THE UNIVERSITY OF ARIZONA | College of Engineering

ARIZONA engineer

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# eBlocks are hands-on fun

## *UA professor hopes little plastic boxes will excite middle school students*

While Sputnik-generation engineering graduates are retiring in their thousands, the National Academy of Sciences estimates only 6 percent of today's undergraduates are engineering majors.

The resulting "engineering gap" – with far fewer engineers available to replace those who are retiring – could cause America to fall behind in technology development and bring disastrous economic consequences.

Closing the gap is not impossible, but the question is: How do we interest more students in math and science?

Part of the answer might be found in a series of small, plastic boxes that were strewn across Susan Lysecky's desk recently.

Ed Stiles

**Assistant Professor Susan Lysecky** (left) and graduate student Anuradha Phalke demonstrate some of the eBlocks they have designed and built. They hope these eBlocks, which can be linked together to make electronics projects and test equipment, will show today's middle school students that science and math are not only worth studying but fun and exciting, too.

Lysecky, an assistant professor in Electrical and Computer Engineering, hopes these "eBlocks" will show today's middle school students that science and math are not only worth studying – but actually fun and exciting.

Continued on Page 14

# Lowells give $2 million to Mining and Geological Engineering

UA alumni J. David and Edith Lowell have made a $2.06 million gift to create the David Lowell Professional Program in Mineral Resources in Mining and Geological Engineering.

David Lowell is considered one of the world's leading experts in mining exploration, having discovered more copper ore than any other person in history. In 2002, he was inducted into the American Mining Hall of Fame.

The $2.06 million is part of a $4.5 million gift the Lowells made to UA in January. The other $2.5 million will go toward construction of the new basketball and volleyball practice facility northeast of McKale Memorial Center.

Lowell received a bachelor's degree in mining engineering from the UA in 1949 and a master's degree in geology from Stanford University in 1957. He obtained a professional engineer degree from the UA in 1959. He also received honorary doctorates from Universidad Nacional de San Marcos in Peru in 1998 and the UA in 2000.

With rapid changes in technology, computer automation and robotics, Lowell and faculty in Mining and Geological Engineering (MGE) recognize the need to help mining executives stay competitive globally. The Lowell Professional Program in Mineral Resources will be a distance-based master's program that combines engineering and management courses.

"In addition to covering cutting-edge research in the field, the program

Continued on Page 14

© UA/Robert Walker

DEAN'S VIEWPOINT

**By Tom Peterson**

# Engineering Solutions to Social Challenges

*In a resource-limited world, UA engineers are pioneering technologies for more efficient use of our finite natural resources*

You have probably been following news of the successful Phoenix Mars Mission, led by The University of Arizona, as it analyzes the polar Martian soil for evidence of water and other chemical species. The intellectual pursuit of information about resources on Mars certainly captures our imagination.

Perhaps less glamorous, but certainly far more critical, are the resource challenges here on Earth that are in many ways unprecedented in history. Energy, water and natural resource needs have risen to levels that affect the political and social fiber of the entire globe.

Our alumni and students are integrally involved in the Phoenix mission. Similarly, the College of Engineering and its faculty, students and alumni are doing their part to solve some of the technological problems on which hinge the balanced use of the planet's energy, water and other natural resources. This newsletter highlights a small sample of this work.

Not surprisingly, given our location in the sunny Southwest, some activities in our college focus on both the benefits and the potential dangers of living in an area of high insolation. Joe Simmons, head of the Department of Materials Science and Engineering, leads the universitywide Arizona Research Institute for Solar Energy (AzRISE).

Under the supervision of Ray Kostuk, professor in the Department of Electrical and Computer Engineering, a group of engineering students designed and built instrumentation that will evaluate the efficiency of photoconversion devices. And a group of our senior design students is developing realistic solar ovens that can, surprisingly, be used indoors.

In addition, realizing the potential dangers to long-term exposure to solar rays, Jennifer Barton, professor of biomedical engineering, is developing new methods for early detection of skin cancers and other cancers and abnormalities that exist on the surface of tissues.

Materials for construction and manufacturing, such as copper and aluminum, are in high demand as countries such as China and India undergo substantial economic growth.

David Lowell, College of Engineering alum and probably the world's most prolific discoverer of copper ore, has invested in a program here in mining engineering that is designed to assist in the continuing education of mining engineers throughout the world. Loren Wood, engineer, financial adviser and adventurer, has honored his father with an endowed Professorship in Aerospace and Mechanical Engineering.

You can read about all these developments in engineering in the pages that follow. Clearly, solutions to many pressing societal problems are only going to be found through engineering and technology. Our faculty and students are contributing tangible solutions to some of these problems, and we're proud of the programs they represent.


# Arizona Engineer

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**Editor:** Pete Brown
E-mail: pnb@email.arizona.edu
Telephone: 520.621.6594
**Photographer:** Matt Brailey



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# News Briefs

## UA ECE students win 2008 edition of the Intel Robotics Challenge

A team of UA Electrical and Computer Engineering students defeated three Arizona State University teams in April to win the 2008 Arizona Robotics Challenge.

The all-senior team – Tony Leung, Joe Joyce, John Stockbauer, Michael Anderson and Thanh Ho – was able to overcome a server crash to win the competition against three teams from Arizona State University.

UA's self-guided security robot, Aegis, demonstrated that it could map an unknown floor plan, avoid obstacles and detect intruders.

The challenge was held in an indoor office environment with a number of cubicles, which served as the testing ground.

Each team's robot had to demonstrate its ability to learn the floor plan of the testing ground by generating and sending a map of the testing area to the monitor station.


Arizona State University photo

UA's winning robotics team with faculty mentors M. Anthony Lewis (far left) and Charles Higgins (far right). Higgins and Lewis are associate professors in Electrical and Computer Engineering.

In addition, the robot had to detect objects or people, send an alert and transmit a video of the object or person to the monitoring station.

The robot also had to track people it detected and request a security code or password. The robot also served as a fire alarm when it detected intense heat.

"Even more than the engineering skills the students showed, I was impressed with their ability to work under pressure, to make significant changes to their system with only 10 seconds to go," said Associate Professor Charles Higgins, one of the team's advisors. "That's the kind of leadership skill you can't really teach."

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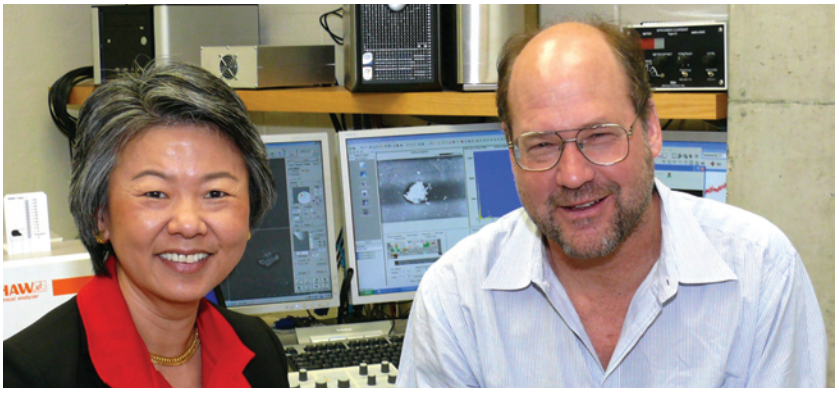
**More info: Robotics Challenge**



Ed Stiles

**USIF Director** Supapan Seraphin (left) and Bryan Tracy, manager of the Materials Characterization Lab at Spansion, during the USIF Open House. They are sitting in front of a Hitachi S3400N scanning electron microscope that's equipped with an X-ray spectrometer and Renishaw structural and chemical analyzer.

## UA's new imaging lab opens its doors

Nearly 70 people from Arizona's universities and their corporate supporters celebrated the official opening of UA's new University Spectroscopy and Imaging Facilities (USIF) in April.

USIF and its partners — Hitachi High Technologies America, Thermo Fisher Scientific and Renishaw PLC — have teamed up to make state-of-the-art spectroscopy and imaging technologies available to Arizona's universities and high-tech industries.

USIF gives researchers from public and private institutions, and from industry, access to expensive state-of-the-art equipment that may not otherwise be available or would require obtaining a grant, remodeling space and setting up equipment. Researchers pay to use the USIF facilities and various rates apply depending on whether an investigator needs a technician to operate the microscope and other factors.

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**More info: USIF**

## Student wins $3,000 in Michelin contest

Daniel Marsh, a junior in Mining Engineering, won $3,000 and an engraved plaque in the 2007 Michelin Mining Essay Contest.

Marsh was the first runner-up in the contest.

Matt Brailey

**Daniel Marsh**

Experts from the mining industry selected the winning essays. The essays were judged on how well they addressed the topic, as well as for creativity, originality and how well the essay communicated the student's thoughts.

Students at 13 colleges and universities throughout North America entered the contest, which is in its third year.

Marsh submitted a 1,500-word essay titled Mining Reclamation and Sustainability.

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**More info: Michelin**

## New AzRISE institute works on solar energy solutions


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With Arizona Board of Regents support, UA has established the Arizona Research Institute for Solar Energy (AzRISE) with the goal of fully developing solar energy's potential through research, industry partnerships and policy solutions.

