliminating ignorance," in order to find out the best way to take advantage of battery bounce, and the result of this process is LGW's patented energy management system. Using this system, LGW can make super-efficient batteries, which can store energy to augment the power grid or help solar and wind powered homes disconnect from the grid completely.

Winkleman and John Macguire, a former Tyson chief financial officer and LGW's CFO, realized that the best way to develop and commercialize their technology was to work with the University of Arkansas. They teamed up with Roy McCann, professor of electrical engineering, and set up an office in the Genesis Technology Incubator.

The Technology

LGW's system uses two lead acid batteries. While one is discharging, the other battery rests. Batteries rely on electrochemical reactions to move electricity between the electrodes. When a battery is charging or discharging, however, the molecules of these chemicals get displaced, moving away from the active surfaces. Without these reactants in place, the battery appears to be dead. After a rest period, however, the reactants redisperse and the battery will work again.

McCann explained that, by carefully designing the electrochemistry formulation of their batteries and using the cycle of discharge and rest, LGW maximizes this



McCann, foreground, and Moody work with LGW's energy management system.

process. The energy management system also eliminates another limitation on battery efficiency by making sure all cells in their batteries charge and discharge at the same rate. In other batteries, cells closer to the electrodes tend to fail before the ones in the middle, compromising the strength of the entire battery. Making sure their batteries don't contain these weak links further increases the efficiency of the company's energy management system.

The Importance of Storage

Energy storage is a vital part of any renewable energy system. Solar and wind are not consistent energy sources, and a home or business that relies on this kind of power must have stored energy that can be used when sun has

set and the air is still. Energy storage could also make the traditional electrical grid more efficient. Batteries that charge during periods of low demand and discharge during peak times could eliminate the need for the extra generators that utility companies keep on hand for high-demand hours. This would save money for both the utilities and their customers. In the past, however, energy storage systems had to be very large and very heavy to store the amount of energy needed for these purposes, making them impractical for everyday use.

LGW's system can change that. Their two-battery unit, which is about the size of an air-conditioning unit, can be installed outside a home or business. In addition to providing energy storage for the building, the system monitors energy use, taking a reading every five seconds. These readings are used to program the charging and discharging cycles, so that the system operates as efficiently as possible.

In cooperation with electric companies and using funding from the Department of Energy, LGW has installed their energy management system in five locations in order to test and refine the technology. These sites include the Fayetteville Public Library, private homes, commercial buildings and industrial facilities. Some of them use only power from the grid, while others incorporate solar arrays or wind turbines. Using these test sites, LGW can evaluate their systems in a variety of settings. Eventually, they hope to use a combination of solar arrays and battery storage to power their own offices.

Bridging the Gap

David Moody, who joined LGW as president in 2011, explained that the U of A was instrumental in helping their company avoid what he calls "the valley of death," which lies between a good idea and a commercially viable product. In order to develop their products, LGW needs equipment, facilities and expertise. "All of those things take money," he said, "unless you have a partner like the U of A who is willing to get in the boat and give you access to those things."

In addition, Moody explained that having offices at the Arkansas Research and Technology Park means "you have all this brain power within a couple hundred feet in any direction. That's a great resource to have...being able to go down the hall and talk to people who have been successful at getting grants and commercializing products."



BlueInGreen, in partnership with the Oklahoma Water Resources Board and the Central Oklahoma Master Conservancy District, installed an SDOX system on Lake Thunderbird in Oklahoma, which serves as both a drinking water source and a recreational destination for residents in the Oklahoma City metropolitan area.

BlueInGreen

BlueInGreen was co-founded in 2004 by two faculty members in the department of biological engineering: Marty Matlock and Scott Osborn. This company provides innovative products for improving and maintaining water quality.

BlueInGreen's SDOX system is an important new tool for delivering dissolved oxygen to a body of water, a key factor in restoring and maintaining healthy aquatic ecosystems. The SDOX system is capable of treating bodies of water that could not previously be effectively treated, such as rivers, and it has a smaller footprint than conventional aeration, allowing greater flexibility in treatment options.

In 2010, BlueInGreen received funding through the Rapid Response Program at the National Science Foundation to deploy SDOX technology in bays and estuaries that have been contaminated from the Horizon Oil Spill. The SDOX efficiently delivered dissolved oxygen to critical locations to support the habitat of oysters and help the vital fishing industry recover.

