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Engineering Senior Creates Industry Buzz With Robot Design



College of Engineering/Pete Brown

The Joy of Hex—Electrical engineering senior Matt Bunting watches his robot's camera track his face.

A six-legged robot that uses cognitive reinforcement to learn how to walk generated much media interest and opened some professional doors for UA electrical engineering senior Matt Bunting.

The success of the as-yet-unnamed hexapod, built as a spring 2009 class project for UA cognitive robotics class ECE 596C, includes Intel Corporation ordering two of the robots and Bunting agreeing to develop software for a robotics company's products.

“One of the things I wanted to explore was the idea of reinforcement learning. I didn't want to preprogram any of those walking algorithms; I wanted it to figure out how to walk straight forward on its own,” Bunting said. “It has the ability to figure it out itself.”

The robot features a camera and uses successively taken images to determine if it is moving forward, sideways or backward

or tilting. By analyzing the visual feedback, the robot “learns” though experience how to most effectively achieve its goal of moving straight forward.

Bunting's instructor, Tony Lewis, UA associate professor of electrical and computer engineering, said, “Matt is exploring a flexible paradigm that can be applied to many different situations: not only walking but perhaps other skilled tasks. And if a leg breaks or a motor gets damaged, it can relearn how to walk.”

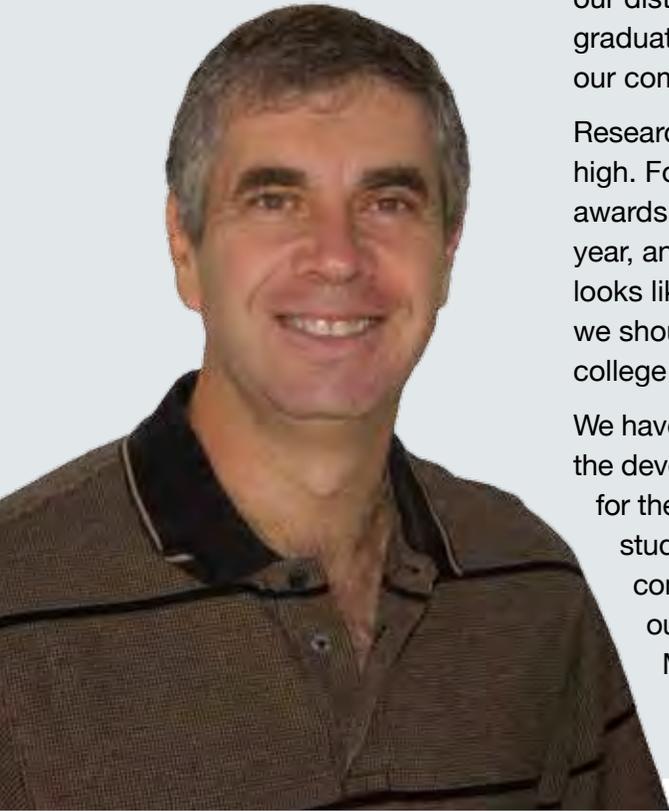
Bunting posted a YouTube video of his robot in action that quickly caught the eye of Stewart Christie, product marketing

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Strategy and Vision Come Into Focus

We have developed a clear picture of who we are, what we want, and where we are going

I have now been the dean for one year and I can assure you that time flies. Each day brings a new set of opportunities and the most difficult decision is where to invest time and resources. By all measures we have had a great year and this is due entirely to our strong students, faculty, staff, and supporters.



Notable achievements include receiving approval to offer a bachelor of science degree in biomedical engineering and a master of science degree in engineering management; we will graduate approximately 450 bachelor of science students this year. In addition, we are increasing our distance education offerings in graduate programs, and expanding our community college partnerships.

Research awards are at an all-time high. For the first three quarters, awards are up 75 percent on last year, and a strong fourth quarter looks likely. By the end of the year we should reach \$35 million, a college record.

We have made great progress in the development of a strategic plan for the college. Fifty faculty, staff, students, and industry and community partners attended our first planning retreat in March, at which we formalized our vision, mission, goals and core values. Our draft

vision statement is set out below and I invite you to drop me an e-mail or a phone call if you have a comment.

Our vision is that the UA College of Engineering will be one of the top 10 U.S. public educational institutions for engineering and a global leader in technology innovation to improve the quality of life. Our graduates will be actively sought as leaders to solve complex societal problems, and we will be recognized as an economic engine and community partner. "Invent, Impact, Inspire."

Our task is difficult but the team is strong, the work is rewarding, and the result is critical to success for Arizona and the nation.

Bear Down!

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Many stories in this print edition have been edited for length, and it is not feasible to include related multimedia material such as video and audio files, and hyperlinks to related Web sites.

 To get the full story, look for the story number by the **Ae** icon embedded in the article, then go to the online edition and enter the story number in the search box.



College of Engineering/Pete Brown

Tried and Tested—Engineering 102 students prepare their robot, created using the Lego Mindstorm Robotics kit, for a demo in the AME courtyard.

High School Students Try Out College Engineering Classes

“Trying engineering at the university can be difficult,” said Jeff Goldberg, dean of engineering at the University of Arizona.

“It takes time. It’s expensive. And if you don’t like it, you may have trouble transferring credits to another major.”

“So our idea was: Why not let students try engineering in high school—in a safe place, with a teacher they know and trust?”

This chance to take an engineering class before committing to the major in college now exists at six Arizona high schools through the Engineering 102 in High Schools program. The course will expand to include 20 schools by fall 2010.

