MIZZOU ENGINEER

Engineering for the advancement of humanity

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University of Missouri College of Engineering

Nuclear nonproliferation: developing a method to produce radiopharmaceuticals with low-enriched uranium

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MIZZOU ENGINEER is a biannual magazine. It is our intent to capture moments in time that communicate glimpses of the past, present and future of the MU College of Engineering. We hope it also renews old acquaintances and friendships, spawns volunteerism and encourages philanthropy.

Questions, comments and suggestions for future articles are welcome. Please send them to the Engineering Advancement Office at umcengrdev@missouri.edu

This magazine is funded by the Mizzou Engineering Office of External Relations.

Mizzou Engineering Alumni and Friends,

Two of the stories in this issue of Mizzou Engineer are on topics of energy, two deal with medical/dental issues and the fifth involves both energy and medicine.

Biomass energy is a topic of much discussion, plagued by questions of financial viability. Logistical models being developed by researchers in the Department Industrial and Manufacturing Systems Engineering provide answers, using Missouri as a test case. The dynamic model they are developing will make it feasible to predict the viability of biomass energy systems in virtually any locale.

Using innovative installation techniques, a civil engineering researcher is modeling agricultural use of ground source energy. Partnering with a Missouri poultry farmer to install the systems for buildings now heated with propane, it is projected that the technology will result in energy savings of up to 50 percent.

Biological engineering researchers have discovered a method to rapidly detect blood infections — sepsis — by measuring the charge stored in individual cells. Sepsis currently is the 10th leading cause of death in the United States, and early detection increases the odds for successful treatment and survival.

A device developed by two mechanical engineers that will create better bonds between teeth and fillings has progressed to clinical trials, placing it ever closer to broad use in the field of dentistry.

Our cover story examines research by a mechanical engineer and an MU nuclear reactor specialist that addresses a need for the production of pharmaceutical isotopes taking into account worldwide issues of nuclear nonproliferation. The researcher is developing a method to produce the necessary isotopes using low-enriched uranium with international collaborations and global interest in the project.

Each of these Mizzou Engineering research projects has far-reaching potential to improve lives of people all over the world, and in some cases, may even save lives. And you read about them here first.

Jan Wiese-Fales
Editor

"Every great dream begins with a dreamer. Always remember, you have within you the strength, the patience, and the passion to reach for the stars to change the world."

–Harriet Tubman

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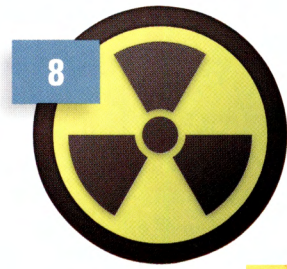
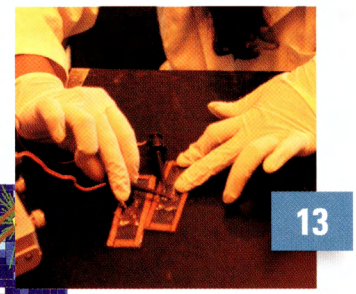
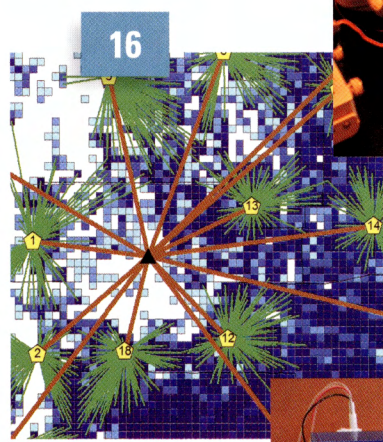
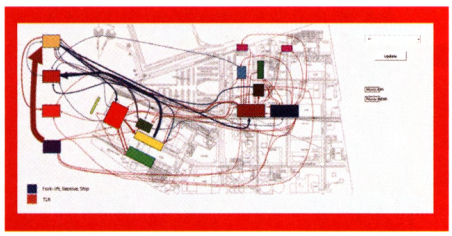






Of Note

COVER: Mechanical engineering Associate Professor Gary Solbrekken, at right and Casey Jesse, one of his graduate students, pose by the apparatus in Solbrekken's lab used to simulate the mechanical deflection of the low-enriched uranium targets that occurs in a nuclear reactor.



MU CELDi helps company save more than $2 million

"The value that CELDi gave to this particular project was significant," said Bill Abernathy, head of Bayer CropScience's North America product supply project management office, after receiving the results of a yearlong project from the University of Missouri's National Science Foundation-supported Center for Excellence in Logistics and Distribution (CELDi).

CELDi is a university-based enterprise established nearly 10 years ago that conducts applied research, resulting in innovative logistics and distribution solutions. Industry member organizations like the Kansas City Bayer Crop Science facility, which specializes in herbicide, pesticide and fungicide production, pay an annual membership, and in return, receive a company-specific project, with shared fundamental research and collaborative research results from the consortium, and access to top, logistics-trained students.

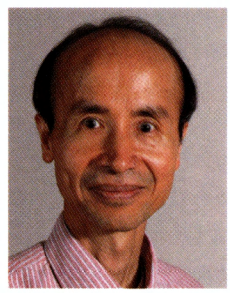
MU investigated how Bayer could better operate its material flow — how the facility stores, transports and maintains materials throughout its production plants and warehouses.

Mustafa Sir, an assistant professor of industrial and manufacturing systems engineering, said Bayer had acquired the facility, and had since added buildings on-site, as well as renting off-site storage space. These multiple locations, as well as the multiple production plants, raw materials, packing materials, finished goods and equipment used for transport on- and off-site, all factor into the complex logistics system.

With the CELDi crew's information, Bayer's projected savings total nearly $2.8 million over the next three to four years, and the company has proposed a three-phase system to implement the suggestions.

Hsieh's soy chicken research moves closer to consumer kitchens

Biological engineering professor Fu-Hung Hsieh's research into the development of a soy-based chicken substitute with the flavor and texture of the real thing has resulted in his technology's licensing by the university to Maryland-based Savage River Farms, now known as "Beyond Meat." Consumers will soon get a chance to taste-test it for themselves. According to a May 17 piece about the company on NPR, the Whole Foods Market chain plans to start selling prepared food using Beyond Meat chicken in Northern California in June.



Fu-Hung Hsieh

In addition to its appeal to vegetarians, the soy chicken offers health conscious consumers a "meat" alternative that is heart healthy with an added benefit of potentially preventing certain types of cancer.

The soy chicken product has garnered additional favorable coverage in The New York Times and Mother Jones, magazine.

The licensing agreement specifies that the licensee must initiate and maintain a physical presence in Missouri within five years.

MU Engineering online learning offerings increase

Galen Suppes, a chemical engineering professor, is a proponent of online learning for a variety of reasons and has developed three online courses: Mass and Energy Balance (CH ENG 2225), Computer-Aided Calculations in Chemical Engineering (CH ENG 2226) and Process Simulation and Design (CH ENG 4980).

"Both online courses and regular courses have advantages and disadvantages," Suppes said, adding that he believes hybrid classes, a blend of both, are preferable. "The key is to tap into both."

Mary Myers, an associate teaching professor in the Chemical Engineering Department, also works as director of continuing education for the College of Engineering. As such, she has taken the lead in getting engineering coursework online, a project that has greatly benefited from MU's decision to use a portion of student IT fees to fund eight instructional designers for various units on campus, including engineering, through the Academic Technology Liaison (ATL) program.

"Pil Won On is an instructional designer and an online content expert. She teaches faculty how to teach online courses," Myers said.

On and the faculty she has worked with spend hours pinning down measurable objectives and then structure them into a meaningful online offering. Luis Occeña, professor and chair of industrial engineering, worked with On to develop an engineering economic analysis (IMSE 2710) course.

"Pil Won turned my approach to the online course around 180 degrees. Now I can easily manage an online class with 102 students because of the changes we

made," Occeña said.

Two additional successful online course collaborations between On and engineering faculty are offered through Mizzou Online: Hani Salim, LaPierre associate professor in civil engineering, offers Statics and Elementary Strength of Materials (ENGINR 1200); and Marie Steinwachs, director of the Environmental Assistance Center, has developed Pollution Prevention: Applied Engineering for Sustainable Business Practices (CV ENGR 4285, Sec. 2).

Electrical engineer honored as 'Best Reviewer'

Alina Zare, assistant professor of electrical and computer engineering, has been recognized by the Institute of Electrical and Electronic Engineers (IEEE) Geoscience and Remote Sensing Society as a 2011 Best Reviewer of the Society's peer reviewed journal: Geoscience and Remote Sensing Letters. This honor was bestowed in recognition of her outstanding service to the journal, both in terms of the technical excellence of the reviews performed and the timeliness with which they have been consistently provided.

Alina Zare

"Anonymous peer reviewing is one of the cornerstones of vigorous advancement in science and engineering research, but it is also often one of the most underappreciated of the many requests and demands made of subject experts,"wrote Editor Paolo Gamba. "It is for this reason that our society is extremely grateful for the time, energy and dedication that have been shown. It is an honor well deserved."

Project offers students opportunities to work on energy efficiency on Missouri farms

Missouri Agricultural and Energy Saving Team — A Revolutionary Opportunity (MAESTRO) is an interdisciplinary project implemented by the MU College of Agriculture, Food and Natural Resources, the MU College of Engineering and MU Extension. Its focus is energy-efficiency improvement for the agricultural sector in Missouri. The Missouri Department of Agriculture is leading the overall project with funding from the United States Department of Energy.

For their role in the project, the College of Engineering is installing energy-saving equipment and Sanjeev Khanna, mechanical and aerospace engineering professor, along with Robert Reed, a civil and environmental engineering professor, are working with undergraduate students to develop a monitoring system to track the energy savings from the equipment installed through MAESTRO.

Professor Sanjeev Khanna, foreground, discusses installation of data acquisition systems with engineering technician, Rich Oberto, in a greenhouse that is participating in MU's MAESTRO project.

Tracking the energy use before and after new equipment is installed will allow the monetary and environmental benefits of the installations to be accurately predicted in the future.

Since the system is being developed from the ground up, the undergraduates working with Reed and Khanna benefit from a range of experiences.

Kyle Nordike, a senior in mechanical engineering, works on the program in LabView to analyze the information collected by the monitoring equipment installed at three MAESTRO sites.

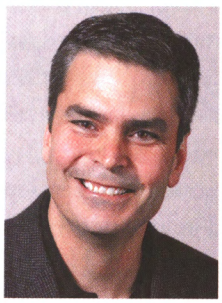
Jeffrey Burman, a senior mechanical engineering student, also is working on the project. They presented the results of their work on an energy-monitoring and verification system at the annual Undergraduate Research and Creative Achievements Forum on April 24, 2012.

Khanna said he believes this interdisciplinary approach to energy efficiency will become more important as the technology improves. "Every industrial entity must institutionalize this program of energy efficiency," Khanna said. "Through this MAESTRO program, we can highlight this among the agricultural producers and bring this to the top of their minds that they can do this."

"[The equipment installation] will pay for itself in the end. There are so many ways to waste electricity and not even realize it," Nordike said. With energy efficiency and consumption under more scrutiny than ever, this program will help make the tools necessary for improving energy use much more available and easy to use than ever."

Convection battery increases power output

Galen Suppes, J.C. Dowell Professor of chemical engineering, has developed and demonstrated a new "convection battery" to replace those dependent on petroleum. The battery uses a pump, similar to a radiator pump in an automobile, to increase power output of batteries.



Galen Suppes

"What is needed is technology that will cut the price of large batteries by more than half while simultaneously reducing charging time," said Suppes.

The convection battery pumps a liquid electrolyte directly between electrodes via a flow-permeable separator. This direct flow is the key to the increased power output. Increased power for a given area of separator can be used to reduce battery costs and reduce charge times.