AzRISE research goals include identifying, funding and coordinating Arizona-specific solar energy research, developing intellectual property and promoting development and widespread adoption of solar energy.

Joseph Simmons, head of the UA's Materials Science and Engineering Department is the AzRISE co-director for research. Gary Jones joined AzRISE as co-director, leading the outreach and business side of the institute. He will work with utilities, industry, the Arizona Corporation Commission, local governments and other organizations to identify areas where AzRISE can make a difference.

Ardeth Barnhart, a policy analyst for AzRISE, is responsible for helping to identify policy solutions that will help local governments meet their solar energy needs and new businesses to succeed.

Faculty members from several UA colleges are involved in AzRIZE. These include the colleges of Science, Agriculture and Life Sciences, Engineering, Law, Architecture and Landscape Architecture, Optical Sciences and the Eller College of Management.

AzRISE is an outgrowth of the Arizona Solar Electric Roadmap Study, which recommended the development of a solar energy center of excellence within the Arizona university system.

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**More info: AzRISE**


Beth Weaver

**Sean Dessureault** (second from left) has received the James F. Bly Faculty Award Endowment. **Dave Newman** (right), past president of the UA chapter of Engineers Without Borders (EWB) received on behalf of EWB the inaugural award from the Bly Family Student Endowment Fund. **James F. Bly Jr.** (left) represented the Bly family at the award luncheon, and **Mary Poulton** (second from right), department head in Mining and Geological Engineering, also attended.

## Inaugural Bly award winners named

Assistant Professor Sean Dessureault and the UA chapter of Engineers Without Borders (EWB) are the first recipients of the James F. Bly Awards.

Dessureault, of Mining and Geological Engineering (MGE), received the James F. Bly Faculty Award Endowment, while Newman received the first Bly Family Student Endowment Award on behalf of EWB's UA chapter.

The awards were celebrated with a luncheon at Joel's Bistro near the UA.

The endowments were established by the late Mildred Bly, wife of James F. Bly Sr., a 1940 graduate of UA's mining engineering program.

The endowments were given through the James F. Bly Family Trust, and James F. Bly Jr. represented the family at the luncheon.

After a career with Mobil Oil, James F. Bly Sr. founded Pasco Petroleum, which grew to be the largest chain of independent gas stations in Arizona. The chain was sold to Mobil in 1972.

Engineering Dean Tom Peterson, MGE department head Mary Poulton and Beth Weaver, director of development at the College of Engineering, also attended the luncheon.

## McGuire Center honors UA engineers

The McGuire Center for Entrepreneurship in UA's Eller College of Management gave its 2008 Technology Fellowship Award to a Norwegian scientist, a solar cell industry pioneer, two UA engineers, and two local entrepreneurs who worked together to found Solar Technology Research Corp. (STRC).

David Lynch, of UA Materials Science and Engineering, and Harald Øye, of the Norwegian University of Science and Technology, collaborated to invent a new method for refining silicon.

They were joined by Gordon Geiger, of UA Systems and Industrial Engineering, Robert Hall, a pioneer in the solar cell industry, and entrepreneurs Terje Skotheim, chairman of Intex, and Jeff Baymor to develop and commercialize the new refining process, which is a giant step toward reducing the cost of solar energy. Solon America has partnered with STRC to advance the technology.

# Engineering Design Day

## *Students Win $7,000 in Cash Awards*

Student engineers won a total of $7,000 in eight award categories during the 2008 Engineering Design Day.

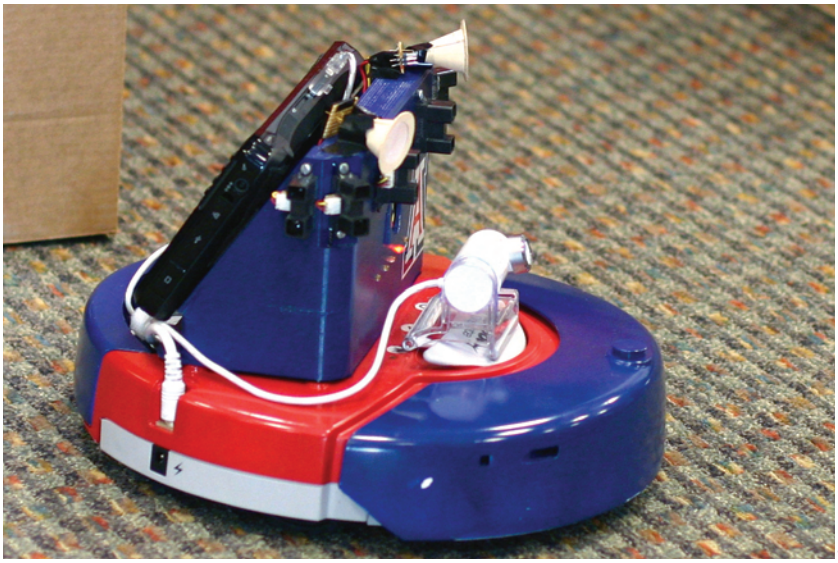
Design Day is an annual event on the UA campus in which senior design teams display the projects they have been designing and building for the past two semesters.

Nearly all engineering students work on a team-based project during their senior year as a requirement for graduation.

Industry sponsors or faculty researchers usually fund the projects.

While giving students experience with a real-world design project that involves budgets and deadlines, the projects also benefit sponsors by providing them with custom-designed engineering solutions and valuable experimental data.

Design Day 2008 included 55 projects that were judged by nearly 60 practicing engineers.



Matt Brailey

**This security robot** was built by the Intel Robotics Team I, which won the $750 Raytheon Best Engineering Analysis Award during Engineering Design Day.

The awards included:

- Lockheed Martin Best Overall Design Award ($1,000)
- Ventana Innovation in Engineering Award ($1,000)
- BAE Best Overall Software Award ($750)
- Raytheon Best Engineering Analysis Award ($750)
- Technical Documentation Consultants of Arizona Best Technical Documentation Award ($750)
- Texas Instruments Best Presentation Award ($750)
- Honeywell Team Leadership Awards ($250 each)
- Texas Instruments Analog Design Award ($1,500)

More info: Design Day

Ed Stiles

**Jennifer Barton** (left), chair of the Biomedical Engineering Interdisciplinary Program, demonstrates optical coherence tomography (OCT) to **Brian Ten Eyck**, associate director of research support in ECE, following the da Vinci Circle dinner. OCT is a noninvasive technique that can image cells below the skin's surface.

# Cancer imaging displayed for da Vinci Circle

Members of the da Vinci Circle, the Engineering College giving society, learned how research being conducted by Professor Jennifer Barton promises to aid in early detection of cancer.

Barton, chair of the Biomedical Engineering Interdisciplinary Program, was the featured speaker at the annual da Vinci Circle dinner in March.

Membership in the da Vinci Circle, includes an annual dinner and special tours and events. Members learn about today's innovative developments in engineering and science, as well as those occurring in art, music, architecture and other disciplines.

To learn more about the da Vinci Circle, go to *http://www.engineering.arizona.edu/visitors/davinci*.

# SHPE sponsors high school career day

The Society of Hispanic Professional Engineers at UA (SHPE/UA) held its second annual Advancement of Latinos in Engineering (ALE) Day in February.

ALE Day promotes higher education and careers in engineering, math and science for at-risk high school males. More than 130 high school students from the Tucson area attended. ALE Day complements SHPE/UA's Young Latina Forum, the female version of the event, held in November.

The ALE Day opening ceremonies speaker was James Valenzuela, a Raytheon senior manager and SHPE/UA alumnus. Throughout the day, students also were involved in various IBM engineering/technology workshops.

# Materials Class Transports Students Back in Time

Students in Pamela Vandiver's class, Materials Science of Art and Archaeology, recently traveled back to the Bronze Age by reproducing what would have been a cutting-edge technology 5,000 years ago.

During the process, they gained direct, hands-on experience with copper smelting and casting as it was practiced in the Near East.

Setting up the smelter, making a pair of hand-operated bellows and creating a pottery crucible was a lot of work for one class, but well worth the effort, says Vandiver, a professor of materials science and engineering.

"A chapter in a book might put students to sleep," Vandiver said. "But actually working with the tools and processes that people used thousands of years ago doesn't put them to sleep, and they won't forget the experience."

The class also visits several other eras to study technologies such as Neolithic techniques for making imitation precious stones and egg tempera panel painting as it was practiced during the European Middle Ages.

"I want students to see how materials transformations occurred and to then understand the underlying science behind what were exciting technologies for their times," Vandiver said. "These were advancements that changed society through the exploitation of materials. Ultimately, I hope students learn to see the differences among what was possible with Paleolithic, Neolithic and Urban States technologies.

"This experience gives non-engineering majors a long-term perspective about technology, along with some of the analytical approaches and tools needed to investigate current science and engineering."

Ed Stiles

**John Anesi**, an anthropology sophomore, uses a hand-operated bellows to stoke the fire while **Lesley Frame** (center), a graduate student in materials science and engineering, adds sand to further insulate a crucible for melting copper. They were working on a demonstration experiment in Bronze Age technology during Materials Science of Art and Archaeological Objects, a Tier II science class taught by **Pamela Vandiver** (right).