The class carries UA credit and has three main goals, said Fred DePrez, principal at Hamilton High School in Chandler: To introduce engineering to

math- and science-savvy students who may not have considered it as a career, to give students who really want to be engineers a head start on college, and to help students find out if the career is for them.

“If they find they don’t like engineering before they go to the university, it can save them time and a small fortune for their parents,” said DePrez, who contacted UA in 2007 about setting up such a program.

“We give high school teachers the tools they need, and some sample projects, but we also encourage them to come up with their own activities because they are in the best position to fine-tune the problems for their students,” said Eniko Enikov, a UA associate professor of aerospace and mechanical engineering involved in the program.



College of Engineering/Pete Brown

Summer Fun—Young engineers prepare for a robot road race outside Old Engineering.

UA and Industry Promote Engineering Among Less Privileged Students

Nearly 200 middle and high school students attended the 2009

Ae FULL STORY Number 76 summer engineering academy and

robotics camp, and parents soon started clamoring to enroll their kids in the 2010 summer engineering schools, which are part of the College of Engineering’s Multicultural Engineering Program, or MEP.

“We had 119 high school students for the Summer Engineering Academy and 73 middle school students for the Summer Engineering Robotics Camp,” said Ray Umashankar, assistant dean and MEP director.

The summer programs are open to students from all backgrounds, but the MEP aims to attract Hispanic and Native American students, particularly from poor economic backgrounds. “We awarded almost \$20,000 in scholarships to students who really wanted to attend the program,” Umashankar said.

Jeff Goldberg Retained as Permanent Dean



Jeff Goldberg

Jeffrey Goldberg has been appointed dean of the College of Engineering. Goldberg has been interim dean of the college

since November 2008. During that period, Goldberg guided the college through a major reorganization that included the creation of the new



School for Sustainable Engineered Systems

and the new department of biomedical engineering.

Engineering's new freshman class also has grown by more than 10 percent and is more diverse than ever. Part of that success comes from an expanding outreach program, Engineering 102, an advanced placement class in six local high schools. Goldberg said the number of schools in the program will grow to 20 this fall.

"Good ideas drive the economy, and the fastest strategy for an economic rebound is having engineers that come up with and implement the kinds of innovative ideas that are critical for economic development in Arizona and the nation," Goldberg said.

"Jeff is a dynamic and effective leader who already has a distinguished record of achievement serving as interim dean," said UA Provost Meredith Hay. "He has my full confidence in his ability to lead the UA College of Engineering to a position as a national leader in teaching, research and public service."

Water Contaminant Expert Joins College

Shane Snyder has joined the College of Engineering as a professor of chemical and environmental engineering.

In 1998, Snyder discovered that estrogens and pharmaceuticals were common contaminants in



North American waters.

His research has been hailed as the first in North America to link the presence of trace steroids to reproductive problems in fish.

Much of his research has centered on Lake Mead and the Colorado River, which provides water for more than 30 million people, or 10 percent of the U.S. population.

Snyder's research focus is on the fate, transport, and treatment of what are known as "emerging contaminants," such as endocrine-disrupting compounds, perchlorate, nanoparticles, and pharmaceuticals.

Research by Snyder and others has revealed that U.S. drinking water commonly contains trace amounts of pharmaceuticals, insect repellents, flame retardants, and an array of potential endocrine-disrupting chemicals. Many of these compounds originate in wastewater discharged into rivers and lakes.

Several of these chemicals have been linked to abnormalities in fish and there is growing concern about the implications for public health. In water-scarce regions of the world, including Arizona, water reuse is essential for sustainability, and Snyder's research is recognized as a critical component of water reuse projects.

Snyder says he plans to bring together municipal and private sector water experts who are interested in addressing challenging water sustainability issues. "I envision a strong interdisciplinary approach that encompasses various colleges, departments, and centers from



Shane Snyder

across the UA and among leading academic institutions globally," Snyder said.

Snyder's research on emerging contaminants and sustainable engineered systems for water reuse will play an important role in the planning and design of sustainable cities. "Considering the far-reaching consequences of climate change and burgeoning human pollution and urban density, the demand for clean, sustainable water will continue to escalate," Snyder said.

"By fostering interdisciplinary teams," Snyder added, "I hope to develop an integrated research program that will consider the effects of changing freshwater flows and urban demand on economic, societal, and public health aspects of sustainable water systems."

Snyder will be part of the School of Sustainable Engineered Systems, directed by professor Pierre Deymier, who said: "Dr. Snyder will be a catalyst for water-related research in the school and will be an asset in developing interdisciplinary research initiatives and programs in water quality and sustainability."

Engineer Builds Custom-Made Body Parts in the Lab

Jonathan Vande Geest's laboratory at the University of Arizona combines engineering and medicine in the study of complex diseases and design of medical devices.

"Many of the answers to medical problems are often very similar to answers to engineering problems," Vande Geest explains.

His Soft Tissue Biomechanics Laboratory (STBL) applies engineering testing and analysis to human biological systems, which are similar to engineering designs, complete with bio-based pumps, valves, electrical wiring, pipes and other hardware.

The lab focuses on two research areas: improving medical device design, and identifying relationships between structure and function in soft tissues.

In one application, Vande Geest is working with Protein Genomics Inc. to grow proteins that can be molded into replacement blood vessels. Although these tubes are constructed from biological materials, the FDA treats them as medical devices, he said.

Vande Geest's contribution to the project involves testing the artificial blood vessels to determine their maximum pressure ratings, strength, and optimal mechanical properties for various applications.

Another STBL project focuses on developing a patient-specific prosthesis for abdominal aneurysms that form in the aorta where it splits to feed blood to the legs. The aneurysm is a blood-filled bulge that occurs more often in men over 50 and in smokers. It is sometimes called "the silent killer," because it generally grows without symptoms until it ruptures—typically a fatal event.