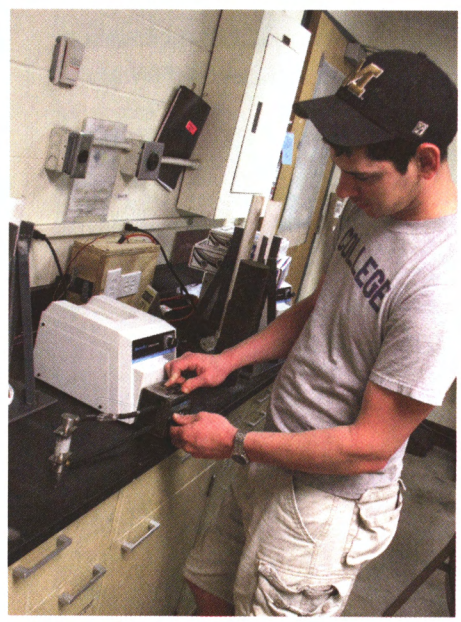
In validating studies, the convection battery supplied nearly six times as much power output as an identical, traditional battery without a pump. A series of use and charge cycles also yielded outstanding performance.

This technology can be used to improve the best available battery chemistries, as well as future breakthroughs in materials and chemistries. Compatibility includes traditional battery chemistries such as the lead-acid battery and the batteries currently used in electric vehicles.

Research on the convection battery, initiated in 2008, has received funding from both the National Science Foundation and the Energy Innovations Small Grant Program of the California Energy Commission.

Results from the studies have been published in the American Institute of Chemical Engineers (AICHE) Journal and the Journal of Applied Electrochemistry. They were also presented at the AICHE annual meeting in October 2011. Since then, definitive data have been collected that verifies increased power output and recharging capabilities.

Other researchers contributing to the project are graduate students Bryan Sawyer, Michael Gordon, Michael Heidlage and Donald Dornbusch.



Chemical engineering doctoral student Michael Gordon assembles a test cell for a convection battery developed in the lab of Professor Galen Suppes. The battery, which uses a pump, supplies nearly six times more energy than traditional batteries used in electric cars, and is less expensive.

Computer science grad student's 'cloud' platform finds journalism links

"I've built my own cloud platform that allows for real time massive communication," said Ryanne Dolan, a University of Missouri College of Engineering doctoral candidate in computer science. "Some people call it pushbutton web. It allows you to have a conversation with a million people."

Ryanne Dolan

Dolan developed the technology as part of an electrical engineering research project and then began thinking about additional applications.

Last summer, he took his "real time massive scale commenting system" to the MU Reynolds Journalism Institute (RJI) hoping he might become a technology program fellow for them and further develop the concept. Instead, they offered to fund exploration of the project because the implications of his technological innovation were both evident and exciting from a journalistic point of view.

"I wasn't sure how it was related, but they saw its potential and how it could be used," Dolan said. "It's a way for journalists to collaborate and receive info back from readers."

Dolan explained that currently, conversations in a chat environment are simply a long history of nested comments. "It doesn't encourage a conversation," he said.

The plug-in that he and a journalism capstone group have developed features ways to enable fast-paced discussions, which focus on one article or event.

"The students have named it Pinn'r because you can "pin" a particular sentence and see what others have pinned and vice versa. It's a visual way to add context to a conversation that is otherwise just spaghetti," Dolan said.

"If we can build our own platform, we are enabling journalists to mine data they wouldn't otherwise have access to," he added.

Dolan said that he has been working with one of the RJI fellows to identify disparate networks of journalists throughout the world and using the technology to identify connections among them that aren't apparent to the journalists.

According to Dolan, CNN has expressed interest in the technology, and he is in discussion with MU's public access radio station, KBIA, about using it for election coverage.

Three new engineering minors provide expanded opportunities for undergraduates

Engineering encompasses a broad array of disciplines, and while the majors offered to undergraduates help to define fields of study, sometimes a minor can help students expand a chosen field into a research breakthrough or a career. That's the intent of three new minors offered through the University of Missouri College of Engineering, which aim to give students a better understanding into energy, aerospace or neuroscience.

The undergraduate minor in energy engineering is aimed at providing better insight into the roles engineers play in the energy industry.

"The Missouri Division of Workforce [Development] was doing a study of tradespeople, ones who'd been recently laid off, and they were trying to figure out what kind of training would have best benefited them," said mechanical engineering Associate Professor Gary Solbrekken, who also is the director of undergraduate studies and coordinator for the energy engineering minor.

"That was the genesis of how we could get an energy focus in our engineering degree program," he said.

Development of the minor was partially funded through a $6 million grant from the U.S. Department of Labor awarded to the Missouri Division of Workforce Development. The funds were subdivided to schools and workers' unions to establish and promote opportunities and training programs that could lead to careers in the energy industry.

To complete this minor, students must complete a minimum of 12 credit hours of required core courses, plus an additional six credit hours of approved emphasis area courses.

The Department of Mechanical Engineering will now offer a minor in aerospace engineering, replacing the aerospace emphasis currently offered.

"There's an interest in having something more focused than an emphasis," Solbrekken said. "With a minor, it will put our students in better positions when they graduate."

The aerospace minor will allow for a more structured program that includes two required courses, at least two core courses and up to two more auxiliary courses.

An undergraduate minor in computational neuroscience expands upon the graduate neuroscience courses already offered at MU through the Interdisciplinary Neuroscience Program.

Electrical engineering Professor Satish Nair said the minor in computational neurobiology is the first program in this field of research offered to undergraduates.

"We started this initiative about eight years back. Our focus was computational neuroscience, and we began research projects with neuroscientists," said electrical engineering Professor Satish Nair, head of Mizzou Engineering's Computational Neurobiology Center.

Along with David Schultz, an associate professor of biological sciences, Nair said the "timing was right" to take the program and structure it as a minor available to undergraduate students in engineering or the College of Arts and Science (A&S).

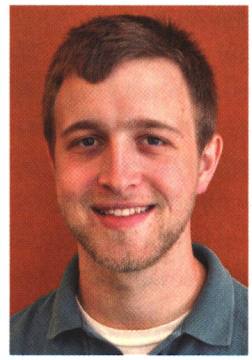
"Biologists have the data, and engineers have the tools to make sense of the data," Nair said.

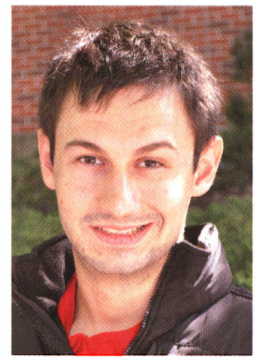
Students minoring in computational neuroscience complete a six-credit core — a "biology core" for engineering, physics, math or psychology students, and a "engineering/physics/math core" for biology students. All students take a computational neuroscience course, and at least four additional classes, with at least two biological science and two engineering/physics courses.

All three minors are currently available to students and graduating seniors if they have completed the required courses.


Rebekah Conley


Adam Daily


Andrew Haddock


Dmitriy Karpman


Sarah Smith

Five Mizzou Engineering seniors receive NSF graduate research fellowships

Five University of Missouri College of Engineering seniors received fellowships from the National Science Foundation's (NSF) Graduate Research Fellowship Program (GRFP).

The GRFP recognizes and provides fellowships for outstanding graduate students who are pursing a research-based master's or doctorate degree in an NSF-supported field. The fellowships cover up to three years of graduate-level education, which is usable over a five-year period.

Biological engineering senior Rebekah Conley studied under Associate Professor John Viator, working on his photoacoustic melanoma detection device. The senior biological engineering major plans to begin graduate work at Vanderbilt University.

Adam Daily, a senior biological engineering major, also worked in Viator's lab. Daily will work with University of Texas at Austin Department of Biomedical Engineering chair Nicholas Peppas, on oral delivery of insulin for the treatment of Type 1 diabetes. Daily also received an additional fellowship from Texas.

Electrical engineering senior Andrew Haddock is interested in doing research at the University of Washington-Seattle's new Center for Sensorimotor Neural Engineering. At MU, he worked in the computational neurobiology lab of Professor Satish Nair.

Computer science, math and statistics senior Dmitriy Karpman had already planned on going to Stanford University for graduate school. He had been accepted and was making plans for a move. Karpman performed his undergraduate research under Associate Professor Ye Duan with a focus on computer graphics and biomedical imaging.

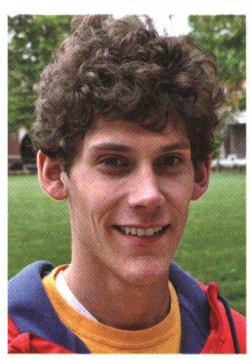
Biological engineering senior Sarah Smith plans to continue working in the lab of Associate Professor Sheila Grant at MU. As an undergraduate, Smith said she worked in Grant's lab on tissue scaffolds, using gold nanoparticles and pig tissue to make tissue scaffold for various tissue scaffold engineering applications, mostly wound healing.

Approximately 2,000 NSF fellowships were awarded. Currently, fellows receive an annual $30,000 stipend and up to $10,000 to cover education costs. Budget proposals may increase the cost-of-education allowance to $12,000 for next year.

In addition to the five award recipients, two additional MU Engineering students received honorable mentions from the NSF: computer science grad student Brittany Morago and biological engineering grad student Evan Buettmann.

Bioengineering student secures research internship

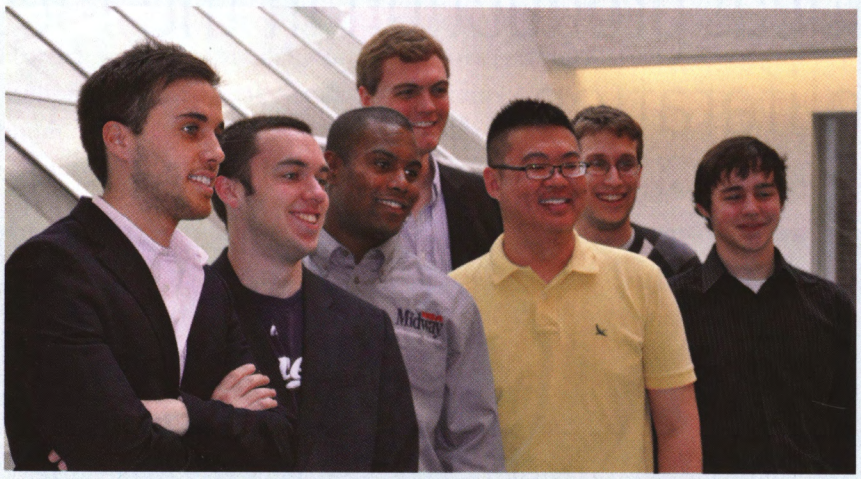
MU bioengineering student Jimmy Winkelmann has secured an internship with the HST-Wellman Summer Institute for Biomedical Optics this summer. The institute is a joint program by the MIT-Harvard Health Sciences and Technology division and the Wellman Center at Massachusetts General Hospital, with support from the National Science Foundation. Participants perform research, attend seminars led by experts in the field and participate in professional development workshops.


Jimmy Winkelmann

Winkelmann has worked with John Viator, an associate professor of biomedical engineering, since the summer of 2011.

"He's come up with very creative ways to solve problems," Viator said. "He's pretty unique in matching creativity with more traditional measures of intelligence."

Only 12 students are accepted to the Wellman research internship program each year. Winkelmann will be doing research with Seemantini Nadkarni, an assistant professor at Harvard Medical School. Nadkarni's work focuses on optical detection at the early stages of plaque buildup in arteries, among other biomedical optics areas.



Engineering students Jamar Williams, third from left, and Zach Winkler, far right, along with l. to r., MBA candidate Francesco Marconi and journalism students, Scott Wexler, Russell Chapin, Derrick Ho, and Alex Blum made up the winning team at the 2012 Reynolds Journalism Institute (RJI) Student Competition.