The SDOX system has been installed at the Noland Wastewater Treatment Facility in Fayetteville since 2008. Partly based on data from this installation, BlueInGreen received the 2010 Innovative Technology Award from the Water Environment Federation, an international not-for-profit technical and educational water quality organization.

Silicon Solar Solutions: A Classy Enterprise

Silicon Solar Solutions began as a class project. Douglas Hutchings, a graduate student in the microelectronics-photonics program at the time, had always been interested in starting his own business, so he signed up for a class called New Venture Development, which is taught by business professor Carol Reeves. In this class, students are required to come up with an idea for a start-up company and write a business plan. Douglas teamed up with business students Ben Allen and Alan Perkins, and the three of them started looking for ideas.

While Reeves' class does not require students to carry out their business plan, these three students saw it differently. "To us, the first step was having a real company," said Hutchings. Wanting to start a high tech company, the students began to search for technology they could commercialize.

"We were looking at tech licensing offices across the country, but could not find a good fit," said Hutchings. "Luckily, we finally looked in our own backyard." The students found the perfect business idea in the University of Arkansas electrical engineering department.

Hameed Naseem, professor of electrical engineering, was developing a cost-effective method of creating high-efficiency solar cells. He agreed to join the company as chief technology officer, and Seth Shumate, another microEP student, became Silicon Solar Solution's senior scientist. The three engineers worked together to develop and test the technology, which Silicon Solar Solutions calls top-down aluminum-induced crystallization, or TAIC.

The Technology

Most solar cells are made of silicon, which comes in two forms: crystalline and amorphous. Crystalline



Hafeezuddin M. Khaja, research scientist at Silicon Solar Solutions, loads a sample for processing.

silicon is made up of crystal lattices, and it is very good at transporting electrons. Unfortunately, silicon made up of one uniform lattice, called mono-crystalline silicon, is expensive. Silicon made up of separate crystal grains, called poly-crystalline silicon or poly-silicon, is lower in cost and easier to process. These separate grains are less efficient, however, because electrons cannot easily move across the boundaries between them. The other type of silicon, amorphous silicon, has no crystals and does not transmit electrons well.

The TAIC process turns amorphous silicon into poly-silicon with grains that measure up to 150 micrometers in diameter, while traditional solar cells have grains that measure 0.5 to 1 micrometer. These large-grain solar cells have fewer boundaries to slow down electrons, which makes them more efficient. Silicon Solar Solutions' cells have grains that average 30 micrometers, a size that maximizes efficiency while minimizing the expense of processing them.

In addition, the TAIC process itself is more efficient than traditional manufacturing methods. Most solar cell manufacturers must add texture to their cells in order to increase the amount of photons they can absorb. Then, in order to form a p-n junction, manufacturers must diffuse boron or phosphorous onto the front of the cell, using a process called thermal diffusion. Thermal diffusion

requires high temperatures—up to 1000 degrees Celsius. In addition, because this process results in diffusion on all sides of the cell, manufacturers must either isolate one side using a process called laser edge isolation, or they must remove the excess diffusion later.

In contrast, TAIC can be performed at 300 degrees Celsius and the process itself texturizes the cell, so extra texturizing is not necessary. The TAIC process is single-sided, which eliminates the need to remove excess diffusion or use laser edge isolation. These improvements result in solar cells that cost 26% less than traditional cells.

Success Stories

The business plan developed by Hutchings, Allen and Perkins has been very well received. Silicon Solar Solutions has won five international business plan competitions, and placed in the top three at six more. They have received a Small Business Innovation Grant from the National Science Foundation, a grant from the Arkansas Science and Technology Authority and \$200,000 from an angel investor. In total, Silicon Solar Solutions has raised almost one million dollars in seed capital.

Hutchings explained that the company's relationship with the university has provided a strong support structure that helped get them where they are today. In addition to the help they've received from faculty, the group has been able to secure access to lab and office space at competitive rates, and they have benefitted from the university's technology licensing program, as well as the Genesis Incubator program.

Right now, Silicon Solar Solutions is focusing on testing their technology and increasing their workforce. They currently employ six people and four others are involved on an equity basis. The company has been producing solar cells for several months now, and the next step will be evaluating their cells in specific applications.

"I didn't really expect to be here at this point," Hutchings said about being a young CEO. "I was applying for other jobs before I graduated and I had offers that I had to turn down." He is happy about the way things worked out, though. "This is the perfect time in life to do something like this. Otherwise you might look back years later and wonder why you never did it."