The aneurysm is often discovered when a patient is being seen for another



College of Engineering/Pete Brown

Full Stretch—Vande Geest tests the tensile strength of tissue samples.

medical condition, said Vande Geest, who holds appointments in aerospace and mechanical engineering and in biomedical engineering.

Research Indicates That Regulation of Greenhouse Gases May Increase Global Climate Change

Paul Blowers, associate professor of chemical and environmental engineering, and senior James Lownsbury recently cast doubt on the global warming credentials of a new group of chemicals called hydrofluoroethers, or HFEs.

Their research suggests that these new chemicals, originally thought to have low global warming potential when used as refrigerants, might lead to increased greenhouse gas emissions. Their conclusions were published recently in a paper in *Environmental Science & Technology*, the leading journal for environmental science and engineering.

The U.S. government wants to regulate the use of hydrofluorocarbons, which could lead to increased use of hydrofluoroethers as a replacement. Both are greenhouse gases, and UA research indicates that HFEs might be worse for the environment than HFCs.

Blowers and Lownsbury agree that HFEs have a low global warming potential in terms of their chemical properties studied in isolation. They contend, however, that the true global warming potential of an HFE can only be determined by a complete analysis

of its entire life cycle from manufacture through use to disposal.

For instance, an HFE could have low global warming potential but the refrigeration or air-conditioning system in which it is used might have poor energy efficiency. The source of the electricity to run the system is also a factor in determining environmental impact.

Blowers and Lownsbury say in their paper that refrigeration system compressors use about 70 percent of the total electricity requirement. Quoted in the journal's comment section, Blowers said: "What's often hidden is the indirect emissions due to the efficiency of the equipment and the chemical, and the need for electricity to run compressors or pumps, or to deliver water."

Algae Biofuel Could Be at the Pump in 5 Years

Research originally focused on growing algae to feed astronauts could within five years offer a readily available renewable source of fuel for our vehicles here on Earth, says agricultural and biosystems engineering professor Joel Cuello.

Cuello researches the mass production of algae for biofuels, so that instead of feeding astronauts the microscopic organisms can be used to produce renewable energy to power vehicles.

While algae production is successful on a laboratory basis, the challenge today is making large-scale production of algae cheaper and commercially feasible, he said.

One of the largest costs for commercial algae production is the photobioreactor, a container where algae grows with the help of circulating nutrients and light.

Enter the UA's Accordion, a photobioreactor that Cuello and his graduate student Joe Ley designed and which Cuello believes could be used to inexpensively produce the huge amounts of algae needed for an effective biofuel program. UA has been granted a provisional patent for the device, and is working for a full patent, Cuello said.

The device, named after the musical instrument because of a loose similarity in shape, flows water and nutrients through a vertical series of clear panels set at a variety of angles, allowing the mix to have a controlled flow and receive a steady dose of light needed for growth.

The mix of algae and liquid nutrients is pumped to the top of the device, where it flows down from section to section while bathed in soft fluorescent light. In a real-world application, rows and columns of Accordions could be arranged inside a greenhouse or even outdoors in the open air where sunlight would be the principal source of light.

The design is scalable, and sites featuring vertical towers of hundreds, or thousands, of Accordions could produce the vast amount of algae needed for high-output production of biofuels, Ley said.

"We could develop acres and acres of systems like this for the higher production needed to produce biofuels," Ley said.

Cuello believes the day is not too far off when we will be able to fuel our vehicles



College of Engineering/Pete Brown

Pump It Up—Professor Joel Cuello and the Accordion photobioreactor at the UA Campus Agricultural Center.

with biofuels derived from algae. "I really believe we will be able to make use of algae-based biofuels, probably in two to three years," he said. "We will have the right mix of technologies in place in two to three years, and it will be at the pump, I would say, in five years."

UA Engineering Takes Lead in National Biofuels Research Program

The National Alliance for Advanced Biofuels and Bioproducts, of which the UA is a member, has

received a grant from the U.S. Department of Energy totaling more than \$44 million for algal biofuels and bioproducts research and development.

Professor Kimberly Ogden of chemical and environmental engineering will serve as UA's principal investigator and head of the alliance's engineering efforts. "To tackle the problem of large-scale production of algae for fuels and other products we have to have a better



Kim Ogden

understanding of everything from the biology to the interfacing with existing petroleum processing plants," Ogden said. "We're looking at the whole thing," she said. "From growing algae to putting fuel in your tank."

The Department of Energy announced that nearly \$80 million would be awarded under the American Recovery and Reinvestment Act to the National Advanced Biofuels Consortium, or NABC, and the National Alliance for Advanced Biofuels and Bioproducts, or NAABB, of which the UA is a founding member.



NASA Marshall Space Flight Center/Emmett Given

Space Rack—Research team members examine a picture of the Materials Science Research Rack (MSSR). Left to right are John Kramer, MSRR Operations; Matthew Goodman, UA graduate student; and UA professor Robert Erdmann.

UA Engineers Are First US Researchers to Use New NASA Test Bed Aboard Space Station

When astronauts aboard the Space Shuttle Endeavor docked with the International Space Station on Feb. 10, more than 200 miles above the Atlantic west of Portugal, part of their mission was to collect a sample from an experiment conducted by UA College of Engineering researchers.

The small ingot of aluminum-silicon alloy was the first material sample supporting U.S. research to be processed in NASA's Materials Science Research Rack on the orbiting space station. The rack is fixed to the outside of the station and suspended in open space.