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**More info: Vandiver**

# UA Team Ties for Micro Air Vehicle Win at MAV 08 Competition

UA's Micro Air Vehicle Team recently tied for first place in the most difficult and complex competition yet presented to the tiny spy planes.

The UA's strong showing – along with two fellow winners, an MIT/corporate team and another corporate team – demonstrated that UA is among the leaders in developing the world's smallest and most capable micro air vehicles, known as MAVs.

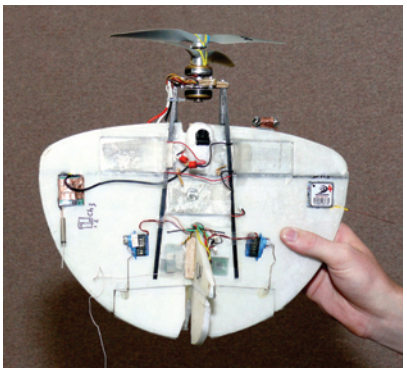
Fifteen teams gathered in Agra, India, for MAV 08, a competition designed to push the tiny planes and autonomous ground vehicles to their limits and beyond. The U.S. Army sponsored the competition in cooperation with several Indian agencies.

MAVs are tiny radio-controlled airplanes that can be sent into situations that are too dangerous, difficult or time consuming for human observers. Some MAVs have wingspans of less than 5 inches. Most are powered by electric motors and carry onboard video cameras and various sensors.

The MAV 08 test scenario required teams to work with commandos to rescue hostages who were being held by terrorists in a bank.

Each team was given only 40 minutes to find the best route through a maze of streets, clear land mines and obstacles, and get the commandos to the bank. The UA team entered two planes – a fixed wing design and a vertical takeoff and landing, or VTOL, plane. The other winning teams flew helicopters.

In addition to tying for first place with the other teams, the UA team won the prize for the best exotic vehicle with its VTOL plane and a meritorious award for the team's performance during the competition. The other two winning teams also won meritorious awards.



Ed Stiles

**The UA's vertical takeoff and landing** micro air vehicle won the Best Exotic MAV Design Award at the MAV 08 competition in Agra, India.

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**More info: MAV**

# Remote fix

## *UA engineers create self-healing computer systems for spacecraft*

Ali Akoglu and his students are working on hybrid hardware and software systems that one day might use machine intelligence to allow spacecraft to heal themselves.

Akoglu, an assistant professor in the Electrical and Computer Engineering department, is using field programmable gate arrays (FPGAs) to build these self-healing systems. FPGAs combine software and hardware to produce flexible systems that can be reconfigured at the chip level.

Because some of the hardware functions are carried out at the chip level, the software can be set up to mimic hardware. In this way, the FPGA firmware can be reconfigured to emulate different kinds of hardware.

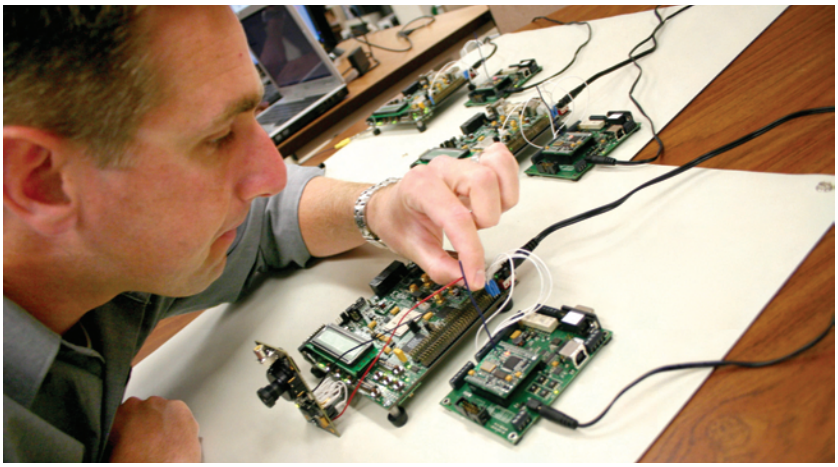
Akoglu explains it this way: There are general-purpose systems, like your desktop computer, which can run a variety of applications. Unfortunately, even with 3 GHz, dual-core processors, they're extremely slow compared with hardwired systems.

With hardwired systems, the hardware is specific to the purpose. As an example, engineers could build a very fast system that would run Microsoft Word but nothing else. It couldn't run Excel or any other application. But it would be super fast at what it's designed for.

"In that case, you have an extremely fast system, but it's not adaptable," Akoglu explained. "When new and better software comes along, you have to go back into the design cycle and start building hardware from scratch."

"What we need is something in the middle that is the best of both worlds, and that's what I'm trying to come up with using field programmable arrays," he said.

Work on the self-healing systems began in 2006 as a project in Akoglu's graduate-level class. His students presented a paper on the system and sparked interest from NASA, which eventually provided an $85,000 grant to pursue the work.



Matt Brailey

**Kevin Carr**, an undergraduate in electrical and computer engineering, adjusts one of the transmitter modules that is used to wirelessly link five units being tested in a self-healing computer system. The unit to the left of the transmitter is a field programmable gate array (FPGA). Other transmitters and FPGAs can be seen in the background.

Akoglu and his students now are in the second phase of the project, which is called SCARS (scalable self-configurable architecture for reusable space systems). The project is being carried out in collaboration with the Jet Propulsion Laboratory.

Currently, they are testing five hardware units that are linked together wirelessly. The units could represent a combination of five landers and rovers on Mars, for instance.

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**More info: Akoglu**

# Optical computing

## *Speed versus efficiency*

Ahmed Louri and his research team in Electrical and Computer Engineering are using photons instead of electrons to address three major problems in computer communication: bandwidth, latency and power consumption.

"Optics affords greater bandwidth because you can pump many more signals down a single fiber," he said.

"The biggest benefit is there is no interference between photons," he added. "Photons are not charged particles like electrons. So you can pack them close together, send a lot of signals and also save space."

Similarly, photons travel faster and farther than electrons on a given amount of energy, further reducing both power consumption and latency. "Optical interconnects provide ultra-high throughput, minimal access latencies and low power dissipation that remains independent of capacity and distance," Louri said.

©iStockphoto.com

Louri and his team are also working on "dynamical reconfigurability," to handle bandwidth allocation and cut down on power consumption. This involves creating a reconfigurable system in which signals can be shifted to underused optical fibers, effectively increasing the bandwidth.

"There's a direct relationship between performance and power consumption," Louri said. "You have to have a balance. You have to optimize your performance while you are also monitoring and optimizing your power utilization, heat removal and power consumption in the system."

"That's why this is a challenge."

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**More info: Louri**

# Thinking cars

## *Jonathan Sprinkle wants to build robotic cars that act like a human is at the wheel*


Courtesy of Jonathan Sprinkle

**Jonathan Sprinkle** with the DARPA Urban Challenge car he worked on at the University of California at Berkeley, before coming to the UA.

Jonathan Sprinkle wants to build robotic vehicles that pass the Turing Test, which was proposed by Alan Turing in a 1950 paper, Computing Machinery and Intelligence. It requires a robot's behavior to be so lifelike that an observer can't tell if he's dealing with a robot or a person.

Sprinkle, an assistant professor in Electrical and Computer Engineering, worked on a DARPA Urban Challenge project at the University of California at Berkeley before coming to UA. The Urban Challenge race took place in November, with smart vehicles driving themselves through 60 miles of simulated city traffic.

Sprinkle now would like to see the engineering community take a collective deep breath following the Urban Challenge, step back and design a system that isn't specific to one group of researchers or a single prototype.

The best way to do this is to work on each component of the system in detail, he said. That involves giving a small component of the system to each researcher and making it as robust as possible.

Much of Sprinkle's research is based on model predictive control techniques, which involve combining models of various behaviors (such as obstacle avoidance) with data from the real world to calculate future moves (braking, turning or acceleration, for instance).

The result is a control system that anticipates what will happen ahead and plans for future scenarios, rather than driving reactively in the present moment.

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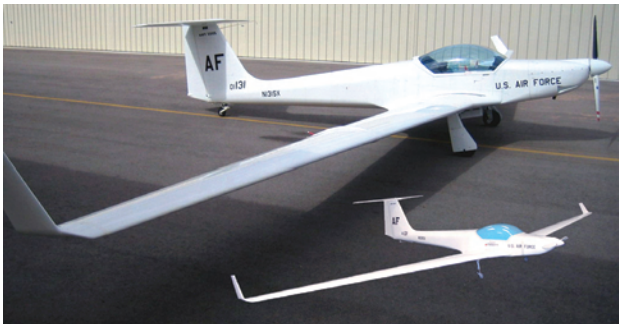
**More info: Sprinkle**

# Research could cut aircraft development costs, improve safety




Courtesy of Hermann Fasel

This composite photo shows the size difference between a full-size motorglider and a one-fifth scale model built in Hermann Fasel's lab. Fasel is using supercomputers to learn how to construct scale models with the same flight characteristics as their full-size counterparts.