MWY's executive management team (left to right: James Ulmer, Jeffrey Richards, Carl Yates, Lane Crider, Brad Hammond), posing with portraits of the company's founders, L.M. McGoodwin, Terry Williams and Carl Yates.

McGoodwin, Williams and Yates

Although it was founded long before the University of Arkansas Technology Development Foundation existed, McGoodwin, Williams and Yates has a long history of working closely with the U of A and providing jobs for College of Engineering graduates.

According to company legend, L.M. McGoodwin moved to Fayetteville in 1946 with plans to open a toy factory. It was George P. Stockard, the dean of the College of Engineering at the time, who convinced him to open a civil engineering firm instead. Sixty-five years later, McGoodwin, Williams and Yates employs 13 licensed Professional Engineers, all of them graduates of the University of Arkansas, including Carl Yates, CEO, and Brad Hammond, president.

The company's executive team agree that U of A civil engineering graduates have been well-prepared to work in the field. "We interact with engineers from all over the country that have gone to other schools," said Hammond, "and we can say that U of A grads are second to none."

McGoodwin, Williams and Yates specializes in water and wastewater engineering. They also provide other civil engineering and architectural services. In 2006, they won a National Honor Award for Excellence in Engineering from the American Council of Engineering Companies (ACEC) for their design of the Beaver Water District's raw water intake facility. In addition, the company has won the Grand Conceptor Award from ACEC of Arkansas four times in the past six years, most recently in 2011 for a water master plan they developed for the city of Bentonville.

VSSB

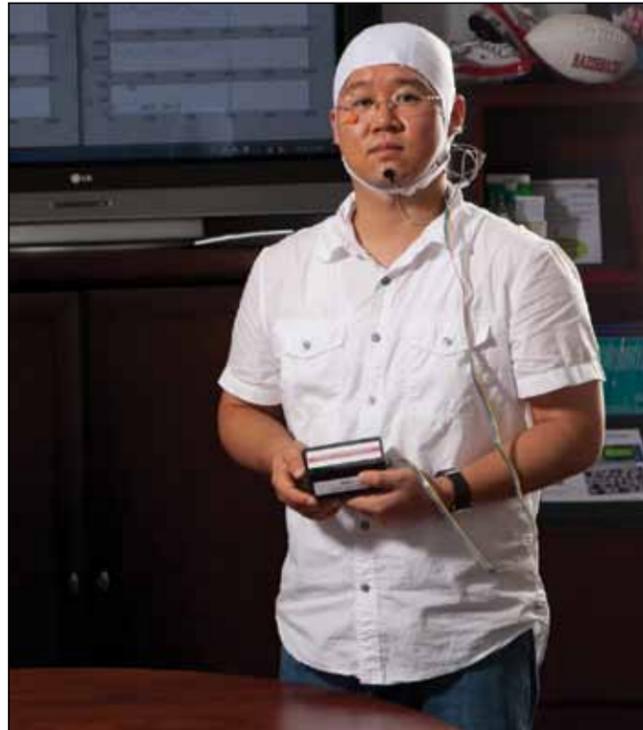
In order to diagnose and monitor conditions such as heart disease, epilepsy and sleep apnea, doctors rely on electrodes to capture signals from the body. These electrodes must be taped or glued to the skin, augmented with a special conductive gel and connected by wires to the equipment that interprets and records the signals.

Anyone who has spent time in the hospital knows how inconvenient this can be: electrodes can fall off, causing false alarms, and the wires prevent patients from moving around freely. While it would be ideal to monitor patients for heart conditions and epilepsy as they go about their daily lives, the need for wires and equipment makes this impossible.

VSSB hopes to change that. This Genesis company has developed a sensor that uses gold nanowires to pick up signals from the body. These sensors don't rely on conductive gel, and they can be woven into fabric, making them more comfortable and easier to wear for long time periods. In addition, VSSB is working on wireless connections between the sensors and a receiver, in order to eliminate the wires that restrict patients' movements.

With this technology, a patient could continuously send brain or heart signals to her doctor simply by wearing clothing embedded with these sensors. Patients at sleep clinics could rest under a special sheet that monitors their breathing and movements, while a cap wirelessly transmits the brain signals that indicate sleep or wakefulness.