Professors David Poirier and Robert Erdmann of the UA's department of materials science and engineering, and professor Surendra Tewari of Cleveland State University, are researching how molten metals solidify in zero gravity and will study the sample.

Poirier and his team are studying a process known as directional solidification. "The model alloy under study by the U.S. investigators is an aluminum-silicon alloy, closely related to alloys used to produce castings," said Poirier. "The main focus is to study the role of zero gravity on the solidified microstructures that result from directional solidification, and to compare the microstructures with samples made under similar conditions on Earth."

"In addition to learning about the underlying science of alloy solidification, the space experiments are particularly relevant to the manufacture of alloys used in the high-temperature gas turbines that power aircraft and produce electric power," Poirier said. The knowledge gained from this research could help the casting industry improve processing and eliminate defects.



Lab Partners—Frederic Benoliel, right, of CNRS, and UA President Robert Shelton announced the inauguration of the International Associated Laboratory for Materials and Optics.

UA-French Lab Opens

International research in the fields of thermal imaging, remote

spectroscopy, medical imaging and astronomy has a home on the campus of the University of Arizona thanks to collaborations between researchers at the UA and two French universities.

UA President Robert N. Shelton met with representatives from the Centre National de la Recherche Scientifique, or CNRS, to mark the inauguration of the CNRS International Associated Laboratory for Materials and Optics on the UA campus.

The laboratory's creation is the result of 10 years of collaboration between Pierre Lucas, a UA associate professor of materials science and engineering, and Jean Luc Adam of the University of Rennes.

In France, the collaboration includes the chemistry department at the University of Rennes and the Institute for Electronic and Nanotechnology at the University of Lille. The U.S. team is led by Pierre Lucas and Pierre Deymier, director of the College of Engineering's School of Sustainable Engineered Systems.

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International Space Station on Feb. 10,

Unmanned Ground Vehicle Wins Best Overall Engineering Design Award

An autonomous ground vehicle that could one day be used in hazardous rescue operations, and a soil-coring rig for shoring up bridge columns were just two of the 60 student engineering projects on display at Engineering Design Day.

The award for best overall design went to UGV 2010 at this year's Engineering Design Day.

The design team consisted of mechanical engineer Elliot Hart, computer engineers David Irving and Ivan Lizarraga, and electrical engineers Touseef Ahmad, Khalid Al Hmili, Ben Baskett and Jose Rodriguez.

The project sponsor, Tucson Embedded Systems, tasked the team with creating an autonomous robot capable of point-to-point navigation using GPS while avoiding simple obstacles. The team was also asked to develop a command and control graphical user interface for the unmanned ground vehicle.

Tucson Embedded Systems wants to develop an unmanned ground vehicle for search and rescue. Unmanned

vehicles are increasingly being used for dangerous tasks, and some emergency service providers currently use UGVs for life-saving missions in dangerous environments. The mission of this project was to build a UGV that could be further developed into a life-saving UGV.

UGV 2010 was just one project among 60 designed by UA engineering students and shown at Engineering Design Day, the UA College of Engineering's premier showcase of student design.

Design Day is organized by the college's Interdisciplinary Design Program, Engineering 498, and co-sponsored by Lockheed Martin and BAE Systems as well as the college.

"Engineering 498 is our dry run for students," said Jeff Goldberg, the college's dean. "We give students the



Courtesy of the UGV 2010 team

real-life experience of doing a project for an external client. The course is really a simulation of that first project."

Goldberg also noted that Design Day is a great way to give middle and high school students a better picture of what engineering is. "It is by far our best advertisement for what engineers do once they get out of college," Goldberg said.

Goldberg said that Design Day judges have seen similar events at dozens of other universities, and the feedback

Hands-Off—The unmanned ground vehicle designed by the UGV 2010 team can navigate autonomously while avoiding obstacles. The team and its sponsor hope to turn it into a search and rescue vehicle for use in hazardous environments.



College of Engineering/Pete Brown

Core Values—Mechanical engineering senior Jeremy Tysinger demonstrates his team's soil-coring apparatus for shoring up crumbling bridge columns. Tysinger and his team were awarded \$750 for giving the best project presentation.

from them is that UA's event is by far the strongest.

"What makes our Design Day stronger than so many others are our great industry clients, our instructors, and a lot of really good students who enjoy building a prototype and solving the design problems," Goldberg said.

Seniors in the UA College of Engineering competed for more than \$10,000 in prize money during the competition, which this year was held in the Student Recreation Center.

Prize Winners

Best Overall Design • \$1500

UGV 2010

Design team: Touseef Ahmad, Khalid Al Hmili, Benjamin Baskett, David Irving, Elliot Hart, Ivan Lizarraga, Jose Rodriguez

Project sponsor: Tucson Embedded Systems

Prize sponsors: Lockheed Martin and BAE Systems

Best Overall Design, Runner Up • \$1000

Beam, diffuse and global irradiance sensor for solar panels

Design team: Neriya Carter-Samuel, Ethan Held, Alexander Hickey, Zachary Hillman, David Romero, Shira Wolf

Project sponsor: Biosphere 2

Prize sponsors: Lockheed Martin and BAE Systems

Best Analog Design, First Place • \$1500

Team iPulse – remote pulse oximeter

Design team: Brian Bailey, Brian Ebel, Chris Stemple, Erica Morey, Jack Grantham, Joey Sankman, Scott Galvin, Scott Little

Project sponsor: Texas Instruments

Prize sponsor: Texas Instruments

Best Analog Design, Second Place • \$500

Situational wireless awareness network

Design team: Austin Scheidemantel, Ibrahim Alnasser, Benjamin Carpenter, Paul Frost, Shivhan Nettles, Chelsie Morales