Engineering students compete in RJI contest

Two computer science students from the University of Missouri College of Engineering were on the winning team of the 2012 Reynolds Journalism Institute (RJI) Student Competition. Jamar Williams and Zach Winkler coded a widget allowing local advertisers to integrate their messages with personalized news content on Hearst newspaper websites.

The winning team, one of three finalists, also included four journalism students, Alex Blum, Russell Chapin, Derrick Ho and Scott Wexler, and an MBA candidate, Francesco Marconi.

Williams was the backend programmer for the team and Winkler designed the web interface and the recommendation algorithm for the widget.

"It was all the skills I learned from the computer science classes I've had," Williams said.

Winkler agreed that the coding skills from his classes were essential. "It was a great experience," Winkler said. "It was a lot of work but really fun."

Williams said the competition was time consuming and high-pressure. The teams had only three months to design a new revenue source for Hearst's newspaper and television stations using web analytics. "Spring break wasn't really a break," Williams said. "But it paid off in the end."

Hearst Innovation sponsored the contest, as it has for the past three years.

"At Hearst we're constantly challenging ourselves to focus on the future," said Beth Polish, director of Hearst Innovation. "Our partnership with RJI is a very fulfilling way to nurture and support our own pioneering culture, while encouraging the same spirit in the next generation of media leaders. We congratulate all the talented students who took part in this year's competition, especially the winners, on their impressive work and dedication to shaping the future of media."

The winners received an all-expense paid trip to New York in late May to share their project with other Hearst executives and take part in a Missouri School of Journalism alumni event. All of the students who participated received a third generation iPad.

First rapid prototype class offered at Mizzou

Contracted prototype work from on-campus entities and private companies has allowed the University of Missouri College of Engineering to build a cutting-edge rapid prototype facility that doubles as a teaching lab. MU students can gain experience in cutting-edge technology within the rapidly expanding prototype field.

Mizzou Engineering offered its first prototyping class in the 2012 spring semester, co-taught by Mike Klote, director of engineering technical services, and Luis Occeña, department chair of industrial and manufacturing systems engineering.

"Rapid prototyping is quite powerful in its ability to convert computer solid models of objects into tangible models that satisfy form, fit and function," said Occeña. "Products requiring several operations in traditional prototyping can be completed in one additive/layered build operation."

Jian Jiao, a graduate student working in the lab of Associate Professor Jae Wan Kwon in electrical and computer engineering, said she decided to take the class after going to an introductory session about it. She realized at once that the process could be used to build a unique mounting for the MEMs device that is part of her research.

"It's an exciting technique. Many companies are using it globally," Jiao said.

Students completed six to eight models during the course of the semester, utilizing all of the lab's capabilities.

Radiopharmaceutical production in the face of nuclear nonproliferation

story by Jan Wiese-Fales

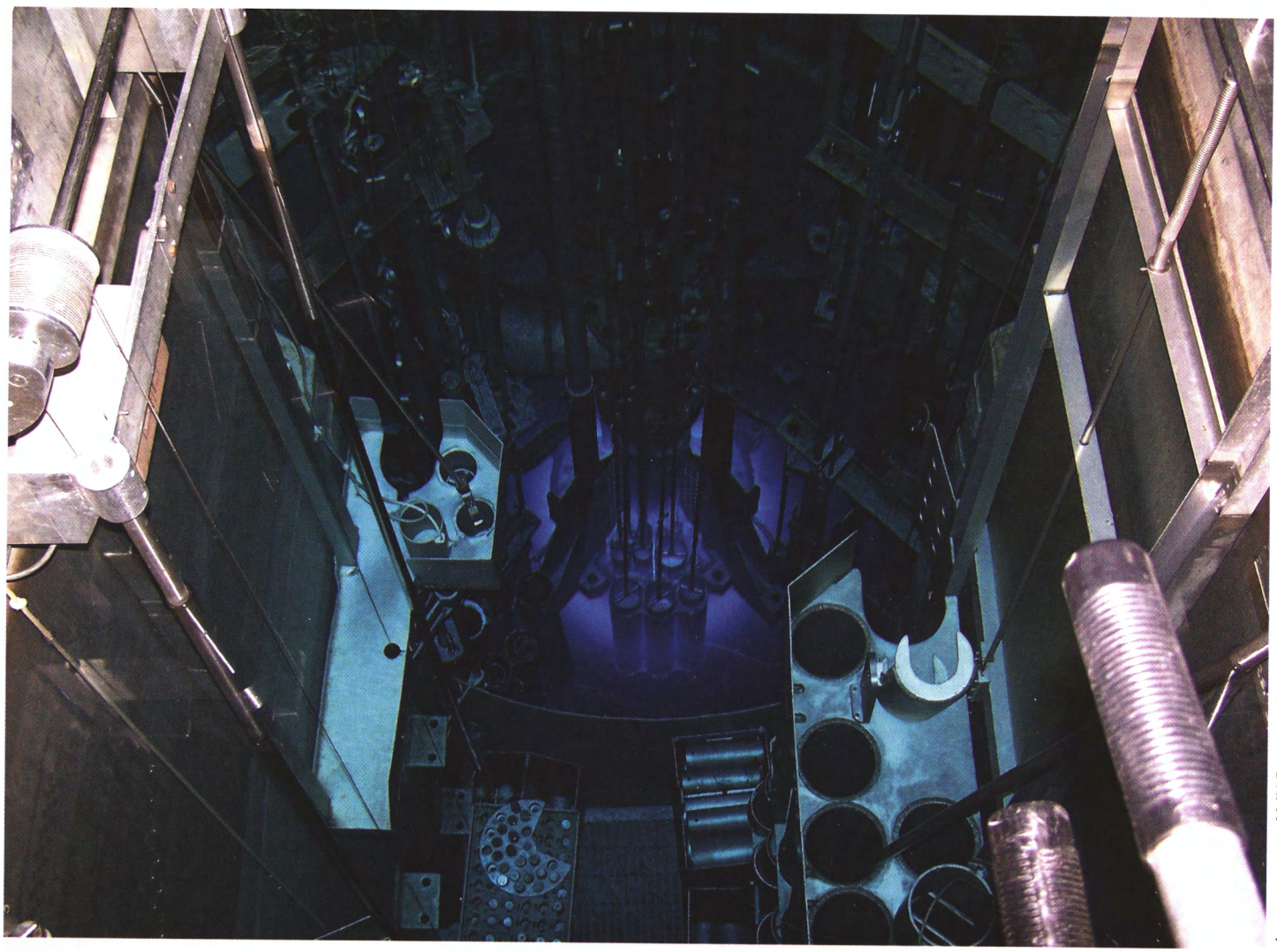
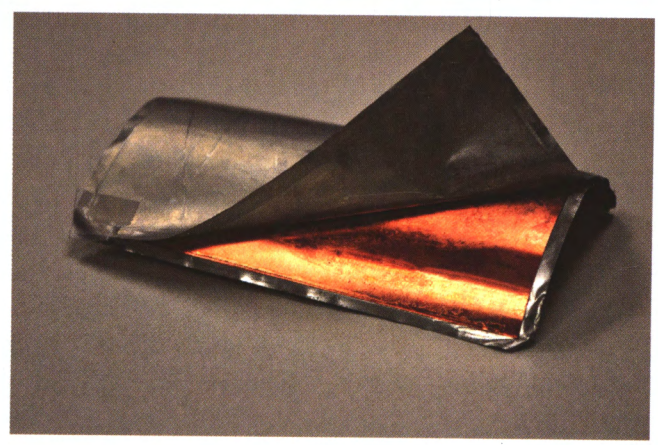


photo courtesy of MU Research Reactor



According to the World Nuclear Association, approximately 90 percent of nuclear medicine procedures conducted worldwide are diagnostic in nature and fully 30 million of them annually utilize the radioisotope technetium-99m (Tc-99m). More than half of these procedures occur in the United States, and for nearly a decade, there has been an international effort to ensure that a reliable and safe supply is available.

Currently, up to 95 percent of the world's molybdenum-99 (Mo-99), the parent isotope of Tc-99m, is extracted from nuclear weapons grade, highly enriched uranium (HEU)-based targets. Mo-99 is produced by irradiating these targets in a nuclear reactor. Five large-scale producers are responsible for a majority of the world's Mo-99 supply, with facilities located in Canada, the Netherlands, Belgium, Australia and South Africa.

A primary goal of the Department of Energy National Nuclear Security Administration's (NNSA) Global Threat Reduction Initiative (GTRI) is to convert civilian research reactors and radiopharmaceutical production facilities worldwide from HEU to low-enriched uranium (LEU).

At the Nuclear Security Summit in Seoul in late March of this year, Belgium, France, the Netherlands and the United States agreed, subject to regulatory approvals, to support conversion of European Mo-99 production facilities to non-HEU-based processes by 2015.

"That's where we come in," said University of Missouri mechanical engineering Associate Professor Gary Solbrekken of the growing international commitment to nuclear nonproliferation goals.

Since 2006, the University of Missouri's Research Reactor (MURR) Center has been working to develop a new LEU target design that will replace the current HEU target. The purpose of the LEU target is to not only produce Mo-99 without the use of HEU, but also to maintain the current Mo-99 yield per target. Collaborating with Charlie Allen, MURR's Mo-99 project manager, Solbrekken has received in excess of $1 million in funding since 2009 from Oak Ridge Associated University (ORAU), the Department of Energy's Y-12 National Security Complex (Y-12) and The Department of Energy's Argonne National Lab (ANL) to develop LEU targets.

"Depending on what pharmaceutical Tc-99m is tagged to, the isotope will concentrate in different parts of the body where it can be imaged by physicians," Solbrekken explained. "It has a half-life of approximately six hours, which makes it attractive when working with biological systems because you want it to decay and get out of the system as quickly as possible."

With a half-life of six hours, Tc-99m's rapid decay makes stockpiling and transporting necessary quantities unrealistic, thus Mo-99 with its 66-hour half-life is used to allow for limited stockpiling and transportation over greater distances.

THE PROCESS

Traditionally, the production of a Mo-99 target involves mixing HEU powder with aluminum powder and encapsulating the mixture within an aluminum envelope, or plate, called cladding. The target is placed in a nuclear reactor and bombarded by neutrons — irradiated — and once removed, the entire target is dissolved in a chemical bath to extract Mo-99 and other radioisotopes.

"The dispersion target (powder target) has great bonding, is exceptionally strong, and it cools quickly; it's a proven technology," Solbrekken said of Mo-99 production using HEU.

Satisfaction with established methodologies is only one reason there is resistance on the part of radiopharmaceutical production facilities to switch to LEU. It is estimated that there will be a slight increase — less than 10 percent — in the cost to produce Mo-99 using LEU, but reactor facilities would have to be retrofitted to accommodate new LEU-based isotope production, adaptations that potentially could carry large price tags.

"Producers must make a profit. They will convert when it becomes cost effective," Solbrekken said, adding that the main focus of GTRI is on the conversion of the Mo-99 production to non-HEU based methodologies. "Working with a variety of entities, each with their own unique goals, has created an interesting tension between business, politics and technology."

In addition to a change in the target design, there must be an adaptation to the current cooling areas and containment

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Opposite page at top, the "blue water" in the depths of the University of Missouri's research reactor, MURR.

Opposite page at bottom, are a cut-away and a close-up detail of models of low-enriched uranium targets being developed and tested by Associate Professor Gary Solbrekken's research group. An actual aluminum annular (cylindrical) target contains a layer of high-density LEU foil, with a layer of nickel electroplated to both sides to keep the uranium from bonding to the cladding. It is placed between the two aluminum cylinders — cladding — and the target is assembled using pressure to ensure the bond is secure.

equipment used for chemical recovery and processing.