VSSB, which was founded in 2009, is named for its four original members. Vijay Varadan, inventor of the technology, is a Distinguished Professor of electrical engineering at the U of A and holder of the Twenty-First Century Endowed Graduate Research Chair in Nano, Bio and Medical Technology. Ashok Saxena, dean of the U of A College of Engineering, is currently the acting CEO. Sudir Shah is director of the division of nephrology at the University of Arkansas for Medical Sciences. Bami Bastani, a College of Engineering alumnus and former CEO, has left the company to accept a position with another organization, but remains on excellent terms with his former colleagues.



Sechang Oh, one of Varadan's doctoral students, demonstrates a cap with nanowires, which can be used to monitor brain waves for sleep studies.

Saxena explained that the resources of the U of A and UAMS are vital for the development of the company. Varadan and his research team have spent many hours in the lab in order to develop and test the concepts behind the technology, and the researchers at UAMS will be vital for the company's next steps toward commercialization.

Medical equipment must pass rigorous tests of safety and effectiveness, so VSSB's next goal is to produce a prototype of its monitoring system and begin clinical trials. In Little Rock, Shah is coordinating with other UAMS doctors to set up these trials. VSSB has just begun its journey to commercialization, but at the end of this journey, the company's technology could bring significant improvements to the healthcare industry.

Meet Ben.

He'll graduate from the University of Arkansas in December with a degree in computer engineering and minors in mathematics and Spanish.

Ben credits his exceptional experience in the College of Engineering to his involvement in ECAP, the college's Engineering Career Awareness Program, which provides financial assistance and keeps students on track starting the summer before their freshman year all the way through to graduation day.

Additionally, the college's Freshman Engineering Program gets students off on the right foot and offers resources like tutoring, advising and peer mentoring.

These indispensable keys to student success are supported by gifts made through the Annual Fund, and every day, students like Ben prove the impact of giving.

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"I came into the university not feeling lost at all. It was a really easy adjustment. My only focus is doing well in school, not wondering how I'm going to write the next tuition check."

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2011 College of Engineering Alumni Awards Banquet

Hall of Fame:
Bob Mitchell (ELEG)

Distinguished Alumni Award

Kevin Brown (CHEG)
James Davis (ELEG)
Jack Giles (MEEG)
Bill Harrison (INEG)
Richard Rorex (BAEG)
Jeff Sanders (ELEG)
Garry Young (MEEG)

Outstanding Young Alumni Award

Charles Jeffers (CSCE)
William Sommers (ELEG)
Paul Strickland (MEEG)



Juan Balda, Alan Mantooth, William Sommers, James Davis, Jeff Sanders and Samir El-Ghazaly



Tom Spicer and Kevin Brown



Charles Jeffers and Susan Gauch



Jack Giles and Tammy Busemi



Bob Mitchell and Neil Schmitt



Paul Strickland, Matt Gordon, Garry Young and Jack Giles



Dean Ashok Saxena and Bill Harrison



Lalit Verma and Richard Rorex

Julian Stewart Gives College of Engineering Commencement Speech

Julian Stewart, who graduated from the U of A in 1957 with a civil engineering degree, spoke about his view of success at the 2011 College of Engineering Commencement. He explained that he considers himself successful because of his faith, his family and his career.

Stewart's career began at United Gas Pipeline Company. He has served in the Air Force and worked for United Gas, IBM and Frost Bank. Since 1992 he has been self-employed, managing his investment portfolio and devoting his time to philanthropic causes.

Stewart is widely recognized for his leadership roles during the University's Campaign for the Twenty-First Century, which recorded \$1.046 billion in gifts and pledges designated for student and faculty endowments, academic programs, capital improvements and university libraries.



Julian Stewart

Sherman Black Gift Supports Colleges of Engineering and Business

Sherman Black, originally of Greenwood, Ark., is a 1987 graduate of the University of Arkansas College of Engineering.

He, along with his wife, Lynnette, a graduate of the Sam M. Walton College of Business the same year, made a gift of \$250,000 to support scholarships in both colleges.

The scholarships will be awarded to graduates of Greenwood High School who have an interest in business or engineering and have financial need. Preference will be given to students who are first-generation college attendees, and scholarship recipients will be expected to maintain a 3.0 grade point average to be considered for renewed support.

Black is the president and chief executive officer of Rimage Corp. in Minneapolis, Minn., a provider of digital publishing infrastructure and solutions.



Sherman Black and his family.

In Memorium

Kenneth W. "Bill" Keltner

Kenneth W. "Bill" Keltner of Little Rock, a devoted husband, caring father, loyal friend and mentor to many, passed away Sunday, August 14, 2011. Keltner was born on December 27, 1936 in Springfield, Missouri. He spent most of his youth in Fort Smith, later attending the University



Bill Keltner, left.