Professor Hermann Fasel is using some of the world's largest computers to create scale model airplanes that accurately mimic the flight characteristics of full-size aircraft.

"Right now, there's only so much you can do with wind tunnel testing and computations," said Fasel, of UA's Aerospace and Mechanical Engineering department.

"Then you have to make a big jump and build a full-size airplane, a prototype. Then you fly and test this airplane to see if it performs as predicted by calculations and wind tunnel tests. Oftentimes, engineers have to make major changes, in view of flight test results, in order to not compromise the efficiency and safety of the original design."

Fasel is using some of the world's largest supercomputers to crack this problem by constructing simulations that create scale models with the same flight characteristics as their full-size counterparts.

Aircraft companies are interested in Fasel's research because it could save them millions of dollars by shortening the time needed to develop new aircraft. Simultaneously, it would create safer airplanes.

Fasel and his students have built one-fifth-scale models of a motorglider – a sailplane with an engine that can be turned on and off during flight. The U.S. Air Force has four of these full-size motorgliders.

The Air Force planes and the models will be flown through the same flight tests so that data from model and full-size planes can be compared directly.

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**More info: Fasel**

## Optics research pushes back threshold of early cancer detection

Early detection is the single most important factor in cancer survival.

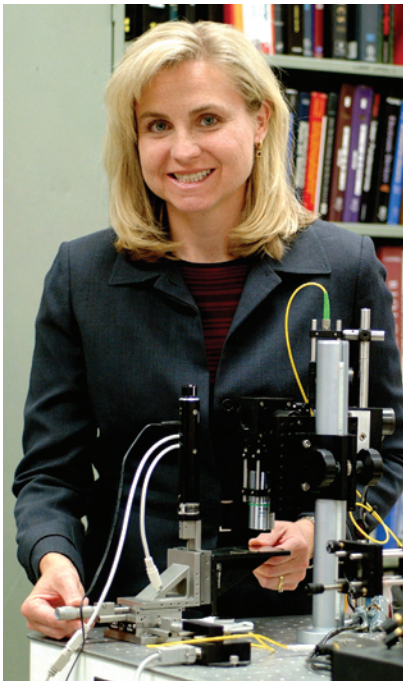
Unfortunately, current testing methodologies have limitations that prevent very early cancer detection. Cell abnormalities have to reach about 1 mm in size before they can be seen by CT, MRI or ultrasound scans.

Sometimes problems at the 1 mm scale are hard to detect with other imaging technologies. In addition, many testing procedures are expensive, time consuming, and, in the case of CT scans, involve radiation. For those reasons, testing isn't normally done on a frequent basis.

Professor Jennifer Barton is working to overcome these technical limitations through her research on optical coherence tomography (OCT).

OCT is a noninvasive technique that concentrates a beam of near-infrared light on tissue. The light penetrates a few millimeters and is reflected back.

OCT is an optical analog of ultrasound, which uses sound waves, and radar, which uses radio waves. Because light waves are so much shorter than the shortest sound and radio waves, OCT provides higher resolution.



Courtesy of Jennifer Barton

**Jennifer Barton**

"Most cancers arise in the thin layer that covers the body," said Barton, of UA's division of Biomedical Engineering and the Electrical and Computer Engineering department. "The skin, lining of the colon, esophagus and the covering of the ovaries are all epithelial tissues." The epithelium is a tissue layer that covers the surfaces and cavities of the body.

"Subtle changes in tissues, such as when cells are starting to deviate from normal, are not easy to see," she said. "The advantage of optics is the extremely high sensitivity. In fact, with certain systems, we can detect single molecules."

The downside is that the light penetrates only a few millimeters. So the light can't be beamed at internal tissues from outside the body, such as with MRIs or CT scans. However, Barton, her students and other OCT researchers have been successful in creating tiny catheters that can take optic fibers into the body. These catheters can be made so small that they will fit inside coronary arteries.

Researchers in Barton's lab are now using OCT in three cancer areas: the skin, colon and ovaries.

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**More info: Barton**

## Simplifying the search for drug combinations that fight, prevent disease

Combinations of drugs – often called "drug cocktails" – have proved to be highly effective in treating some diseases, such as AIDS.

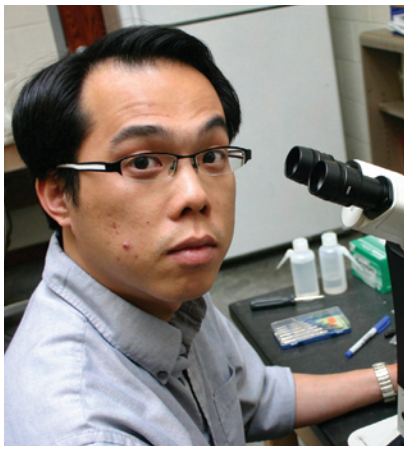
But finding just the right drug and dosage combination that provides optimum results can be a daunting task, given the huge number of possible combinations.

Assistant Professor Pak Kin Wong, of UA's Aerospace and Mechanical Engineering department, is using engineering optimization strategies to bring order to the chaos of sorting through tens of thousands of possibilities.

Wong, who began this work while a graduate student at the University of California, has developed a testing technology that bypasses the thousands of hours of work required to test individual biological pathways and interactions. Instead, he has designed a closed-loop control scheme and search algorithm that responds to the biological system's reactions.

The findings from Wong's UCLA research appeared in the April 1 issue of the journal *Proceedings of the National Academy of Sciences*.

In one test case, there were more than 100,000 possible combinations of drug types and concentrations. "We showed that we needed to conduct only 30 to 50 tests to identify the most potent combination from the possibilities," Wong explained. "Instead of doing 100,000 tests, we were able to determine potent combinations by performing only tens of tests and the dosage required can be much smaller than using individual drugs."



Matt Brailey

**Pak Kin Wong**

Since coming to the UA, Wong has been refining this testing methodology and working with Donna Zhang, an assistant professor in the department of pharmacology and toxicology, to search for a drug cocktail that will prevent cancer.

•

**More info: Wong**

# Green design: Senior projects focus on developing renewables

Photos by Matt Brailey

**The solar stove team** included (from left) Amy Sopko, Stacy Darris, Kelly Stewart and Derek Downey. All are mechanical engineering seniors.

## Solar cooking goes indoors

Anyone who says there's no free lunch has never used a solar cooker.

Not only is the fuel free, but a solar stove doesn't generate greenhouse gases from burning fossil fuels.

But not even solar cookers come without a price. First, you need sunlight. Fortunately that's no problem in the American Southwest and other arid regions of the world, where cloudy days are the exception. So people living in those areas are almost ready to start cooking.

Second, however, you have to cook outside, and you usually have to use a parabolic dish to concentrate the sunlight. This can be very inconvenient and a potential safety hazard, which could exclude a lot of people who might otherwise benefit from solar cooking.

Assistant Professor Peiwen Li, of the Aerospace and Mechanical Engineering department, hopes to change that by bringing solar cooking indoors.

Under Li's direction, a team of engineering students moved solar cooking technology a step closer to the kitchen range by building an indoor solar-powered stovetop for their senior design project.

They used a 3-by-2-foot Fresnel lens to focus sunlight, fiber optic cables to take it inside the house, and a metal burner to be heated by the sunlight.

Because the fiber optic cables couldn't handle large heat loads, the burner only got to 150 degrees. Not enough to boil water, but enough to warm food.

"The data we obtained from this project will allow us to evaluate the light-transfer capacity of our optical cable," Li said. "I want to pique the interest of industry to invest or collaborate to develop a solar light transfer optical cable particularly for the product we are developing. Given the necessity for greener technologies, I believe there is a huge interest in using concentrated solar light for indoor use for both cooking and heating."

•

**More info: Design Day**

## Solar power for remote villages

Fifteen percent of Arizona's electricity will come from renewable resources by 2025 under guidelines set in 2006 by the Arizona Corporation Commission. Currently, about 1 percent of the state's electricity is produced from renewable sources.

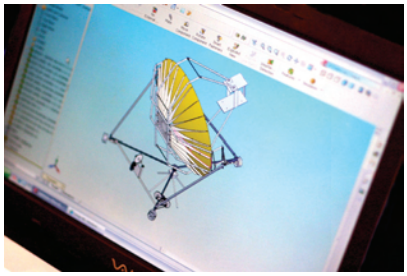
To help move toward this goal, an engineering design team decided to build a low-cost solar concentrator that could be used in Arizona, while also being simple, robust and inexpensive enough to bring electricity to

### Editor's Note

**Several of the projects at Engineering Design Day 2008 focused on devices that use or produce energy from renewable resources. The four projects on these pages were among them.**

**Engineering Design Day is an annual event in the UA College of Engineering, at which students display the results of their year-long capstone design projects and compete for cash prizes.**

**Nearly all UA Engineering undergraduates work on a senior design team as a requirement for graduation.**



**This computer graphic** shows the solar concentrator with a bracket for mounting the Stirling engine at right

off-grid areas in developing countries.

The solar concentrator project was funded by Sunrise Solar Engineering LLC, which is working on a cost-effective approach to generating solar power.