Solbrekken's investigations into successful irradiation processes to produce Mo-99 using LEU have convinced him and his research collaborators — Y-12, ANL, MURR and the International Atomic Energy Agency (IAEA) — that foil targets consisting of a LEU foil and aluminum are the best alternative.

"We know it works, and it's a good economic fit," Solbrekken said of the procedures he and his team have developed.

Solbrekken's research group has been working with an aluminum annular (cylindrical) target in which a layer of high-density LEU foil, with a layer of nickel electroplated to both sides to keep the uranium from bonding to the cladding, is placed between the two aluminum cylinders of cladding. The target is assembled using pressure to ensure the bond is secure.

After the cylinder is irradiated, the cladding is removed and the nickel and foil are dissolved in a chemical bath to extract isotopes, a process similar to that of HEU targets.

"With this target design, it takes less time and energy to extract the Mo-99 from the target," said Allen. "It takes less solvent to dissolve it, so there is less radioactive waste."

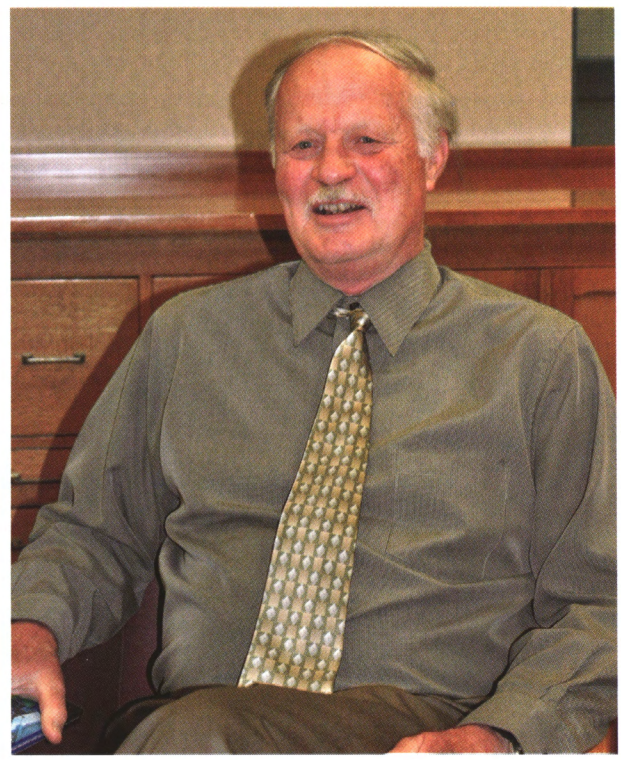
The mechanical process of removing the cladding is being researched in the lab of Solbrekken's Mizzou Engineering colleague, Professor Sheriff El-Gizawy.

But there are some challenges, especially since each country's stringent safety regulations governing the production of isotopes are a key consideration.

"It's tough to get the foil extremely thin. It has a tendency to tear," Solbrekken said, adding that inconsistencies in the foil can cause problems, including the buckling of interfaces.

"Gasses produced by fission in an irregular target, like radioactive Xenon, can cause separation of the foil and the cladding, leading to an undesirable increase in the LEU foil temperature. The high temperatures in the target could cause failure releasing radioactive uranium, aluminum and other fission products into the reactor cooling system," said Kyler Turner, a PhD candidate in mechanical and aerospace engineering, who earned both a master's in mechanical and aerospace engineering and nuclear engineering from MU. He has been working with Solbrekken since 2007.

The research team has been using foils produced by Y-12 and the Korea Atomic Energy Research Institute. Produced using different methods, they each have advantages and disadvantages.



Charlie Allen, the University of Missouri research reactor's Mo-99 project manager, is collaborating with Associate Professor Gary Solbrekken to develop low-enriched uranium targets for the production of radiopharmaceuticals.

"We are working with Romanians [at the Pitesti reactor facility near Mioveni, Romania] on assembly techniques to expand the inner aluminum tube into the outer tube for a tighter fit," Solbrekken said, adding that Allen has been instrumental in connecting him with collaborators around the world.

The team's Romanian partners also are doing post irradiation examination (PIE) of the targets.

"During the PIE test, the Romanians will be examining the various foils after irradiation, investigating how their foils behave under irradiation," said Turner, adding that this data will be instrumental in helping to persuade reactors producing Mo-99 with HEU to consider a switch to LEU.

"We know it works," said Allen, echoing Solbrekken's confidence in the foil targets and the annular geometry. "But no one has ever put together a test plan to use as objective evidence."

Cold tests, with no radioactive materials have been conducted at MURR, as have a limited number of annular foil target irradiation tests.

Allen and Solbrekken agree that students on the research

team can greatly benefit from the experience. Turner is participating in the Nonproliferation Graduate Fellowship with the NNSA's GTRI in Washington, D.C., working on the development of non-HEU-based Mo-99 production both domestically and internationally. He heard about the position during summer internships at Y-12 in 2009 and 2010.

"Through my NNSA fellowship, I support the acceleration of non-HEU-based Mo-99 production methodologies," Turner said. "I manage the funding we provide to the national labs to assist our commercial cooperative agreement partners, funding that allows them to access the immense knowledge base available in the DOE national lab system.

"The non-HEU-based Mo-99 production project has a great deal of high level governmental attention," he said. "As part of my fellowship, I have had the opportunity to directly interact with representatives from the Office of Science and Technology Policy in the Executive Office of the President, the Nuclear Regulatory Commission and the Department of Energy. It's a very interesting, fast-paced job, and living in Washington, D.C. has been an amazing experience."

Because the production and use of Mo-99 for medical procedures and nuclear nonproliferation are highly visible issues of international importance, Solbrekken said the work has been personally gratifying.

"It's not just an academic exercise. Our success means they [LEU foil targets] will be utilized in a real production facility, he said.

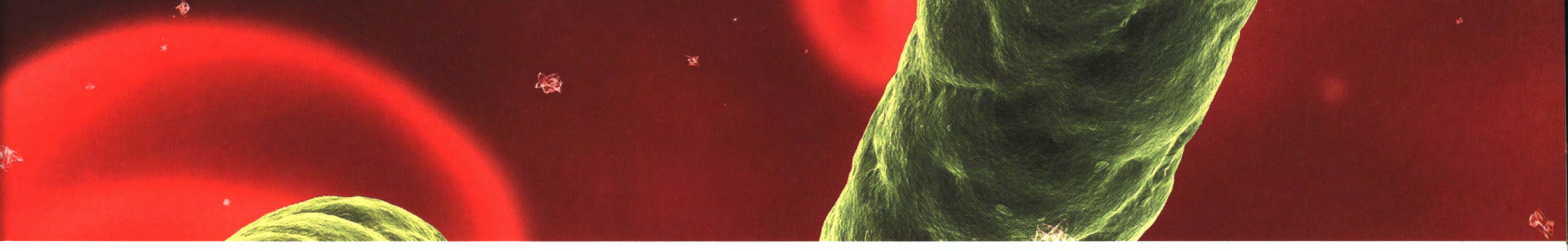
"I've never been interested in nuclear bombs and electricity. It didn't dawn on me that there were so many other nuclear applications, like tracers in ground water, accelerators, cyclotrons and X-rays. As a mechanical engineer, these are things that really connect."

Kyler Turner stands in the middle of Associate Professor Gary Solbrekken's lab on a visit to Columbia during a break from his Nonproliferation Graduate Fellowship with the National Nuclear Security Administration. Solbrekken said many of his students are finding work in the nonproliferation field directly in response to the work they are doing in his lab. Pictured in the lab from left to right are undergraduate Cory Mueller (behind structure), master's student Philip Makarewicz, master's student Bobby Slater, Turner, undergraduate Alex Moreland (back to camera), doctoral student John Kennedy (looking at camera), and doctoral student Srisharan Govindarajan in foreground.

Researchers take aim at rapid detection of sepsis in neonates

story by Jan Wiese-Fales • photos by Ellen Thommesen and Justin Kelley

Shramik Sengupta's investigation into the potential of a novel technique to detect viable bacteria led the University of Missouri assistant professor of biological engineering to the need for early detection of bloodstream infections — those which typically lead to sepsis, a severe, whole-body immune response to the infection that often is fatal.



"This research started when I was working as a postdoc at Notre Dame, where we were trying to develop a faster way of detecting viable bacteria for an environmental application," Sengupta said. "Our original idea was that using electrical impedance measurements, we would be able to detect gas production by living bacteria. But a closer analysis of the data revealed that we were on to something more sensitive — charge storage at individual viable cells."

Sepsis is the 10th leading cause of death in the United States. It is estimated that 28 percent of sepsis cases in the United States are fatal and that the annual cost of treating septic patients is in excess of $16 billion. Seven percent of neonate deaths are traced to sepsis.

Sengupta received a $180,000 research award from the Wallace H. Coulter Foundation to validate and advance the potentially life-saving technique, as early detection of viable bacteria in the blood is the key to effective treatment of sepsis. The foundation funds translational research in biomedical engineering with the goal of accelerating the introduction of new technologies into patient care.

In cooperation with collaborator John Pardalos, MU Health Care's medical director of the neonatal intensive care unit at the Women's and Children's Hospital and MU associate professor of clinical child health, Sengupta's team has been working to prove that his electrical impedance method is consistently accurate, faster and less expensive than current technologies.

Sengupta explained that generally 10 cubic centimeters of blood are drawn from patients in the hospital to perform a "blood culture" test if infection is suspected, though only one cc. is extracted from infants. The blood sample is added to a bacterial growth medium that supports the growth of almost all microorganisms. Hospital technicians then monitor it for up to five days for signs of carbon dioxide (CO_2) production, which indicates the presence of living and thriving bacteria in the drawn blood.

"Using current technology, it typically takes 12 to 72 hours — up to three days — to get a positive reading. They run it for five days before declaring it negative," Sengupta said.

"Instead of looking for CO_2 production, we do an electrical scan on a small blood sample," the researcher explained. "If you hit bacteria with a high frequency AC field, they experience membrane polarization and the cells store a charge. We can pick up signatures of this charge storage with an impedance analyzer in a much shorter time."

For testing purposes, bacteria are added to blood culture broths and gently rocked in an incubator at 37 degrees Celsius.

"Every hour, we take a small amount and put it on a plate to see how many bacteria there are, and put some

At left, Shramik Sengupta, assistant professor of biological engineering, and doctoral student Sachidevi Puttaswamy are developing a technique to reduce the time it takes to detect bloodstream infections, with a focus on neonates.

At right, Yike Chen, a bioengineering senior, Byung Doo Lee, a postdoc researcher, and doctoral student Sachidevi Puttaswamy, remove blood culture "broths" from an incubator in Shramik Sengupta's lab.

in microfluidic cassettes to take electrical readings," said Sachidevi Puttaswamy, a doctoral student working with Sengupta. Because of its incidence of fatality, it is common practice for doctors to put the patient on a broad-spectrum antibiotic at the slightest suspicion of sepsis, though such a drug may not be as effective as one that specifically targets a known bacterium and might also be costly. When a sample comes back positive, the bacteria must then be identified with a panel of selective media, or using DNA-based methods. According to Sengupta, while the identification is relatively fast, the preceding culture step is the key cause of delay in administering the targeted antibiotic. He said that in infants, sepsis can be fatal in three days, and the more rapidly the most appropriate antibiotic is identified and administered, the lower the incidence of mortality.

"It will speed up the recovery process if the baby can be put on the correct antibiotic more quickly — something that is more specific and isn't so broad," said Pardalos. "And a more specific antibiotic will also decrease the possibility of antibiotic resistance."

"With this technique, we can cut down the bacterial detection time to five hours, and we will also be able to say after 24

photo by Justin Kelley

hours that the patient definitely does not have sepsis," Sengupta said of the research he and Puttaswami are conducting.