Bell, with time out to serve as a field artillery officer in the U.S. Army.

of Arkansas, where he received a bachelor's degree in industrial engineering. Keltner spent his career with AT&T and Southwestern

He retired from Southwestern Bell Arkansas as a general manager.

He is survived by his wife of 52 years, Patricia Cross Keltner; daughter Ann Slack (husband Clay and children, Trey and Robert); son Bob Keltner (wife Amy and children, Peter and Hannah); and daughter Julie Hughes (husband Mike and children Isabella and Jackson).

Charles Weaver Baughn

Charles Weaver Baughn was born on October 20, 1912 to Luther Alven Baughn and Elizabeth Anne Weaver Baughn in Gravette, Arkansas. He died on June 13, 2011, in Thousand Oaks, California. He married Alice Stinson Baughn on June 21, 1942, and she died in 1994 just after



Charles Baughn

and sisters Evelyn Baughn Sibley and Alvyn Baughn Marable.

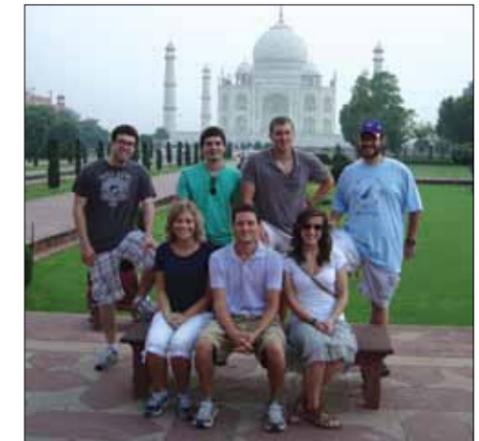
they celebrated their fifty-second wedding anniversary. He was also preceded in death by a brother, William Wallace Baughn;

Baughn graduated from Gravette High School in 1930. In 1935, he graduated with a bachelor's degree in civil engineering. He and Alice created a scholarship here at the U of A in the College of Engineering, and today, over 20 students have been recipients of the Baughns' generosity.

Right, a team of mechanical engineering students designed and raced a vehicle on an off-road track for the SAE Baja competition.



Above, right, and two top right, for the fifth year in a row, engineering students spent several weeks in Dangriga, Belize, working on service projects and learning about a different culture



Above, the U of A's P3 team with their algae-to-butanol device. They won the Student Choice Award and an Honorable Mention at this year's People, Prosperity and the Planet competition.



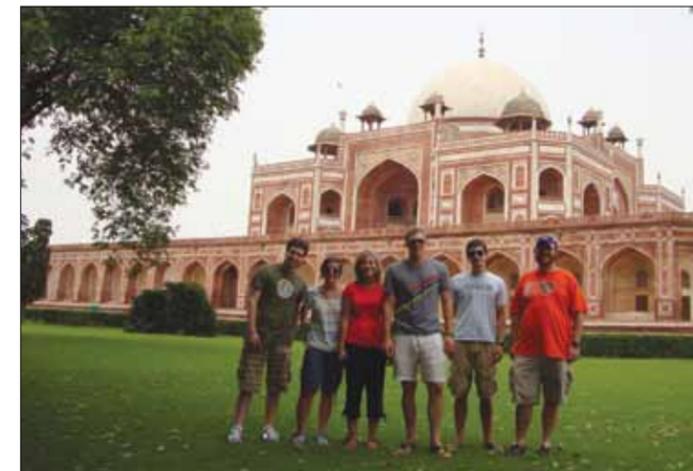
Above, a team of U of A chemical engineering students won the Intel Innovation Award at WERC's Environmental Design Contest. Their water filtration system can provide 3,000 gallons of clean drinking water per day without the use of electricity.



Above, these civil engineering students placed third in the national Geo-Challenge competition. This event was a part of the American Society of Civil Engineers' Geo-Institute annual meeting.



Traveltant, an app designed by CSCE student Sultan Alfarhood, helps travelers stay organized. This was one of the mobile apps featured by Microsoft at their annual Research Faculty Summit.



Two above and two left, in the Global India program, students travel the country and learn about engineering in a global context.

Currents images courtesy of Jeremy Stout, Khushroo Ghadiali, John Bowers, George Holmes, Cary Beth Lipscomb and Bryan Hill.



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