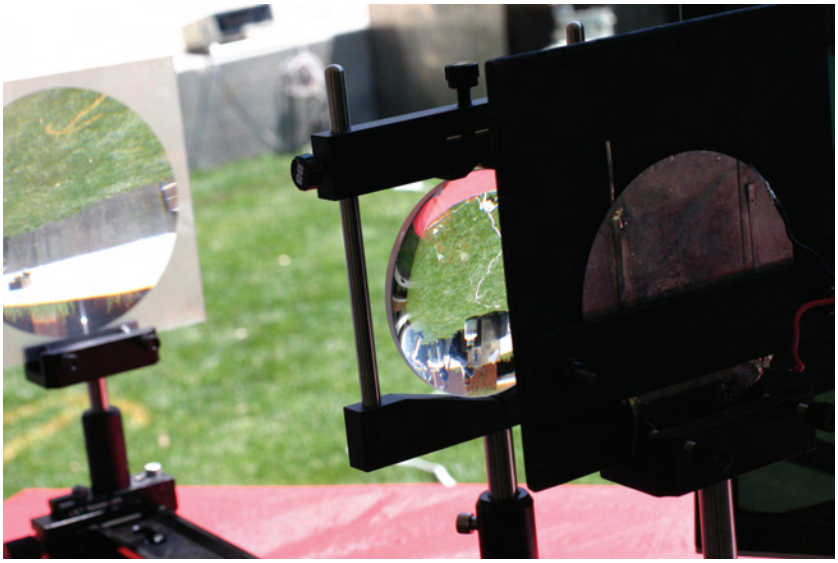
Sunrise Solar is developing a version of the Stirling engine that uses solar heat for fuel. The engine will spin a generator and produce electricity. The senior design team's part of the project is to build a concentrator that tracks the sun with a 16-foot-diameter parabolic dish that focuses sunlight on the Stirling engine.

Stirling engines depend on a temperature differential to alternately heat and cool a gas sealed inside the engine. As the gas expands and contracts, it drives the engine's piston or pistons, which spin a crankshaft, turning heat energy into mechanical energy.

The students focused on using appropriate technology to produce a rugged, low-cost design. They started with a discarded satellite TV dish, stripped off its microwave coating, and polished it to make a solar concentrator. Then they designed an inexpensive metal frame and a drive mechanism built around a surplus automobile axle.

They kept the cost to about $5,000 and designed the concentrator so it can be taken across rough terrain and set up on ungraded sites.

The design team included Scott Lilley, Joseph Pursley, Andrea Gains-Germain and Eric Vonder Reith. All the students are in mechanical engineering except for Lilley, who is graduating in optical science and engineering.



Photos by Matt Brailey

**The solar illuminator** device includes a Fresnel lens (left) to concentrate sunlight and a collimation lens (middle) to create a uniform beam. The lenses are mounted on an optical rail and sunlight is focused onto a 3-inch-square area of each solar cell (right).

•

**More info: Stirling**

## Searching for cost-effective solar

A team of UA engineering students designed and built a solar illuminator and solar cell evaluation device as part of Prof. Raymond Kostuk's ongoing research into efficient photovoltaic systems.

Kostuk, who holds a joint appointment in Electrical and Computer Engineering (ECE) and Optical Sciences, plans to use the students' solar illuminator to evaluate the performance of commercial and experimental solar cells at moderate levels of sunlight concentration — power levels equivalent to that produced by two to four suns.

The illuminator includes a Fresnel lens to concentrate sunlight and a collimation lens to create a uniform beam. The lenses are mounted on an optical rail and sunlight is focused onto a 3-inch-square area of each solar cell.

The students varied the voltage and current being drawn from the solar cell to produce a current-versus-voltage curve for load resistances ranging from almost zero to almost infinity.

Knowing the most efficient point on the curve is important when designing solar arrays for homes and other applications.

Kostuk will now add the students' solar illuminator to his lab gear. "I plan to use this device to evaluate passive concentrator systems that do not require tracking the sun," Kostuk said. "This is important for developing low-cost concentrator systems that can take advantage of conventional photovoltaic cells."

Kostuk plans to fund another senior design project this fall that will monitor the passive tracking capability and the effects of temperature variations on the performance of photovoltaic systems that use different kinds of concentrators.

Kostuk is funding the student projects with an honorarium he receives as the Kenneth Von Behren Professor in ECE.

The student team included Daniel Bauer, Stephanie Barnes, Kyle Yeager

Continued on Page 12

**During Engineering Design Day**, agricultural and biosystems engineering students displayed the bioreactor they used for growing algae for an algal-oil experiment. The students are (from left) Sean Henry, Edward Moreno and Darren Haskett. To read about their project, follow the jump from the stories on this page to Page 12.

## Global engineering

### *Students design key part for African water system*

UA engineering students have designed and built a remote water-level detector that will become an integral part of a water system serving 10,000 people in Ghana.

The water system, which was developed by UA's chapter of Engineers Without Borders (EWB), includes a dam, a filtration plant, pipes, pumps and a hilltop water tank.

The hilltop tank is fed from a pump at the base, but there's no way for it to be checked without having someone run to the top of the hill to look inside. If the tank's water level is not monitored, the tank could become overfilled, causing it to leak or rupture.

The project originated in ECE 372, a junior-level course. Electrical and computer engineering students Kevin Carr, Matt Engleman, and Bill Richardson, an EWB member, saw there was a need for a water-level indicator and built a proof-of-concept device for their 372 class.

They found that it worked, and decided they should build the entire system for their senior project.

Courtesy of Kevin Carr

**The water-level-detector design team** included (from left) mechanical engineering (ME) senior **Mark Moore**, computer engineering senior **Izuchukwu Nwachukwu**, electrical engineering (EE) senior **Matt Engleman**, electrical and computer engineering senior **James Davis**, ME senior **Tavonga Siyavora** and EE senior **Kevin Carr**.

The ultrasonic sensor works much like a sonar system. It sends out a sound wave, which is reflected back from the water. The amount of time needed for the signal's round trip can be converted to distance.

Once the water level is determined, the information is transmitted wirelessly to a health clinic 5 miles away and to the pump house 2 miles distant.

The indicator and transmitter are solar powered, and the signal is transmitted at 900 MHz.

The system is now completed and will be taken to Ghana and set up by EWB volunteers within the next few months.

"We're all really pleased to have been part of this project because of the humanitarian aspect," Engleman said. "It's a device that's going to be deployed in the real world and is really going to help people."

•

**More info: EWB**

## Cost-effective solar

Continued from Page 11

and Ian Tilford. All the students are in optical sciences and engineering except for Yeager, who is in electrical and computer engineering.

•

**More info: Kostuk**

## Extracting oil from algae

Most of us don't intentionally cultivate algae — the green slime that grows on stagnant ponds. But these single-celled plants are more useful than you might think — they can help in creating renewable fuels and plastics.

Several companies are doing research on algae-to-biofuels technologies, and a team of UA agricultural and biosystems engineering students also studied the process for their senior design project.

The students focused on using supercritical $CO_2$ as an alternative to harsher solvents for extracting oils from algae.

They grew *Botryococcus braunii* in a photo-bioreactor, pumped the algae into a pressure vessel and then used supercritical $CO_2$ to extract the lipids.

They got the oil to separate, but had too much water content and ended up with an oil slick that would have required another component to complete the separation. Unfortunately, that would have required some kind of solvent, just what the students were trying to avoid.

But their experiment did succeed as a proof-of-concept. The next step is to refine the process.

Supercritical $CO_2$ is becoming popular as a solvent in many areas because of its low toxicity and light touch on the environment. In fact, it is used to extract caffeine from coffee beans to make decaf coffee.

"Supercritical" means that the $CO_2$ is kept in liquid form by pressurizing it at temperatures where it normally would exist as a gas. Supercritical $CO_2$ behaves like a gas in that it can permeate the algae cell membrane, but it's actually in liquid form. Once the $CO_2$ gets into the cell, it creates enough pressure to burst the cell wall, releasing the oil, which the cell has produced to allow it to float on the surface of the water where it's growing.

The student team includes agricultural and biosystem engineering seniors Sean Henry, Edward Moreno and Darren Haskett.