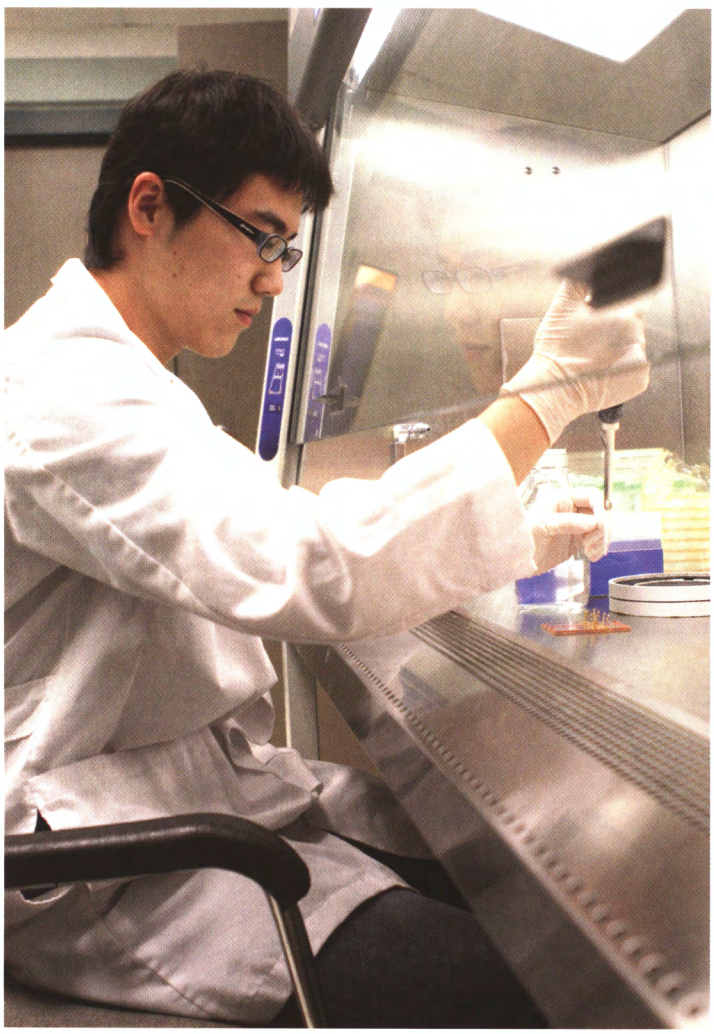
"This saves time in the hospital, reducing health care costs," said Pardalos. "And for me, as a neonatologist, treating a child appropriately is of the utmost importance."

Sengupta and Puttaswamy have a joint patent on the technology and they are working with a private company, Techshot, to develop and test a single unit automated system to do the testing. This project has been funded by the National Institutes of Health (NIH) through a Phase I Small Business Innovative Research (SBIR) grant, which seeks to increase private sector commercialization of innovations derived from federal research and development.

"The best part about this research is that we're not just doing something for the sake of doing it," said Puttaswamy. "It can actually help people. I didn't realize how sepsis affects people — that it was such a huge problem. This is really important."

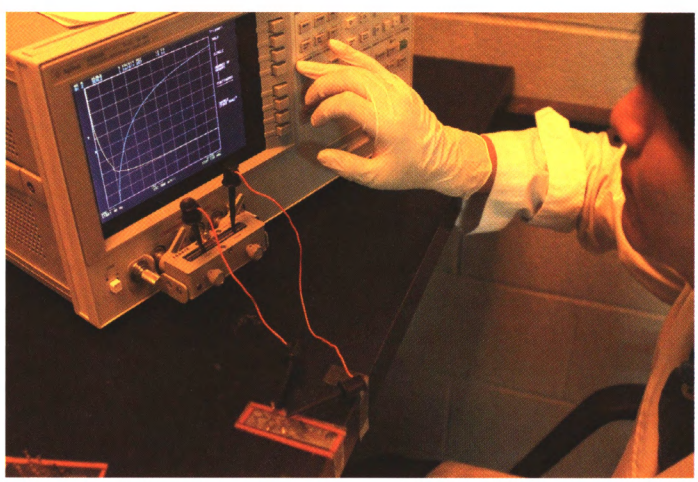
"Being co-owner of a patent is exciting, too," she added.

"Dr. Pardalos has been wonderful," said Sengupta. "Having a medical school on this campus is very useful. My decision to come to MU was a good one."



Facing page, John Pardalos, MU Health Care medical director of the neonatal intensive care unit at the Women's and Children's Hospital and associate professor of clinical child health, examines Carly Ruggles in the care unit. Pardalos is collaborating with Sengupta to more quickly detect sepsis in neonates.

At left, Yike Chen readies blood samples for testing. Below, Byung Doo Lee conducts an electrical scan with an impedance analyzer on a small blood sample to pick up signatures of charge storage in bacteria.



Working out the logistics of biomass as a viable energy resource

story by Jan Wiese-Fales

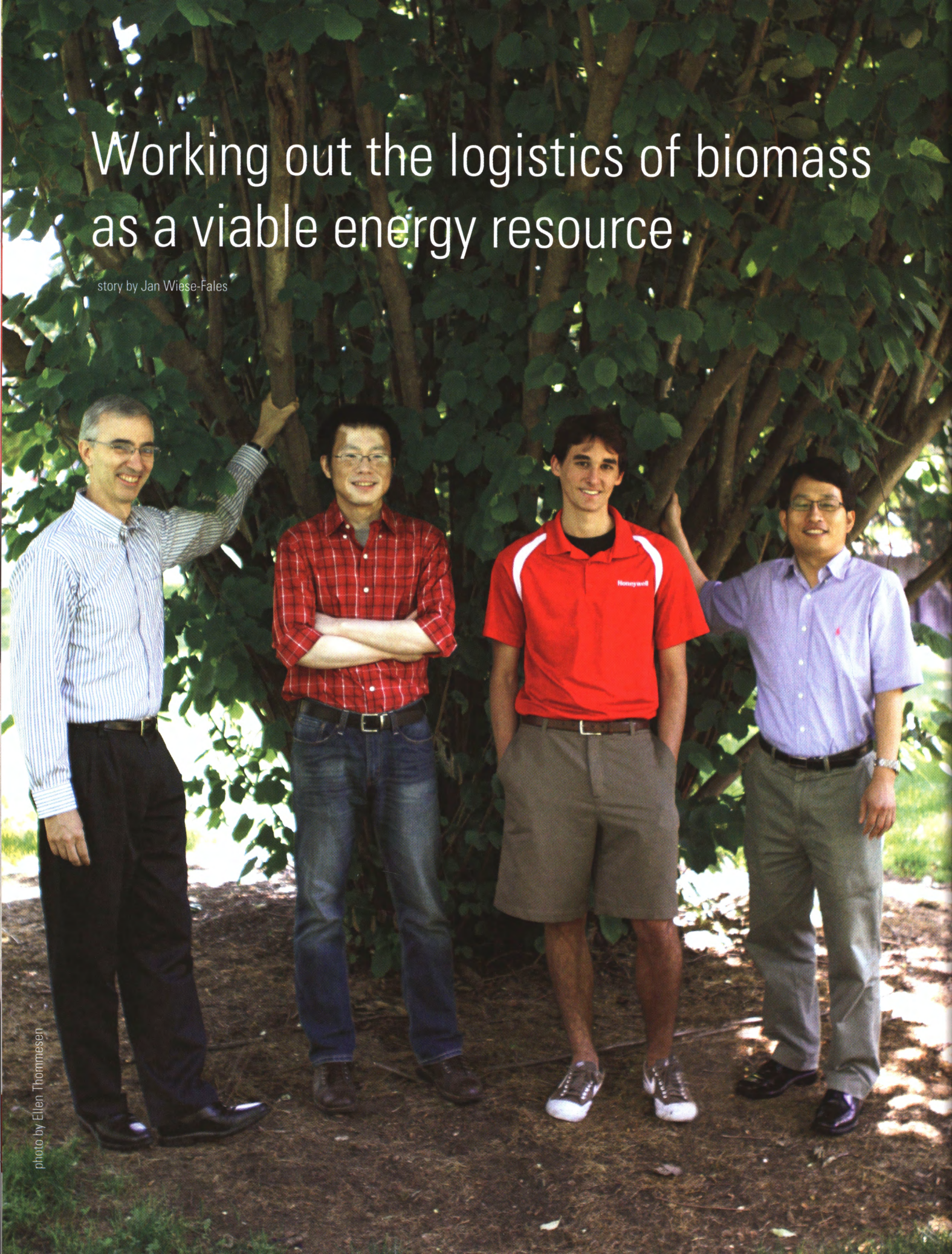


photo by Ellen Thommesen

Biomass is one obvious answer to the question of how this country will address its needs for renewable, sustainable energy resources. But logistical questions and related financial considerations surrounding the initiation and operation of biomass supply and energy output facilities — location, production, harvest, storage and transport, to name a few — are less obvious. University of Missouri industrial engineering Professor Wooseung Jang's current research project will map out a dynamic simulation model of biomass-based energy with widespread adaptability, using Missouri as a prototype.

The computer-based model will pinpoint strategic locations for processing facilities and even potential sites for biomass power plants, taking a complex number of variables into account based on the flow and interplay among four areas of concentration: harvest, processing, storage and power plant destinations.

"Many logistics models are static, but this one is much more dynamic," Jang said of the multi-stage biomass supply chain and logistics framework he is working to develop. "It's much more complicated. There are strategic, long-term decisions to consider, and there are day-to-day operating, more tactical decisions."

Jang received funding for the project from the National Science Foundation (NSF) through the Center for Excellence in Logistics and Distribution (CELDi), an NSF-funded industry and university cooperative research project (I/URCR). The applied research consortium, in which Mizzou Engineering is a one of eight research universities, also includes 30 member organizations. Mizzou Engineering's biomass proposal was selected for funding in an open competition among all I/UCRCs. The intent of the project is to position CELDi as a leading enabler of biomass.

The logistical process

"We started by listing all of the factors we were interested in considering, the data we would need to collect and how we would want to model it," said Jang.

Highway access, elevation, proximity to waterways and urban areas, and distances between processing plants and biofuel power plants are all weighed.

"The biomass must be dense, and it must be affordable to ship," said Professor Cerry Klein, one of two colleagues from the Department of Industrial and Manufacturing Systems Engineering (IMSE) who is collaborating with Jang. He said technologies are being developed that will compact the biomass, making it more economical to ship, and that the group is working on how to make logistics decisions about this part of the process as it is difficult to accurately predict.

"We are trying to predict some of the futurist technologies," Klein said.

"The cost and yield are dependent on weather and political issues, including the cost of oil," said Jang. "Those also are difficult to predict accurately."

Government subsidies are an additional variable that make this project different than traditional models with fixed rules and policies. A Biomass Crop Assistance Program was created as part of the 2008 Farm Bill, in part to address "the chicken or the egg" aspect of a commercial biomass industry. Farmers will not grow biomass if there's no demand, but without a guaranteed biomass source, energy facilities are hesitant about converting or building.

Missouri is an interesting test case as 14 million acres of the state are forested — the seventh most-forested state in the nation — and major river corridors and railroads transverse the state. Additionally, the project is working to identify underutilized farmland where biomass crops such as miscanthus and switchgrass can be planted.

"Missouri has demand points [for biofuels] where marginal land can be utilized just to produce biomass," said IMSE professor Jim Noble, who serves as the MU College of Engineering's CELDi site director.

"We are using two databases, one from the federal government and one from Missouri. With the Missouri spatial data map, we can see the state's forest coverage," said Kurt Ehlers, an IMSE junior working on the project. "We've combined the two to make a map of every county in Missouri."

"We formulate coverage into cells and a percentage of coverage is assigned an amount of available biomass," said IMSE doctoral student Zhongwei Yu, who is spearheading modeling efforts.