Project sponsor: Mike Marcellin, Hao Xin

Prize sponsor: Texas Instruments

Best Innovation in Engineering • \$1000

Novel detector arrays for ultrasound and photoacoustic imaging

Design team: Eduardo Castaneda, Andrew Dotson, Jennifer Freeman, Leon Garcia, Sergio Pesqueira

Project sponsor: UA Department of Radiology

Prize sponsor: Ventana Medical Systems

Best Engineering Analysis • \$750

Apparatus for efficient strengthening of pipes with FRP laminates

Design team: Abdulsalam Alidriss, Hamed Almazrouei, Michael Barry, Thomas Brown, Steven Forbes, Joshua Straton

Project sponsor: QuakeWrap Inc.

Prize sponsor: Raytheon Missile Systems

Best Presentation • \$750

Soil coring apparatus

Design team: Saber Al-Alshaikh, Ayayi Ayih, Matt Hamilton, Ygor Machado, Kevin Phu, Jeremy Tysinger

Project sponsor: QuakeWrap Inc.

Prize sponsor: Rincon Research

Best Design Documentation • \$750

Upgrade to the Shack cube interferometer

Design team: Asher Sussman, Jeffery Morris, John Mongelli, Chris Shanor, William Casson

Project sponsor: Ruda-Cardinal Inc.

Prize sponsor: Technical Documentation Consultants of Arizona

Best Use of Off-the-Shelf Components • \$750

Geolocating target scope

Design team: Mellissa Cordova, Kyle Stelzer, John Bloom, Allison Cicchini, Javier Yanez, Eric Stratton, Nate Cook, Matt Giardina

Project sponsor: Raytheon Missile Systems

Prize sponsor: Edmund Optics

Best Use of Prototyping • \$750

Flow-sensing valve with standalone flow shutoff capability

Design team: Mustafa Albahrani, Ed Baker, Zach Dean, Chris Holt, Oscar Pulgarin, Scott Zimmerman

Project sponsor: Rain Bird Corporation

Prize sponsor: Phoenix Analysis and Design Technologies

Fish Out of Water, First Place • \$250

Novel detector arrays for ultrasound and photoacoustic imaging

Design team: Leon Garcia (winner), Eduardo Castaneda, Andrew Dotson, Jennifer Freeman, Sergio Pesqueira

Project sponsor: UA Department of Radiology

Prize sponsor: Kristy Pearson

Fish Out of Water, Second Place • \$150

BAE lens alignment system

Design team: Josh Gill (winner), Amanda Smith, Tim Budinger, Sterling Jarvis, Ryan Jones, Melissa Stout

Project sponsor: BAE Systems

Prize sponsor: Kristy Pearson

Team Leadership 1 • \$250

Infrared-guided infant blood vessel locator and injection device

Design team: Will Fielder (winner), Amanda Eskinazi, Mitchell Gallaher, Kyle Haston, Benjamin Lewis, Linda Myers, Deepa Patel

Project sponsor: Raytheon Missile Systems

Prize sponsor: Honeywell

Team Leadership 2 • \$250

Apparatus for efficient strengthening of pipes with FRP laminates

Design team: Thomas Brown (winner), Abdulsalam Alidriss, Hamed Almazrouei, Michael Barry, Steven Forbes, Joshua Straton

Project sponsor: QuakeWrap Inc.

Prize sponsor: Honeywell

Erratum

In the fall 2009 edition of *Arizona Engineer*, it was incorrectly stated on page 9 that Rincon Research sponsored the Engineering Design Day team leadership awards. Honeywell sponsored these awards and has done so for several years. Our apologies to Honeywell and many thanks for their continuing support.

What Nature Cannot Provide, Engineers Invent

During the early 20th century, engineers and physicists focused on exploiting the properties of naturally occurring materials. In other words, their work accommodated materials' properties.

Today, they have turned this research model on its head by creating new materials with properties that don't occur in nature, essentially building materials to fit their design needs. Metamaterials are one new class of synthetic materials that are creating excitement in electromagnetics and acoustics.

Professor Richard Ziolkowski of the UA's department of electrical and computer engineering and Nader Engheta of the University of Pennsylvania have written a best-selling book on the subject called *Metamaterials: Physics and Engineering Explorations*.

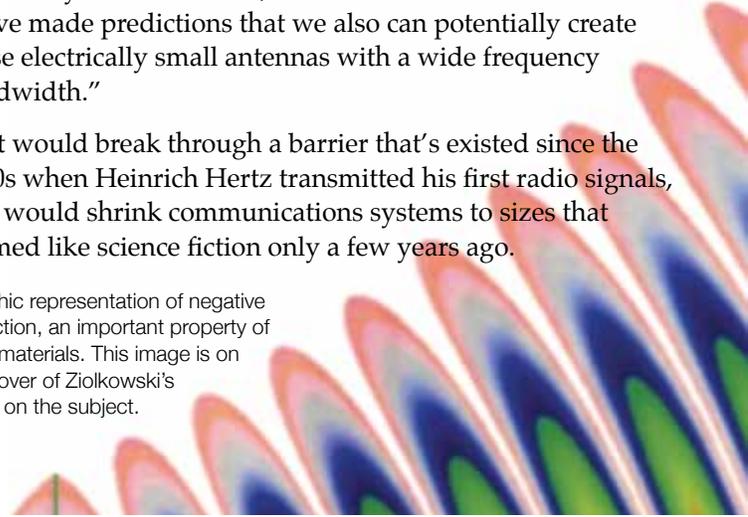
Ziolkowski and his research team started out by modeling the basic physics of metamaterials and then began using those materials to create antennas. "We're creating systems with multiple antennas that have small electrical size. So we can work on multiple frequencies in a very small volume," Ziolkowski said.