•

**More info: Algae**

# Research focuses on building 'smart' radar systems

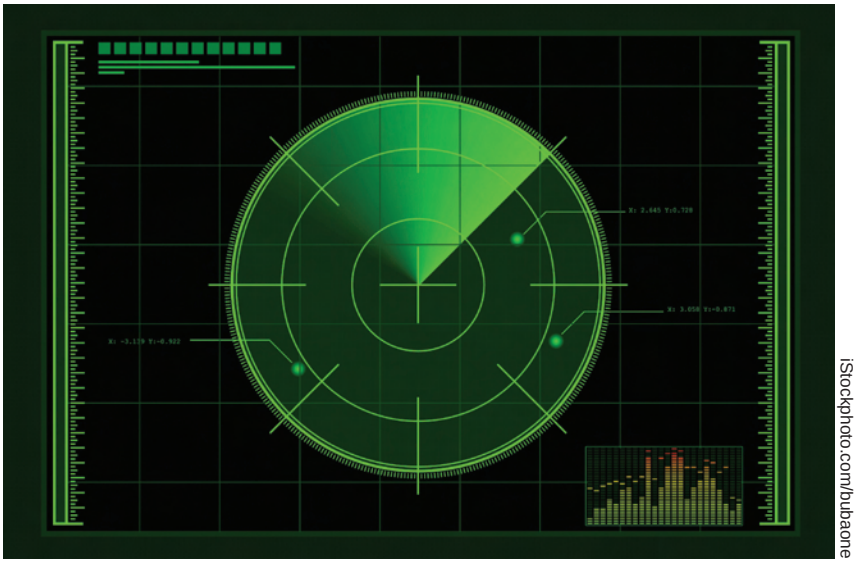
"Bats do exactly what we're trying to do," said Nathan Goodman, assistant professor of electrical and computer engineering. "They have cognitive sonar and we're developing cognitive radar, which is in the electromagnetic spectrum, but the idea is almost exactly the same."

Goodman has received a three-year grant from the Air Force Office of Scientific Research to begin work on the mathematical framework and implementation issues of cognitive radar.

Bats use different chirps as they scan for, identify and approach a target, explained Goodman, who is developing similar strategies for dynamically adapting waveforms in response to echo data returned from a target.

"We typically evaluate and modify the frequency content of our transmitted waveform," Goodman said. "Different targets have different resonances, and that means waveforms will be reflected back more strongly at certain frequencies than at others."

Intelligence is a key component of cognitive radar, Goodman explained. Rather than being hard-wired, it can change in response to its environment.



iStockphoto.com/bubaone

Cognitive radar needs to interpret the signals it receives in order to better understand its environment and modify subsequent transmissions to refine the search and provide additional information, Goodman said.

Cognitive radar also can use multiple radar systems to send out multiple waveforms. In this configuration, the systems work together to develop in-depth knowledge more quickly.

"The system decides not only how to shape the radar's waveform in response to received data, but also whether to employ multiple radars, whether a mobile radar system should move to a better position, or whether to request help from a different sensor type," Goodman said.

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**More info: Radar**

# Autonomic computing used to study plants in UA's Biosphere 2

Experiments beginning this fall in Biosphere 2 will combine living plants and computer intelligence to help scientists learn more about global change.

Biosphere 2, the university's 3.14-acre, glass-enclosed living laboratory, bridges the gap between the laboratory experiments and field work. It combines the control of the lab with the real-world conditions of fieldwork.

Some of the research questions will include how plants acquire and allocate resources to survival, growth and reproduction; how global change affects these processes; and what these changes mean to how ecosystems function. This includes how past climates have influenced plant evolution and how future climates may alter relationships between plants and their environment. Of particular interest is how plants would use water in future climates, which would affect how much of that resource would be available for use by society.

Illustration: M. Anthony Lewis

**This artist's drawing** shows the ground-based robot that is being developed for the project at Biosphere 2. The robot will have four wheeled, leg-like structures that will help it adapt to terrain.

The computer intelligence includes autonomic computing systems and robotic sensors from the UA's branch of the National Science Foundation Center for Autonomic Computing (CAC). Other CAC branches are located at the University of Florida and Rutgers University.

In the Biosphere 2 experiments, autonomic computer systems will monitor plant, soil and air vital signs, such as atmospheric carbon dioxide, water use and temperature.

With traditional plant and hydrologic research, researchers often wait years between the start of an experiment and the final results.

"With autonomic computing, we can accelerate this cycle," said CAC director Salim Hariri, a professor in the Electrical and Computer Engineering department. "Instead of waiting five or seven years, we can do these experiments in real time, immediately gathering and analyzing data."

"This is the most important aspect of this research effort," Hariri added. "We are accelerating the research. That's the story of Biosphere 2."

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**More info: Hariri**

## eBlocks

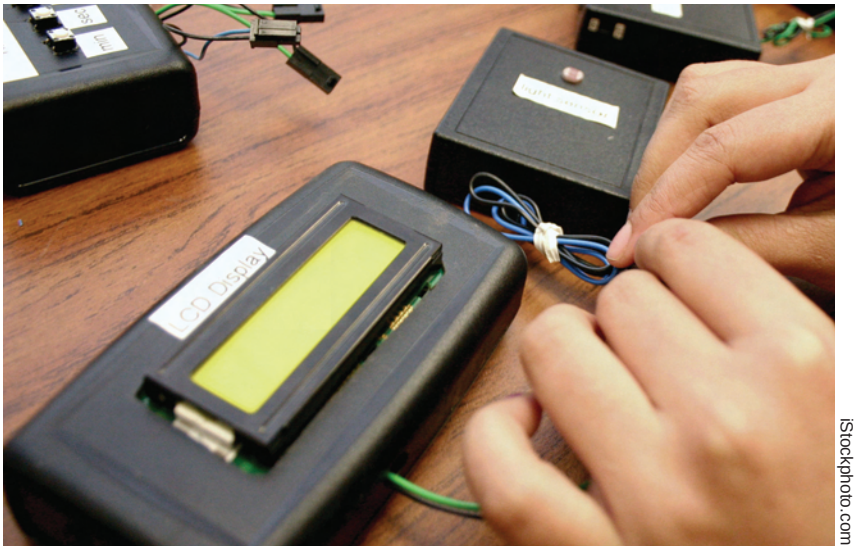
Continued from Page 1

Each box contains a single electronic system – a sensor, switch, speaker, light-emitting diode, digital display, buzzer, electrical relay or other component. Each box is a system, rather than a simple component, because computer intelligence has been added to each circuit. This intelligence lets the boxes "talk" when they're hooked together, allowing them to accomplish complex tasks.

Students can use the blocks to create alarms, doorbells, light-activated switches and other systems, or test equipment for lab experiments. These projects give them the hands-on, applications-oriented side of math and science that is sometimes lacking in K-12 math and science education.

Unlike some robotics kits or other lab equipment that costs hundreds of dollars, eBlocks are inexpensive and can provide lab experiences for the many middle schools that can't afford to equip dedicated science labs, Lysecky said.

That's important, she said, because middle schools are the battleground where the war on America's engineering gap will be won or lost. Students often drop out of technical classes after middle school, making it difficult for them to catch up if they choose to pursue math or science in college.




iStockphoto.com

**Students can snap eBlocks together** to create alarms, doorbells, light-activated switches and other systems, or test equipment for lab experiments.

Lysecky hopes the eBlocks will turn abstract concepts into hands-on fun, giving students a reason to stay with these subjects in high school.

The blocks can be hooked together to perform experiments such as testing the effects of moisture and temperature on mold growth or comparing the freezing point of fresh water versus salt water.

Lysecky is working with faculty in the UA College of Education to design experiments and tests to see how well eBlocks contribute to learning. Eventually, she hopes middle school students will devise their own experiments and share their designs and experiences on an eBlock website.

## Lowell gift

Continued from Page 1

will include elements of technical management," said MGE department head Mary Poulton. "We are able to rethink our coursework and how we offer it to address specific industry needs."

### Creating a Flexible Curriculum

The curriculum will be flexible to enable working professionals to develop academic programs that meet their career objectives and changing industry demands. Most coursework will be offered online via live, two-way video lectures and on-demand content, Poulton said.

Additional short courses will allow students to complete on-campus instruction in just a few weeks. A portion of the program will be project-based research on topics relevant to the student's employer.

"This endowment provides the resources to develop a significant competitive edge in recruiting top executives to study international mining at the UA," said Thomas Peterson, dean of the College of Engineering.

In 2000, the Lowells donated $1.9 million to the UA College of Science to endow the Lowell Program in Economic Geology, a postgraduate education and training program for geologists in the mineral industry.

Lowell expects the two disciplines will find ways to work collaboratively. The industry must strike a balance between addressing environmental sensitivities and meeting society's growing demand for ore-dependent technologies such as computers and electronics.

### Making a Dynamic Investment

"We're satisfied that this is going to be a good thing for a lot of people in the future," Lowell said. "Edith and I believe this is a dynamic philanthropic investment. Money doesn't accomplish anything if it's sitting in a bank."

Lowell began his career as a mining engineer with Asarco in Mexico. In 1961, he became an independent consultant and, between 1961 and 1990, worked for 110 companies in 26 countries.

### Discovering Mineral Deposits

He discovered eight major mineral deposits worldwide, including the Kalamazoo ore body at San Manuel. He also has located major ore bodies in Chile, Peru and the Philippines. He has won numerous awards from the mining industry and is a member of the National Academy of Engineering.

He and Edith married in 1948. She received two degrees from the UA, a bachelor's degree in anthropology in 1948 and a master's degree in Spanish in 1950. She is a member of the Gamma Phi Beta sorority.

# Distinguished professorship honors veteran UA teacher

*The Woods created the professorship to honor Loren Wood's father, who was a longtime faculty member at The University of Arizona*

University of Arizona alumnus Loren M. Wood and his wife, Sally Ann Wood, have created the Dr. Elwin G. Wood Distinguished Professorship in Aerospace and Mechanical Engineering through a leadership gift to the UA.