Yu said he used ArcGIS, a geographic information system, to store, analyze and display the forest database. Matlab was used to analyze and transform numeric data and he is using Lingo, optimization-modeling software, to solve the

Industrial engineering Professor Wooseung Jang, at far right, and members of his research team are working on a dynamic logistics simulation model of biomass-based energy using Missouri as a prototype. Left to right, Jim Noble, professor of industrial and manufacturing systems engineering, IMSE doctoral student Zhongwei Yu and IMSE undergraduate Kurt Ehlers.

mathematical model.

In addition to biomass availability, Yu said there are a number of further considerations that rank each area's viability. Highway access, elevation, proximity to waterways and urban areas, and distances between processing plants and biofuel power plants are all weighed. "Routing is a big issue," he added.

The research group has an interesting opportunity with a "demand point" right in its backyard. The University of Missouri's power plant currently blends up to 10 percent of woody biomass in its stoker boilers, and is replacing one of the plant's solid fuel-fired boilers with a biomass boiler. Each year, the new boiler will use more than 100,000 tons of biomass, reducing the university's fossil fuel use by 25 percent.

"We're beginning commissioning of the various systems with the new boiler this summer and expect it to be operational this fall," said Karlan Seville, MU's campus facilities spokesperson. "We're really excited about providing MU with sustainable energy and working with campus researchers in the development of biofuel resources."

Because of MU's biofuel initiative, Jang's research team has used the university plant in the model, along with additional potential biomass power plants in Ava, Mo., and Salem, Mo. Both are in the southern part of the state where there is the highest concentration of woody biomass.

"The model will show where the MU power plant could go to buy biomass at the lowest cost," said Klein.

Missouri's woody biomass

"Pretty much any woody residue is considered biomass," said Ehlers. "Waste from forest-harvesting operations, twisted trees, stumps and sawdust from sawmills. Missouri's forests are very overpopulated, and most people don't know it," Ehlers said.

Gene Garrett, a retired MU silviculturist who knows Missouri's forests, has served as a consultant to the research team.

Of the state's 14 million acres of forested land, private landowners own 85 percent, and according to Garrett, only between five and 10 percent of it is managed with practices that would encourage a biomass industry.

"Many of these people are not interested in making a profit from their trees," Garrett said. "For them, it's recreational with hunting and outings. Even if we can make a case for managing their forests, they just want to leave it to nature."

Garrett said Missouri's forests are crowded and unmanaged. Depending on the number of stems [trees] per acre, the forest could be under stress, susceptible to insect infestation and disease. To maximize benefits, forests must be healthy and vigorous, meaning certain trees must be removed.

"Recently, the red oak stem borer has caused us to lose an incredible number of acres of trees," Garrett added, saying that crowding contributes to these types of infestations.

The silviculturist said the very idea of managing Missouri forests and utilizing excess woody biomass for energy is extremely exciting, but educating landowners will be a challenge.

The research group also has spoken to foresters about fast-growing trees such as the poplar that could be planted and managed on biomass farms, just like other fuel crops.

"There are tremendous opportunities in this state — profound possibilities. It would create jobs in places where we need them," Garrett said.

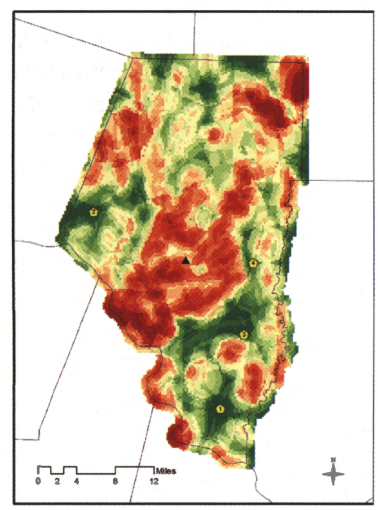
Challenges and payoffs

Jang is hopeful that within five to 10 years, the biomass industry in Missouri might be sustainable, but he said that there are some concerns.

"It may compete with other industries using wood products," he said. "There are plenty of materials to sustain a small number of power plants, but what if there are many? There are some concerns, but we have to begin somewhere, and there are many benefits."

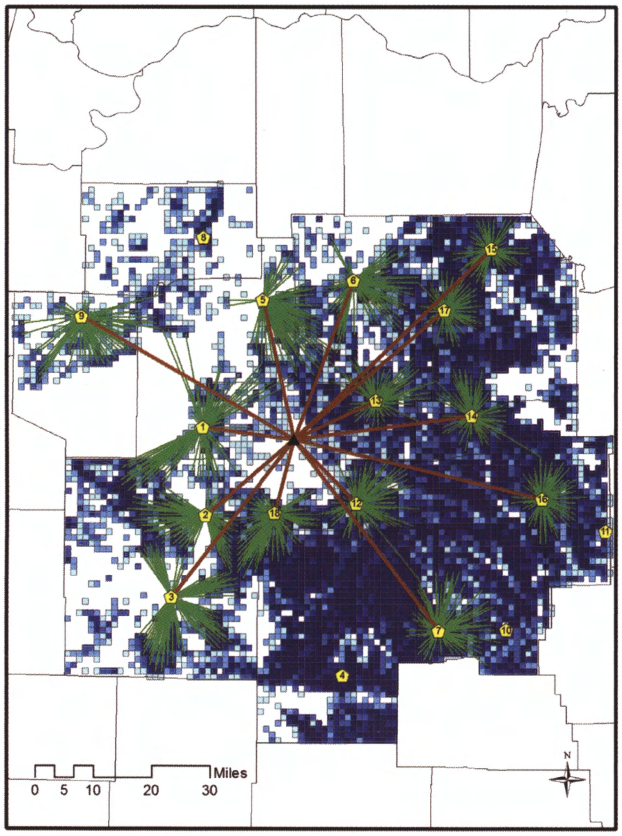
"We see this as having a large rural economic component," said Noble, echoing Garrett's sentiment.

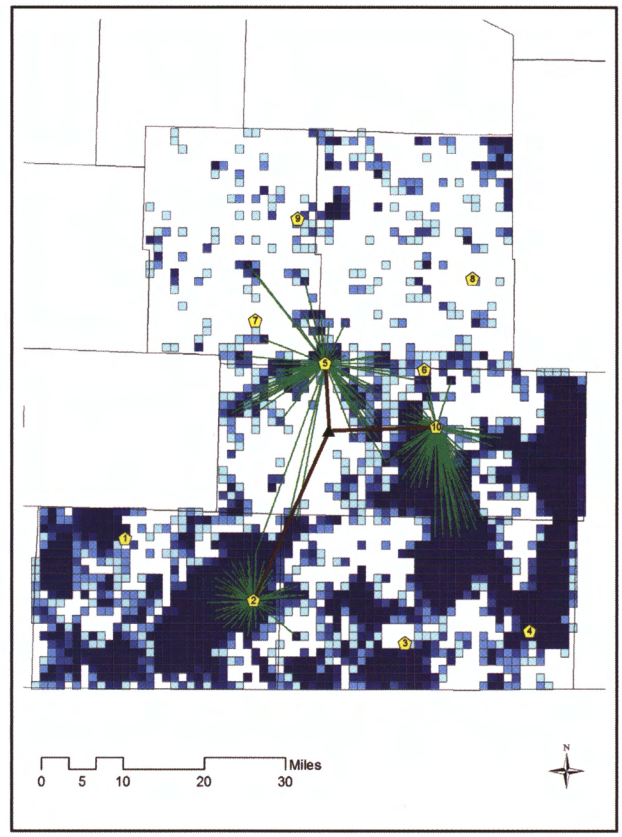
In addition to adding to the country's energy independence, the group notes that using biofuels will reduce carbon emissions, and it will produce cost-effective energy.



Halfway through the project, they expect to have a base model within the two-year period of the grant, one that can be used by nearly any entity to predict the most cost-efficient approach to implement the use of biomass to produce electricity.

"As I've studied this and gotten more into it, I've become more and more interested in the impact this will have in 10 or even 100 years down the road. Many good things may potentially come from our model," Jang said.



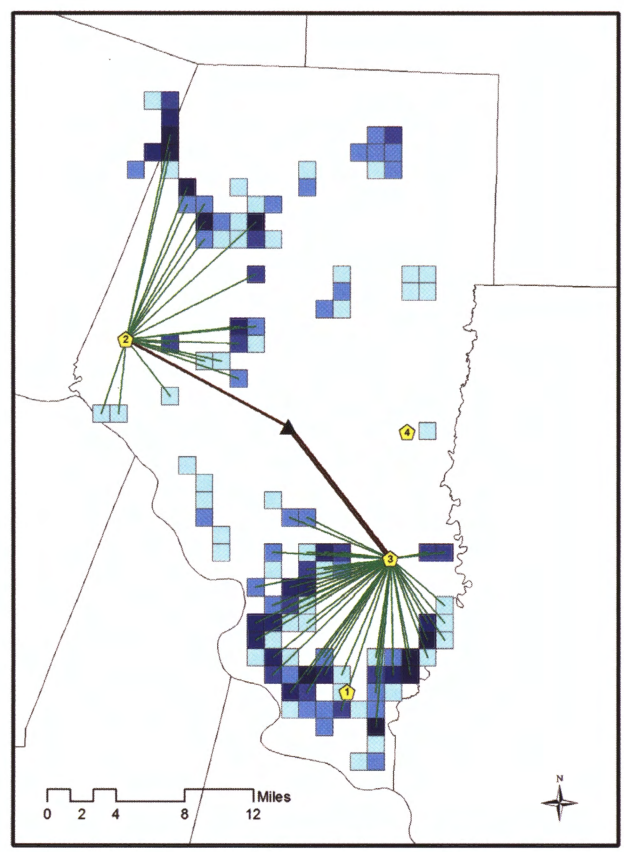


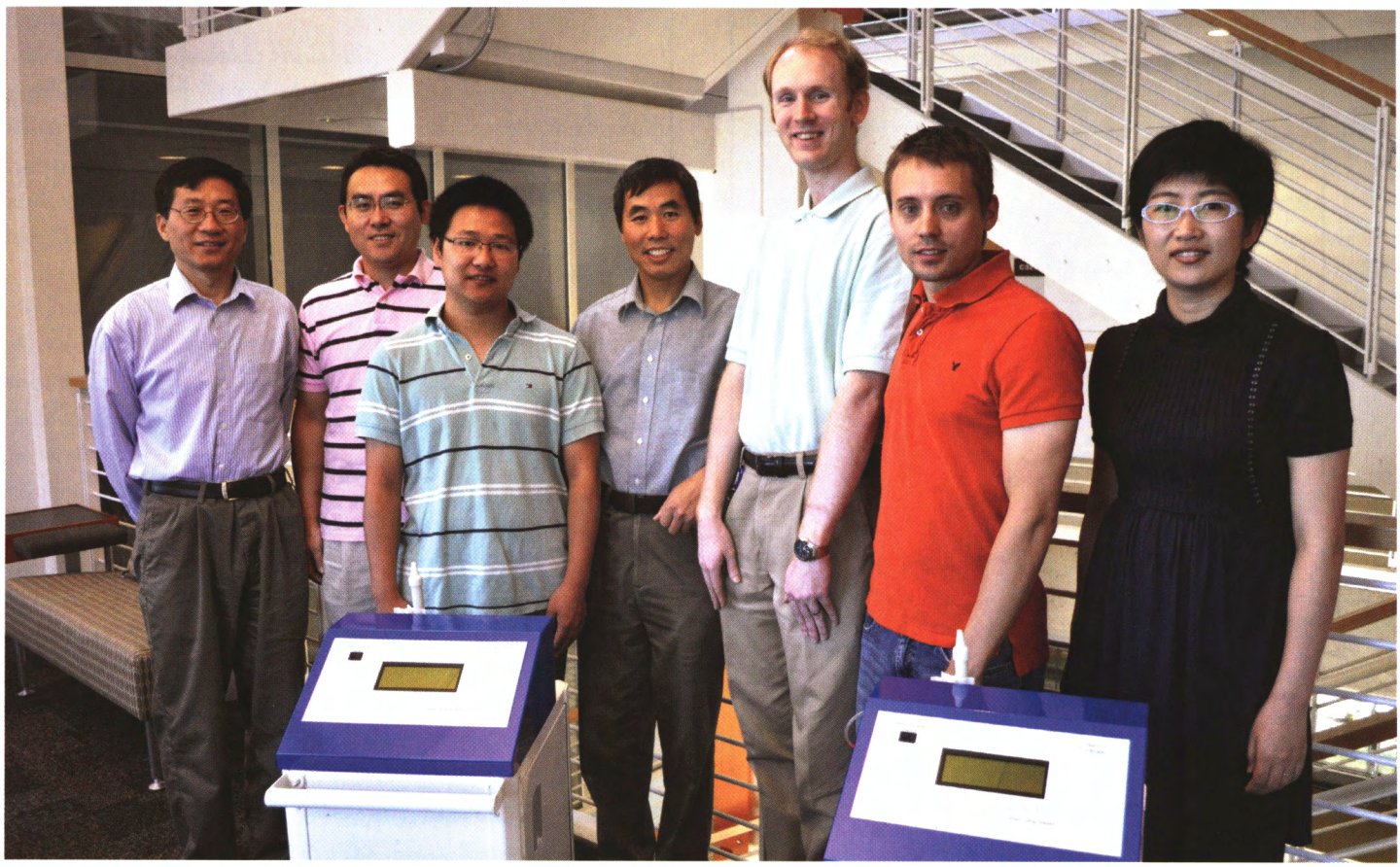
Shown here are maps generated for the National Science Foundation/CELDi-funded biomass logistics project. Blue squares on the three allocation maps on this page are equal to one square mile, with darker blue indicating more biomass. The yellow numbered dots with green "stars" around them show optimal locations for biomass pretreatment facilities with the green area representing routes to transport biomass to them. The black triangles where the brown lines — roads — converge, represent power plants.