Immediate applications include antenna systems for unmanned air vehicles and antennas that could be part of tiny GPS devices sewn into clothing or molded into helmets, allowing military, police or firefighters to know the exact locations of all the members in their units.

"We have demonstrated that we can make efficient, electrically small antennas," Ziolkowski said. "Now we've made predictions that we also can potentially create those electrically small antennas with a wide frequency bandwidth."

That would break through a barrier that's existed since the 1880s when Heinrich Hertz transmitted his first radio signals, and would shrink communications systems to sizes that seemed like science fiction only a few years ago.

Graphic representation of negative refraction, an important property of metamaterials. This image is on the cover of Ziolkowski's book on the subject.



Globetrotting Engineer Designs Instruments to Detect Life at Extremes of Nature, Including Other Planets

At first glance, helping the FBI investigate a crime scene and searching for life on Mars seem worlds apart. That is, unless your world is an instrument lab on the fourth floor of the ECE building and two CDC-approved laboratories in the BIO5 building.

That's where you'll find professor Linda Powers, when she's not off on field trips to Chile's Atacama Desert, the Arctic or a remote volcano.

Instrumentation is the common link in all these activities; primarily optical sensors that scan for microbial life or seek out organic compounds. Powers recently carted a small instrument to a project in the Arctic. It was designed and assembled in her UA labs and fits inside a small backpack.

She dug into the arctic ice and used the instrument, which relies on a microbe's intrinsic fluorescence, to identify life on the spot, in real time. No need to transport samples back to the lab, grow specimens and wait until days or weeks later to discover if microbes were present.

As she dug down five or six feet, Powers didn't find many things living in the ice. But in that thin microenvironment where the ice ends and rock begins, she suddenly encountered thriving microbial communities. "Biofilms grow at the ice-rock interface like you wouldn't believe," she said.



Linda Powers

"If you're going to look for life on Mars, and you're going to return samples to Earth, you can only bring back very small amounts," she said. That means it's vital to investigate areas with the highest probability for living organisms.

Sometimes it's only important to know that microbes are present, such as in a hospital operating theater, but at others it's vital to determine which species are lurking about.

"We design molecules in the laboratory and put them on a long organic tether—something like bait on the end of a fishing line," she said. "The molecule is designed to attach to receptors on only one kind of microbe."

"It's basic science, as well as building equipment," Powers said. "Some of it is molecular engineering and some of it is electrical engineering or optical engineering. But it's all engineering."



College of Engineering/Matt Brailey

What's in a Name?—The key to successful learning, reckons Paul Blowers.

Paul Blowers Selected as 2010 da Vinci Fellow

Paul Blowers, associate professor of chemical and environmental engineering, has been named the 2010 da Vinci fellow by the UA College of Engineering. The fellowship is sponsored by the college's giving society, the da Vinci Circle.

Fellows are selected for their substantial distinguished and sustained contributions to teaching, research and service. A new fellow is named each year, and each fellowship runs for two years. Fellows receive \$10,000 during the two-year span of the appointment.

Blowers intends to invest some of the fellowship funding in the art of teaching itself. He already has quite a reputation as an unorthodox teacher, and a stranger walking into his class is likely to be taken aback at the apparent melee, but there are good reasons why his students have nominated him for so many teaching awards.

In his classes, students can be found interacting in small groups, brainstorming vigorously, debating loudly and launching quickfire ideas at each other. Blowers, meanwhile, plays the room acting as arbiter and agent provocateur while suggesting alternative avenues of analysis or sources of information.

He makes a point of learning his students' names in as short a time as possible. "It took me six class meetings at the beginning of the semester to learn all 103 names of the students in my class," Blowers said. "I work at it really hard, and they tend to pay a lot more attention when they know that you know who they are."

"Students who otherwise might never ask a question forget that they are in a class of a 100 because I know who they are, so they raise their hands. Some say to me after class that that was the first time they ever asked a question."



Courtesy of Kelly Thompson

Top Dog—Kelly Thompson and friend.

da Vinci Scholar Advocates Responsible Engineering

Kelly Thompson was recently selected as the 2010 da Vinci scholar in recognition of her academic achievements.



Thompson is a senior earning dual degrees in chemical engineering and in molecular and cellular biology. She is a member of Tau Beta Pi and an officer in Omega Chi Epsilon. Thompson has organized several fundraising activities, including the donation of clothing to the Primavera Foundation, which promotes economic and social justice while fighting homelessness and poverty.

After graduation Thompson has a job lined up with Procter & Gamble, one of the largest consumer product manufacturers in the world. She hopes to use her knowledge and skills as an engineer to reduce the environmental effects of consumer manufacturing. "I think the role of an engineer should be to ask questions, especially on a large scale," said Thompson. "How can we minimize the impact on the environment?"

Procter & Gamble has pledged to reduce its carbon footprint by 10 percent by 2012. "I won't be vice president there in five or ten years, but I hope to move up the ranks and become one of the people who are setting up those policies," said Thompson.

Keonjian Professor Gets Awards for Research into Artificial Retina and Robotic Planetary Exploration

A new engineering faculty member was recently honored for his work in helping the blind to see and developing a more efficient way to explore distant planets.

Wolfgang Fink, associate professor of electrical and computer engineering and biomedical engineering, received the NASA

Board Award as well as *R&D Magazine's* 100 Award and Editors' Choice Award.