Loren Wood, a Tucson native, earned his bachelor's degree in mechanical engineering from the UA in 1952 and a master's in business administration from Harvard Business School in 1958. Sally Wood is a graduate of Mount Holyoke College, where she received a bachelor of arts degree; she earned a master of social work degree from Boston University in 1960.

The professorship is named for Loren Wood's father, a professor who taught at the UA from 1924 until his retirement in 1966. He continued teaching part-time for five more years until he was 75 years old.

The Woods established a $300,000 charitable remainder unitrust at the UA in 1998 to name a professorship for Elwin Wood. This year, they decided to donate their income interest to the College of Engineering so the professorship could be established during their lifetimes.

The Elwin G. Wood Distinguished Professorship will provide support for a full professor in aerospace and mechanical engineering. The professorship will be awarded on a three-year renewable basis by the dean of the College of Engineering in consultation with the head of the Department of Aerospace and Mechanical Engineering.

The professorship combines Elwin Wood's longtime association with the UA and Loren Wood's connection to the UA's College of Engineering as an undergraduate.

Loren Wood said the professorship is named for his father because "we all look back with gratitude toward what our families have done for us, and this is just something I wanted to do to honor my dad."

Courtesy of Loren Wood

In addition to his professional career, Loren Wood (above) has been an avid mountaineer and outdoorsman for more than 50 years. His achievements include tackling the southeast ridge of Yerupaja in the Peruvian Andes. At 21,766 feet, Yerupaja is the third highest distinct peak in the Western Hemisphere. His group climbed the route to about 19,000 feet before turning back because of the extreme danger from cornice breaks. No one has yet climbed to a higher elevation along this route.

Tom Peterson, dean of the College of Engineering, said, "This endowment from Loren and Sally Wood gives UA engineering a competitive edge in hiring and retaining outstanding faculty members. It is through generous gifts of this kind that our educational program continues to maintain the highest quality of teaching and research, and we are extremely grateful to the Woods for their generous gift."

## Elwin Grant Wood

When Elwin Wood came to UA in 1924, he taught agricultural economics, but the UA eventually combined that program with the business school's economics department, and Wood spent most of his career in what was then called the College of Business and Public Administration.

Wood was a professor of marketing and eventually was named head of the college's marketing department.

Before joining the UA, Elwin Wood earned his bachelor's degree from Washington State College and master's and doctoral degrees from the University of Wisconsin. He was a veteran of World War I and a native of Woods Bay, Mont., which was named for his father.

Elwin Wood taught advertising and served as a consultant for businesses in

Continued on Page 16

## Distinguished

Continued from Page 15

the Tucson community. He was district dean of the American Academy of Advertising, a member of the American Marketing Association and of the Advertising Association of the West.

In 1949, he organized the UA chapter of Alpha Delta Sigma, the national professional advertising fraternity, and in 1950 he helped found the University Junior Advertising Club in the Advertising Association of the West.

In 1959, he was instrumental in founding the Gamma Alpha Chi chapter for women in advertising.

Elwin Wood was a member of Delta Sigma Phi social fraternity and also a member of the honorary business fraternities Alpha Kappa Psi and Beta Gamma Sigma.

In 1963, Elwin Wood was honored with the Golden Anniversary Medal from the national Alpha Delta Sigma Association for his many outstanding contributions to advertising education during the organization's first 50 years.

In 1965, Wood was selected as the Tucson Advertising Club's Silver Medal winner for his lifetime of achievement and service to the advertising field.

### Loren Morris Wood

After graduating from UA in 1952, Loren Wood went to work for General Electric, but soon enlisted in the U.S. Air Force as a first lieutenant, serving as an airborne electronics maintenance officer. His four-year tour of duty was cut to just 11 months when thousands of military personnel were discharged after federal budget cuts in 1953.

Following his military service, Wood went back to GE's Aircraft Engine Division and worked there until 1969.

During that time, he attended the Harvard Graduate School of Business Administration under GE sponsorship and graduated with an MBA in 1958.

Wood's MBA degree and experience in finance led him to change careers in 1969. At first he sought investment capital for a private venture, but then decided to work for Keystone Custodian Funds Inc. as an aerospace and electronics analyst.

In 1983, he left Keystone and founded Systematic Investors Inc., an investment management company for corporate pension funds.

In 1990, Keystone Investment Management Co. (the former Keystone Custodian Funds) acquired Systematic Investors.

Wood retired from Keystone in 1995 as chief investment officer for the company's institutional department.

## Thank You to Our Donors

**In the spring 2008 edition of *Arizona Engineer*, some donors for fiscal year 2006-2007 were omitted from the donor recognition list in the $500 to $999 category. We have listed those names below and apologize sincerely for the error. We value your support greatly and want to give you the recognition you deserve. Thank you again for your wonderful support of the College of Engineering.**

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# Kanto Scholarships Enrich and Support Students' Careers

Getting your hands dirty is one of the best—and most enjoyable—ways to learn engineering. In fact, it can be downright addictive, as many students have discovered once they start working on the racecar projects at The University of Arizona.

Although most students start working on the cars for fun, many car project alumni say the time they spent was career-enriching, as well. Many rate it the most valuable learning experience of their undergraduate years. In addition, the cars and students' enthusiasm make a great recruiting tool for the UA's engineering programs, says Parviz E. Nikravesh, an aerospace and mechanical engineering professor.

The students periodically visit grade schools, middle schools and high schools to talk about engineering as a career opportunity, he noted. "They take the car with them, rev the engine and drive it in the parking lot. The kids go crazy about this," said Nikravesh, who is also faculty advisor to UA's Society of Automotive Engineers, or SAE, chapter.

Although there still is no course credit for the projects, the students are now eligible for scholarships that can go a long way toward paying tuition or the cost of books and supplies.

## Ryan Kanto Starts Scholarship Program

The scholarships are the brainchild of Ryan Kanto, a former team leader for the UA Formula Car team who graduated with degrees in chemical engineering and engineering management in 2007.

When Kanto was preparing to graduate, he talked with Nikravesh about the need for supporting students who might otherwise put all those lab hours into a paying job. "Eventually, Ryan provided the funds himself, and this year we are awarding scholarships to three students on the formula team and one scholarship to a student working on the Baja vehicle," Nikravesh said.

Courtesy of UA Baja Racing

The UA's Baja racecar goes airborne during a test run.

Kanto, who now works for EnCana Oil & Gas in Dallas, is funding the three formula car scholarships. The Baja car scholarship is being funded by an anonymous donor. "My intent in setting up the scholarship was two-fold," Kanto said. "I wanted to help current team members deal with the stress of attending school and having a 'full-time job' in the lab, and to give Formula SAE alumni an opportunity to contribute back to the program that gave them so much."

## Good Career Move

"In every interview for a job or internship I've had—even those completely unrelated to Formula SAE—my experience with this program was an ace up my sleeve," Kanto said. "Now that the scholarship is set up and successful, I'd definitely like to expand it more with help from local businesses and other alumni."

The scholarships are important because they support dedicated team members, who are vital to making the teams successful, Nikravesh said. "We've had several good team leaders who managed the program on a continuous basis, recruiting students during their freshman year and building a continuous year-to-year program in which all the experience wasn't lost when the seniors graduated." The formula car awards are named for Ryan Kanto's grandfathers, W.J. Mayshar and W.J. Kanto. The Kanto award is for senior members who have worked on the car for a number of semesters, while the Mayshar award is for newer members of the program.

## Winners Named for 2008-2009

No Mayshar awards were given for the 2008-2009 academic year but three Kanto scholarships were given: $3,000 to Joel Rhode, $3,000 to Carlos Murphy and $2,500 to Corey Hass. All three are juniors in mechanical engineering. A $1,000 Baja racecar scholarship was awarded to Josh Spivey, a mechanical engineering freshman.

"These car projects are entirely student run," Nikravesh said. "The students do everything themselves, including fund raising. These cars aren't inexpensive to build and the students work hard to fund the cars. So we are now trying to get some additional funding to support the students themselves."

Nikravesh said he will be talking with various corporate sponsors this summer in an effort to raise more money for the scholarship programs so more students can benefit.

# Alumni Echoes

**Melissa Shadman** and **Jovica "Joe" Lazarevic**, both EE 2005, were married in November 2007. They currently work for Raytheon Missile Systems in Tucson, Ariz., Melissa in planning and analysis and Joe in electromagnetic interference. During the next year or two, they plan to travel to Europe and Australia to visit family who were unable to attend the wedding.

Courtesy of the Lazarevics

**Stewart Cramer**, AE 1983, is president of LAI International Inc, which fabricates precision-machined aerospace and industrial components using nontraditional processes such as lasers, abrasive water jets and electrical discharge machining. Cramer is based at the company's headquarters in Scottsdale, Ariz.

After graduating from UA, Cramer was as a structures engineer at McDonnell Douglas, Northrop Grumman and Lockheed Martin. At Northrop Grumman, he was a senior technical specialist in the structures research department, then a project manager on the F-35 Joint Strike Fighter project.

Cramer completed a master's degree in structural mechanics at the University of Southern California in December 1992. He holds two U.S. patents for antiterrorist devices for use on commercial aircraft.