The two allocation maps at the top show the areas around the Missouri cities, from left to right, Salem and Ava. These two communities were modeled both for their rich troves of biomass and also because they were spotlighted in the Missouri Forest Products Association's 2010 "Woody Biomass Technology Demonstration Project" report, as towns that "have extreme electricity rate pressures, and are centered with high volume wood processing clusters to better ensure the steady supply of woody biomass to proposed bioenergy facilities at an affordable cost."

At right, is Boone County's allocation map with the University of Missouri's power plant designated by the small black triangle.

The fourth map, to the left, shows suitable locations for pretreatment facilities in Boone County — the more green, the more suitable, with red coloring indicating less suitable sites.





The research team working to bring the plasma dental brush into commercial use includes, left to right, Meng Chen, chief scientist with Nanova, Inc.; Hao Li, associate professor of mechanical engineering; Qing Hong, mechanical engineering doctoral candidate; Qingsong Yu, associate professor of mechanical engineering; Andrew Ritts, senior research scientist with Nanova, Inc.; Adam Blumhagen, mechanical engineering doctoral candidate; and Xiaoqing Dong, postdoctoral fellow.

Better dental bond means fewer trips to the dentist

story and photos by Jennifer Hollis

Clinical trials are expected to begin early this summer on a technology that aims to make visits to the dentist easier and less frequent.

Mechanical engineering Associate Professor Qingsong Yu said the plasma dental "brush" he and Hao Li, also an associate professor of mechanical engineering at the University of Missouri College of Engineering have developed and filed a patent application for should be ready for clinical testing in June. Nanova, Inc., the researchers' small business, has licensed the technology from the university and is working with the University of Tennessee Health Science Center (UTHSC) College of Dentistry in Memphis to produce multiple, portable machines that would transport between dentists' chairs with ease.

The researchers' plasma brush creates a stronger bond between a tooth and the dental composite resin used to fill cavities, resulting in fewer dental visits.

Yu said much of the dental filling process remains the same when using the plasma brush. What's different is an added step that uses the brush to help create a stronger bond between tooth dentin — calcified tissue just below tooth enamel — and the dental adhesive used to bond the dental composite.

"The problem is the adhesive/dentin interface. The adhesive is organic, but the tooth is mainly inorganic, so the interface is very weak and is not compatible with each other" Yu said.

Current dental restoration methods involve tooth preparation, which includes removal of decayed material and enamel that would otherwise be unsupported after removal of decayed dentin. After preparation, adhesive is applied and cured, followed by layers of dental composite.

The plasma brush is used to modify the surface proper-

ties of the dentin, making it more compatible with the dental adhesive. This results in a stronger bond between the dental adhesive and the tooth. Research data has shown that the bond between tooth dentin and dental adhesive after using the plasma brush to modify the chemical properties of the dentin is about 60 percent stronger than a bond created without the plasma brush, Yu said.

"Plasma modifies the surface properties of the dentin," Yu said. "Then we have a better match with the adhesive."

Over time, the adhesive that keeps the composite in the tooth wears down. Yu said the average dental filling, especially those using dental amalgam — metal dental restoration material — lasts up to about 15 or 20 years. Fillings fall out or separate from the tooth after the adhesive is no longer effective. Plasma treatments could lead to less need for dental restoration work on existing fillings — and fewer trips to the dentist.

Yu also stressed that while the portion of the dental restoration procedure utilizing the plasma brush can be minimally invasive, the rest of the procedure is primarily the same.

"We don't change anything the dentist will do," he said. "By adding one step, we hope to get a better interface bonding, and we're hoping it will last longer."

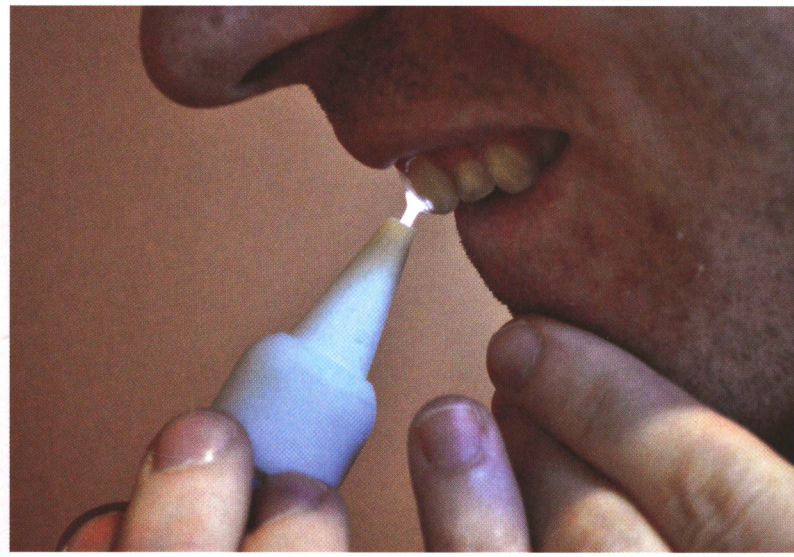
There are no actual bristles on this plasma brush, which uses a "cool flame" that also kills bacteria in the areas it is applied, making it useful for cleaning the affected area during tooth preparation.

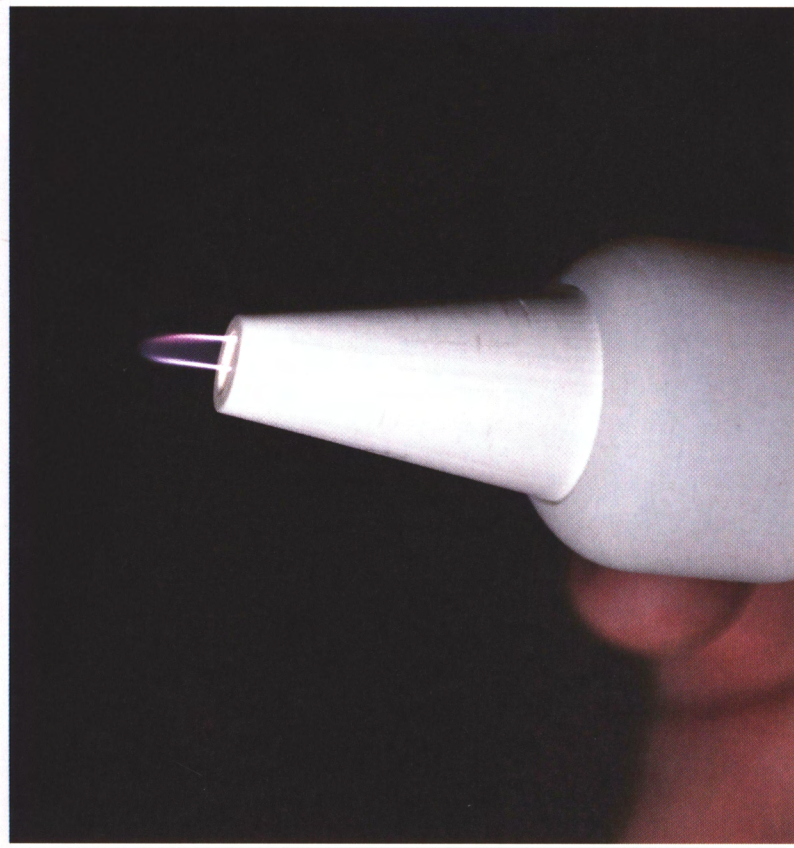
"We've used this technology for material processing," Yu said.

While its use in dentistry is relatively new, the use of plasma technology to create stronger bonds can be found in other industries. It has been used commercially in the automotive industry, Yu said. Some automakers in Europe use plasma to treat bumper moldings prior to applying car paint. The plasma affects the bumper material similarly to the way it affects dentin: it modifies the surface properties allowing a better bond between the molding material and car paint.

Research on the plasma brush began about six years ago with a research grant from the National Science Foundation. Application of the plasma brush to dental research is a collaborative effort from Yu, Li, Meng Chen, chief scientist with Nanova, Inc., Professor Yong Wang, from the University of Missouri-Kansas City School of Dentistry, and Associate Professor Liang Hong, from UTHSC.

Once clinical trials begin, researchers will gain better insight into the effects of the plasma brush on dental restoration. Yu said it is too early to predict how long dental fillings made using the plasma treatment will last, but their durability should be significantly improved.





At top, Andrew Ritts, senior research scientist with Nanova, Inc., demonstrates how non-invasive the plasma "brush" can be. While the dental restoration procedure remains the same, adding a step that includes the plasma brush may help create a stronger bond between teeth and restorative material. Researchers have designed the plasma brush's "cool flame" to be quick and fairly non-invasive.

Above, the plasma's blue flame creates a brush-like appearance only a few millimeters long. Machines that feature multiple functions, such as the output and duration of the plasma flame, are on their way to the University of Tennessee Health Science Center (UTHSC) College of Dentistry in Memphis to begin clinical trials.

Laying the groundwork for agricultural use of groundsource energy

story by Jan Wiese-Fales • photos by Jan Wiese-Fales, Shawn Xu and Chris Holliday

Just a few feet below the surface of the Earth — seasonally baked dry in summer's heat and frozen solid in icy winter months — the soil remains a stable 55 to 65 degrees Fahrenheit, depending on the location. This constant temperature represents an incredible source of environmentally friendly, sustainable energy to heat and cool the buildings where we live and work. Ground source energy is an endlessly renewable resource that is not dependent upon the wind blowing, the sun shining nor the burning of fossil fuels. The U.S. Environmental Protection Agency has rated it one of the most efficient of heating and cooling technologies.