NASA recognized Fink, who holds the Edward and Maria Keonjian Chair, for a tier-scalable reconnaissance technology that could some day see fully automated planetary exploration missions.

The system would use a planetary orbiter, airships in the form of inflated balloons or blimps, and numerous small expendable devices sent to the planet's surface for scientific exploration.

Unlike current missions, which typically see a single lander or rover sent to a

planet's surface armed with a list of tasks to perform, Fink wants to break the system up into smaller components that can decide, without the direction of researchers on Earth, what is of greatest scientific interest on a distant planet. The system could also be managed from Earth if desired, he said.

Fink's work on developing an artificial retina gained him the *R&D Magazine* 100 Award and the publication's Editors' Choice Award as one of the top three of the 100 Award winners.

The U.S. Department of Energy-funded project, which included an array of academic and national laboratory partners, helps restore some sight in blind patients with age-related macular degeneration or retinitis pigmentosa, two diseases that leave the eye's retina unable to convert incoming light into electrochemical signals the eye uses to allow people to see, Fink said.



Wolfgang Fink

The system uses an eyeglass-mounted camera, a control chip and electrode array implanted in the eye, and an image processing and stimulation optimization device worn on a belt.

The image processing and stimulation optimization device on which Fink and associate Mark Tarbell worked allows the patient to make the most of the sight offered by the 60-pixel electrode array implanted in the eye.

Plans call for eventually expanding the array's capability to 1,000 pixels, which would allow gross facial recognition and large-font reading, he said.

Engineering Senior Creates Buzz

CONTINUED FROM PAGE 1

engineer with Intel's Embedded and Communications Group in Chandler, Ariz. Christie asked Bunting to build two of the robots for use as attention-grabbing marketing tools at industry trade shows. The robot uses Intel's Atom Z530 1.60 GHz processor.

"The main reason is that it is really such a cool looking robot," said Christie, who seeks devices that highlight the low-power capabilities of his firm's new Atom processor. "We're looking for the slightly unique, interesting ones. Being a nice slick device that walks around is so much better than a standard desktop demo."

Alex Dirks, owner and designer at Gilbert, Ariz.-based CrustCrawler



Robotics Inc., which provided servomotors used in Bunting's project, agreed: "It's more exciting to see a robot in action than a Windows application."

Impressed by the hexapod design and operation, Dirks sought out Bunting's expertise. "He has agreed to develop the software for several of our products, starting with a walking robot," Dirks said. "Robotics are pretty complex, with physics, electronics and software and programming: all these things must

come together. He has mastered that at a young age."

Bunting is still working on improving his hexapod's design and performance: "It's a very good base to perform higher level science. It's certainly not done. Currently I'm working on terrain adaptation based purely off of vision as a sole sensor, but I do want to further explore reinforcement learning at some time, possibly with different architecture."

"I see that this device might be doing scientific work like autonomous navigation, mapping of different environments, moving over rough terrain and doing exploration, possibly planetary exploration," Lewis said. "I think Matt's robot has a lot of possibilities. It's really not so farfetched that a robot like this could go to Mars."

Multiple Honors for Mary Poulton

In addition to being named a University Distinguished Professor, Mary Poulton, head of the department of mining and geological engineering, has been inducted into the American Mining Hall of Fame.

To mark her induction, Poulton was awarded the medal of merit by the Mining Foundation of the Southwest for her contributions to the industry. Poulton is director of the Lowell Institute for Mineral Resources and the first female department head in the College of Engineering. She received her bachelor's, master's and doctoral degrees in geological engineering from UA.

In 2008, Poulton became director of the newly established Lowell Institute for Mineral Resources, a collaborative push by Science Foundation Arizona, the mining industry and Arizona's universities, led by UA, to found a



Mary Poulton Ted Hewitt Photography

global center of mining excellence. All told, almost \$20 million was invested or pledged to launch and run the institute.

Poulton described her induction as "recognition that we have successfully built a new model for academic-industry partnerships in mining and geological engineering."

ECE Professor Elevated to IEEE Fellow



Marwan Krunz

Professor Marwan Krunz has been named a fellow of the Institute of Electrical and Electronics Engineers, the highest grade of membership

possible in the IEEE, for his contributions to resource management policies in wireless networks.

Krunz is a professor in the department of electrical and computer engineering and in the department of computer science. He is the UA site director of Connection One, a joint research center between the UA, industry and the state that focuses

on radio frequency and wireless communication systems and networks.

Reacting to the news of his fellowship, Krunz said: "It is quite gratifying to see your hard work being recognized by your professional community." During his 13 years at the UA, Krunz has published with many of his graduate students, whom he gives a lot of credit for his achievements. "Without their dedication and hard work, I would not be in a position to qualify for the IEEE fellowship," he said. Besides the personal satisfaction, Krunz believes IEEE fellowships improve a department's stature and ranking nationwide. "Many departments strategically exploit the honors and awards received by their faculty, staff and students as a recruiting tool," said Krunz.

Corral is First UA Researcher to Receive Air Force Young Investigator Award

Erica L. Corral, an assistant professor in the UA's department of materials science and engineering, is one of only 38 early-career scientists and engineers who recently received an award under the Young Investigator Program of the Air Force Office of Scientific Research.



Erica Corral

Corral said there is no official word on the exact amount of her award yet, but that it would be more than half a million dollars.

Corral's winning proposal will investigate whether ceramic coatings can be used to shield carbon-carbon composite based hypersonic vehicles from the extremely high temperatures experienced during flight at speeds in excess of Mach 5.