LAI International has facilities in Phoenix and Tucson, Ariz.; Fridley, Minn.; Westminster, Md.; and Scarborough, Maine.

**Pradeep Fulay**, Ph.D. MSE 1989, professor of materials science and engineering in Pittsburgh University's Department of Mechanical Engineering and Materials Science, has been appointed director of the Electronics, Photonics & Device Technologies program at the National Science Foundation. His main areas of responsibility are micro-, nano-, molecular, spin, organic and power electronics, and micromagnetics.

Courtesy of Pradeep Fulay

**Pradeep Fulay**

**Zoe Diana Draelos**, ME 1979, became a medical doctor and now runs a research lab studying biomechanics of the skin. In 2007, Dr. Draelos received a lifetime achievement award for her research work from Health Beauty America, the professional organization that represents the skin care and cosmetics industry,

This year, Dr. Draelos received the DermArts award for outstanding contributions to dermatology, a national award given annually to one dermatologist. "It was my excellent education at the University of Arizona that started me on the successful path of combining engineering and medicine," says Dr. Draelos.

# In Memoriam

**August V. Hardt** died May 5. He was 67. Hardt was born and grew up in Globe, Ariz., and lived all his life in Arizona. He graduated in engineering from UA in 1963 and joined the State Highway Department — which would later become the Arizona Department of Transportation — as engineer-in-training. He worked there for more than 33 years until he retired 1996, when he was state operations engineer.

After he retired, Hardt was a consulting engineer for Entranco, which was acquired by DMJM Harris in 2005. He was a consultant for DMJM Harris at the time of his death.

Hardt was an avid hunter, angler, sailor and hiker, and had visited many of Arizona's rivers, lakes, canyons and mountains. He also traveled extensively and had visited 42 states and nine countries with his wife, Mary Baack Hardt.

Hardt's family and friends have established an endowed scholarship in his memory that benefits students in Engineering Mathematics and in Civil Engineering and Engineering Mechanics. Preference will be given to Globe High School students.

**Robert Lenon** died July 25. He was 99. Lenon was born November 1, 1908, in Norfolk, Neb., and moved to Yuma, Ariz., in 1914. He graduated from UA in 1929 with a degree in mining engineering and worked in mining in Bisbee, Ariz., and other parts of Southern Arizona. He was the first employee on the All-American Canal.

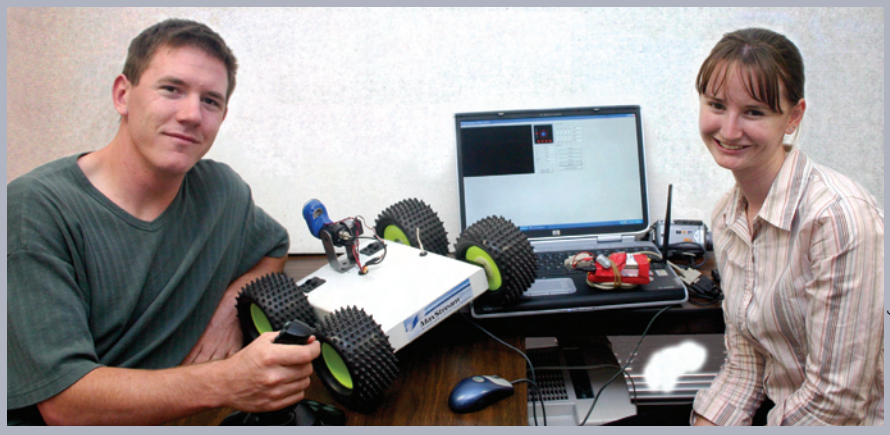
Lenon enlisted in the U.S. Coast Artillery in January 1941 and served in the armed forces for five years. He served as a commissioned officer in the Seacoast Antiaircraft Artillery and later transferred to the Engineers serving in England, France and at the Battle for the Rhineland. He also saw service in Okinawa, Japan, as a troop commander.

In 1946, Lenon established a mining engineering office in Patagonia, Ariz., where he was the first town clerk and a Santa Cruz county engineer. He was active in numerous civic and historical groups, including Pimeria Alta Historical Society, Arizona Historical Society, Westerners, Rotary, American Legion, the 1904 Courthouse Preservation Committee, and Free and Accepted Masons. He co-authored several books and wrote his memoirs when he was in his 90s. *It Seems Like Only Yesterday*, volumes 1 and 2, describe many adventures and memories from his 94 years in Arizona. Lenon is survived by his wife of 56 years, Naomi, and their son, two daughters and two granddaughters.

# Alumni Echoes

Courtesy of Kim Baird

**Kimberley (Hostetler) Baird** (above), AE 1994, was recently named deputy chief of the Space Suit and Crew Survival Systems branch at NASA's Johnson Space Center. The branch develops, operates and maintains crew survivability hardware for the Space Shuttle and International Space Station, and develops suits for launch, entry and extravehicular activity. The branch is currently developing a space suit system for the Constellation program to be used in future missions to the moon and beyond.



Courtesy of the Brocks

In this photo from 2005, aerospace engineering seniors **Keith Brock** (left) and **Jessica Dooley**, soon to become Mrs. Brock, display the mine-exploration rover they built while at the College of Engineering.

**Keith and Jessica Brock**, both AE 2005, recently started up Brock Technologies in Vail, Ariz., after working as systems engineers for 3 years at Raytheon Missile Systems in Tucson, Ariz. As undergraduates, the Brocks made airborne and ground-based robots, and this interest continued during their internships and subsequent employment at Raytheon, where they worked on unmanned aerial vehicles (UAVs) such as the Cobra Unmanned Aircraft System.

It comes as no surprise, then, that Brock Technologies designs, manufactures and tests unmanned vehicles. Some of the Brocks' projects include a semiautonomous Yamaha Rhino, portable catapults for small UAVs and conversion kits to create remotely operated or semiautonomous vehicles.

In June this year, Brock Technologies delivered two products for one of its customers to display at the world's largest unmanned systems exhibition, the Association for Unmanned Vehicle Systems International conference in San Diego.

Courtesy of the Bakers

**Dawn Loman Baker**, ChE 1996 and M.S. ChE 2000, and **Trent Baker**, OE 1997 and JD 2000 (above), were married in 1999 and moved to Salt Lake City after finishing their graduate degrees at UA. Trent now manages his own patent law firm, Baker & Associates PLLC, which prosecutes patents for a wide variety of clients in the outdoor product, medical device and electronics industries, among others. Dawn received her M.D. at the University of Utah in 2006 and is now completing her residency in anesthesiology. They continue to pursue rock climbing and international travel in their leisure time.

**Dylan Taylor**, MSE 1993, is president of global client services for Grubb & Ellis Company, a commercial real estate firm based in Santa Ana, Calif., where he is responsible for about approximately 3,000 employees in six countries. After graduating from The University of Arizona, he received a master's in business administration from the University of Chicago. He lives in Denver with his wife and two children.

**Brian D. Goble**, Ph.D. AE 1988, is senior manager of the Aerodynamics and Computational Fluid Dynamics branch at Lockheed Martin Aeronautics Company in Fort Worth, Texas. Goble and his branch provide engineering support for all Lockheed Martin programs, including F-16, F-22, F-35, C-130J, C-5, F-117 and U-2, in the areas of aerodynamics, aircraft performance, acoustics, store separation and computational fluid dynamics.

Courtesy of the Wileys

**Jill Craven** and **Devin Wiley** (above), both ChE 2007, were married recently in Utah. Jill is an NSF Fellow at Caltech and Devin is in the M.D./Ph.D. program at USC and Caltech. Jill just completed a Fulbright at the University of British Columbia and Devin is about halfway through preparing repertoire for a piano concert. Both have their sights set on the NASA astronaut program.

# Alumni Echoes

**Clay Condon** (right), ME 2004, recently moved to a new position as a contract developer for liquefied natural gas projects for an international oil company in Qatar. He is responsible for overseeing the implementation of sales contracts from several of the major LNG projects in Qatar. His primary area of responsibility is Northern Europe but the projects, some of the world's largest, will also deliver natural gas to North America and Asia. In his spare time he enjoys scuba diving and wakeboarding in the Persian Gulf, and traveling throughout the region. "So far, more than 20 countries in the past two years and still counting," said Condon.

Courtesy of Clay Condon

## HOMECOMING BREAKFAST

**45th Annual Engineers Breakfast**
**Friday, October 24, 2008**
**8–9:30 a.m. • $12 per person**
**UA Student Union Memorial Center, North Ballroom**
**Guest Speaker**
**Alan L. Boeckmann (EE 1973)**
**Chairman and Chief Executive Officer**
**Fluor Corporation**

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For information, contact Judee Aten at 520.621.8051 or *jaten@email.arizona.edu*

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Where has life taken you since graduation? We'd like to know and so would your former engineering classmates.

Please e-mail us (200 words or less) and include the following:

- Name and year you graduated
- Major
- Degree (B.S., M.S., Ph.D.)
- Details of your activities

While you're at it, get out that digital camera or scan a print and send us a digital photo of your family, latest project at work, or that boat or hot rod you just finished building in your garage.

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