Current hypersonic vehicles use ablative coatings to protect them, which means that the coatings vaporize at high temperatures. Corral said there is the potential for longer missions in more extreme environments if ultra-high-temperature ceramics, or UHTCs, are used. "However, the response of UHTCs under hypersonic flight conditions is not well understood, thus limiting some Air Force missions," Corral said.

Ae FULL STORY
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Photo courtesy of Jon Chandler

Quent Augspurgen **BS/ME 1960**

Augspurgen worked in aerospace and manufacturing for 15 years, then founded the Phoenix consulting firm Augspurgen Komm Engineering Inc., which is now in its 34th year. He is a fellow and past national officer of the American Council of Engineering Companies, and past president of ACEC of Arizona. He and his wife Nolya have been married 42 years and live in Troon Village in Scottsdale, Ariz.

Augspurgen is now semi-retired, but his latest project has brought him back to the solar energy field, to which he is no stranger, having served as a Governor appointee to the Arizona Solar Energy Commission. This latest project, which he designed and built, is a greenhouse for growing orchids. The greenhouse provides the glazing and the structure to support 144 louvered solar collectors that control the amount of sunlight entering the greenhouse, collect and store solar energy by heating water, and radiantly heat the greenhouse at night. "The BSME was a great start, and I am currently having more fun than should be allowed," Augspurgen said.

Contact him at naugspurgen@cox.net.

Pat Eisenberg **BS/CE 1991**

Eisenberg is currently the chief engineer for the City of Tucson Water Department, where she oversees pipeline and facility design, construction, and administrative support services. "The City of Tucson eliminated the title of Chief Engineer," Eisenberg said. "So my actual job classification is Water Administrator. However, I'm the water administrator for engineering, and effectively the chief engineer." She and



Pat Eisenberg

her husband David, a Tucson native, have two sons and one grandson. They hike, sing, and read books in their free time.

John R. Doughty, Lt. Col, USAF, retired **MS/AME 1964, PhD/AME 1971**

After getting his doctorate, Doughty worked in chemical laser research and development until 1989, which included a one-year stint in Israel as a visiting researcher and professor. He was then president of a Bible college for 12 years.

Since then he has done research on radiocarbon found in CO₂ gas wells, coal bed methane wells, and deep natural gas wells. "All the well gas samples were analyzed at the NSF/UA Accelerator Mass Spectrometry lab over a three-year period," Doughty said. "That gave me the opportunity to visit the campus and see all the changes since I graduated. I'm now working on the correlation between carbon-14 and xenon-129 found in the well gases. Keeps me busy!"



John Doughty

Doughty flew with the New Mexico Wing of the Civil Air Patrol as a mission pilot for 17 years. He also earned a degree from Albuquerque Bible College and was ordained as a pastor in 1999. He eventually became the New Mexico Wing chaplain for the Civil Air Patrol. He is currently teaching a science class at Noah Webster College in Albuquerque, N.M.



Photo courtesy of Jesse Pleger

Well Done—Civil engineering alumnus Jesse Pleger, center, and some community members gather round a new well in rural Sudan. The blue casing will be completed later by adding a concrete platform and an India Mark II hand pump.

Jesse Pleger BS/CE 1999

Since graduation Pleger has worked overseas in numerous countries, including Panama, Guatemala, Uganda, and Sudan. He recently spent a year and a half managing water, sanitation, and hygiene projects in Darfur, Sudan, for an American relief agency, Samaritan's Purse. "Our agency was, and still is, responding to one of the largest humanitarian crises on the planet by offering food, agricultural, education, and water and sanitation relief projects in rural villages and camps of displaced people," said Pleger. "Darfur was a challenge to work in, in so many ways. Success was hard to see, but one highlight was providing new water wells to a series of villages that had no protected, clean water source prior to our help." He is currently back

in the U.S. and has been sharing his experiences with a few groups and classes at UA. "Soon I'll be heading to south Sudan for more water projects with another relief agency," he said.

Weldon Vlasak MS/EE 1958

Vlasak recently published his fifth book, *The Birth of an Atom*. "What I have shown is how a hydrogen atom is born when a proton attracts an electron," said Vlasak. "This is a problem that has never before been solved. My belief is that electronic engineers of the future will be designing atoms and molecules that result in new forms of matter." Vlasak claims that he has been prevented from answering criticism from physicists who say his ideas conflict with those of quantum physics. "That is why I have self-published all five books," Vlasak said.



Photo courtesy of Bob Roscoe

Robert W. Roscoe BS/MinE 1978

Roscoe is currently vice president of mining and general manager of Doe Run Company's mining and milling operations in southeast Missouri, where the company operates six underground mines and four concentrators. The photo shows Roscoe and family members on a 2009 Thanksgiving trip to Hawaii's Big Island.

From left to right are Bob Roscoe, daughter Tricia, wife Laura, daughter-in-law Monica, Tricia's boyfriend Patrick, son David, son Andy (Monica's husband), and David's wife, Lindsay.

"Due to all the potential conflicts with family get-togethers at Christmas and living in different locations," Roscoe explained, "my wife and I have started a Christgiving tradition of going somewhere with everyone during the Christmas off-season, or Thanksgiving."

Roscoe has been with the same Missouri mining company since graduation. "We live in a little town of 802 people," said Roscoe. "The population total hasn't changed in 32 years, just different people. In 1999 we lived and worked in the highlands of Peru at an underground copper mine. I had a basic background in Spanish, but when you are the only gringo supervising 1,000 Peruvians, your language skills improve rapidly if you want to eat and survive. Fantastic place, people, and job." Roscoe added that he's "looking forward to the time when grandkids start coming."

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