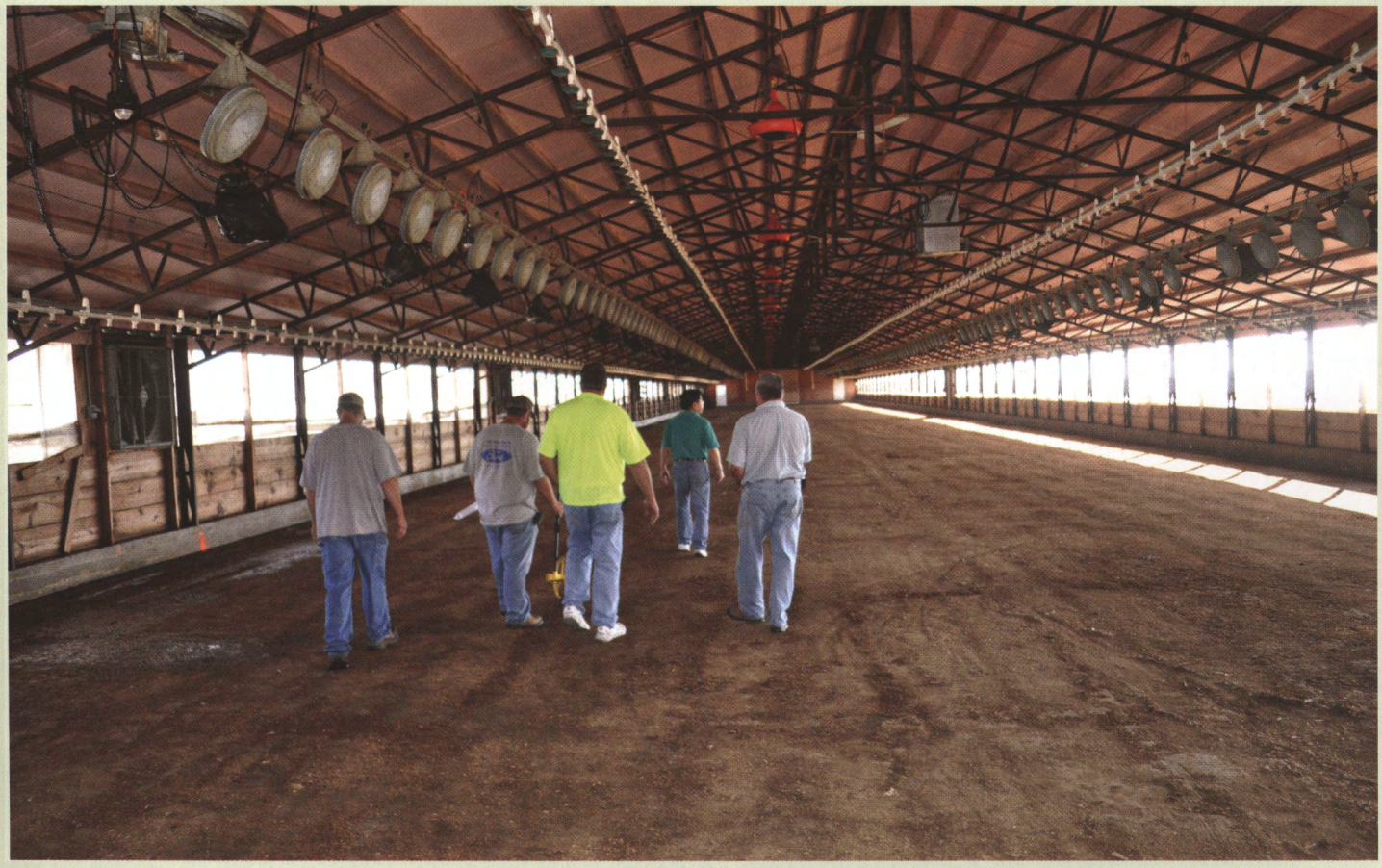
For more than a decade, Shawn Xu, an associate professor with the University of Missouri College of Engineering's Water Resource Center — under the umbrella of civil engineering — has been installing large-scale ground source heat pump systems. His most recent project, partially funded by the U.S. Department of Energy under the American Recovery and Reinvestment Act, is a demonstration project on a large turkey operation in Missouri's Cooper County. Xu and Robert Reed, an associate research professor in civil engineering, are partnering with the farm's owner, Chris Holliday, to equip brooder houses, which have notoriously high heating costs, with ground source heating. Work being shared by the pair could fundamentally change the way the poultry industry operates.

"There are 38 [ground source heat pump] projects nationwide," said Xu. "But I am the only one to propose an agricultural application. I just looked at it from the perspective of who spent the most for propane."

Ground source heating and cooling systems function by circulating water through a continuous loop of pipes buried underground. In winter, the water in the pipes transfers the earth's heat into the building and in summer, the circulating water brings cool air into the building, transferring heat back into the ground.

Traditionally, system installation has been achieved by drilling deep vertical holes into the earth. This intensive excavation increases installation costs, whereas Xu's ground source system design places the pipes horizontally, eliminating the need to drill deep holes, cutting installation costs by up to 30 percent. High initial costs have been the biggest barrier to widespread conversion to ground source systems.

"Horizontal systems are less expensive," said Xu. "These underground loops will provide almost free cooling for the barn and return heat to change the soil temperature for use next winter."



Opposite page, Shawn Xu, associate professor with the College of Engineering's Water Resource Center, looks over plans for a ground source energy system with Chris Holliday, while Scott Keller looks on. Holliday owns and operates a turkey farm and a construction company and is working with Xu to install ground source systems on his turkey farm. The energy system is part of a Department of Energy grant Xu received to introduce the technology into agriculture applications. Above, Xu, Holliday and the construction team walk through the turkey brooder house which is 55 by 355 feet. Holliday spends an average of $50,000 per year to heat his turkey barns.


BALL VALVE

When completed, there will be wetlands covering the ground above the construction, which will help with runoff from the large buildings, and will also serve as insulation to keep heat in the ground during the winter.

Holiday said energy costs to raise turkeys are outrageous explaining that, as poults, turkeys require the brooder house to be at a temperature of 90 degrees. "And adult turkeys like a constant temperature of 70 degrees," Holliday said. "They feel good at that temperature and will eat better."

Holliday said he raises four broods each year, spending an average of $50,000 annually on propane. "I can burn 3,000 gallons in one week," he added.

Because he contracts with Cargill to raise turkeys — which splits the cost of propane with him — the company is keeping a close eye on the project, weighing its potential for the entire industry. Xu predicts energy costs will be reduced by 50 to 70 percent.

Holliday, who owns and operates a construction company, was able to do the installation of the system. "I didn't have to bear the burden of the entire construction myself, and that really made it worthwhile," he said.

Both Xu and Holliday are hopeful that the project will serve as a model that will provide future geothermal construction projects for them and others.

As this story is published, heat pumps for the first brooder house are installed and are undergoing testing. Work soon will begin on Holliday's second brooder house, which will use solar-assisted heat pumps. Plans are to install cooling systems for the farm's two additional barns where adolescent turkeys are raised to adulthood.

"I'd really like this to work," Holliday said. "No farmer is going to step out like I did, but after they see this work, they'll all want to do it."

Opposite page at top, Shawn Xu, Chris Holliday and Kirby McKenzie look on as Scott Keller does some exploratory digging to see what the team will encounter when they excavate to lay horizontal heat pipes. Opposite page at bottom left, Xu examines the housings Holliday has constructed to shelter the five industrial pumps, shown, freshly unpacked, at bottom right.

At left, excavation and the initial placing of the pipes. At top above, pipes in the configuration in which they will be buried six feet beneath the ground. Above, testing is conducted during installation to pressurize the pipes a couple of times. The gauges are removed when the pipes are buried. Xu said no metal is left beneath the ground.

Class Notes

Share your news with fellow alumni. Use the form on the inside back cover and mail it to the address on the form.

1960s

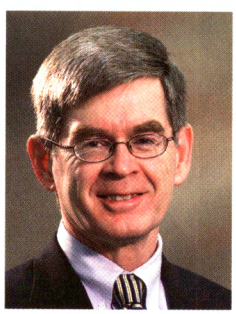
Lewis Walker, BS EE '67, MS '68, Ph.D. '70, of Plymouth, Mich., was awarded the annual Gold Award by the Affiliate Council of the Engineering Society of Detroit. Walker is the current president of Lawrence Technological University, located in Southfield, Mich., a suburb of Detroit. The Detroit chapters of the American Institute of Architects and the Institute of Electrical and Electronics Engineers nominated Walker. He has served in his current position since 2006. Walker joined the university in 1994 and will step down as president on June 30.

William Thompson, Jr., BS CiE '68, of Irvine, Calif., was one of six honorees recognized at the 17th Annual Director of the Year Awards and dinner in March. Thompson and his wife founded the University of Missouri Thompson Center for Autism and Neurodevelopmental Disorders. He was honored in the category of Corporate Leadership and Service. Thompson is the retired managing director, co-chief executive officer and member of the board of PIMCO. He also serves on the boards of Citigroup, Inc., and Pacific Life Insurance Company. He earned his Master of Business Administration from Harvard University in 1970, and received an honorary doctorate from MU in 2005.

1970s

Larry Frevert, BS CiE '70, of Kansas City, was recently designated a Public Works Leadership Fellow (PWLF) by the American Public Works Association (APWA). In this role, Frevert will serve as a mentor to public works professionals enrolled in the APWA Donald C. Stone Center for Leadership Excellence throughout 2012. He is among 96 public works professionals recently inducted as a fellow. Frevert is the vice president of HDR Engineering.

Stephen W. Searcy, BS AGR '74, BS AGE '76, MS '76, of College Station, Texas, was named the head of the biological and agricultural engineering department in the College of Agriculture and Life Science at Texas A&M University. Searcy served as the interim department head since September 2010; prior to that time, he was the associate department head. Searcy has been on the Texas A&M faculty since 1980. He earned his doctorate in agricultural engineering from Oklahoma State University.



John T. Lindsay, BS ChE '75, MS '78, Ph.D. '83, of Pinckney, Mich., was recently named a member with Stanford Who's Who, a social and networking organization that connects professionals and executives from all industries. Lindsay, who serves as president and CEO of Guardian Food Services, LLC, was recognized for his efforts in the food production industry. Lindsay also has served as the president and vice-president of the International Society of Neutron Radiographers (ISNR).

Class Notes continued on page 28

Generous gift establishes mechanical engineering scholarship

"When I think back, starting here and ending up where I did, I never in my wildest dreams considered I would be able to attend college," said University of Missouri alumnus Charles Buehler.

The 1946 mechanical engineering graduate said it was his mother, Bertha, who ensured that he and his brothers, Raymond and Harold, were the "first Buehlers that ever set foot in a college."

"It's something I'm very proud of," he said. "She was in nursing school but had to come home to take care of her mother, halting her education. She was a great inspiration." His father, a machinist at the Crystal City, Mo., glass factory, also was a source of encouragement

Following family tradition, Buehler became a machinist apprentice in 1935 and worked two years learning the trade. But in 1937, he decided to pursue his dream of becoming an engineer and headed to Mizzou.

Hoping to make a difference in the lives of other aspiring engineers, Buehler recently made a $100,000 gift to the College of Engineering to fund scholarships in mechanical engineering, with students from his Missouri home area high schools, Festus and Crystal City, receiving priority consideration.

When he started at MU, Buehler was living in a university-sanctioned boarding house, which charged $1 per day room and board. He worked his way through

college, putting his pre-college training to good use building lab equipment under the watchful eye of Professor Ralph Scorah, mechanical engineering faculty member and department chair from 1944 to 1958.

As a student in the years leading up to World War II, Buehler said he and his classmates saw things heating up politically and talked about it among themselves.

"We all knew something was going to happen. We asked ourselves, 'Are we going to sleep in the mud or on a cot?' and joined ROTC," Buehler said.

"I went home for Christmas vacation in 1941, knowing that I would receive orders any day and got the telegram calling me to active duty. Mom was very upset," he added.

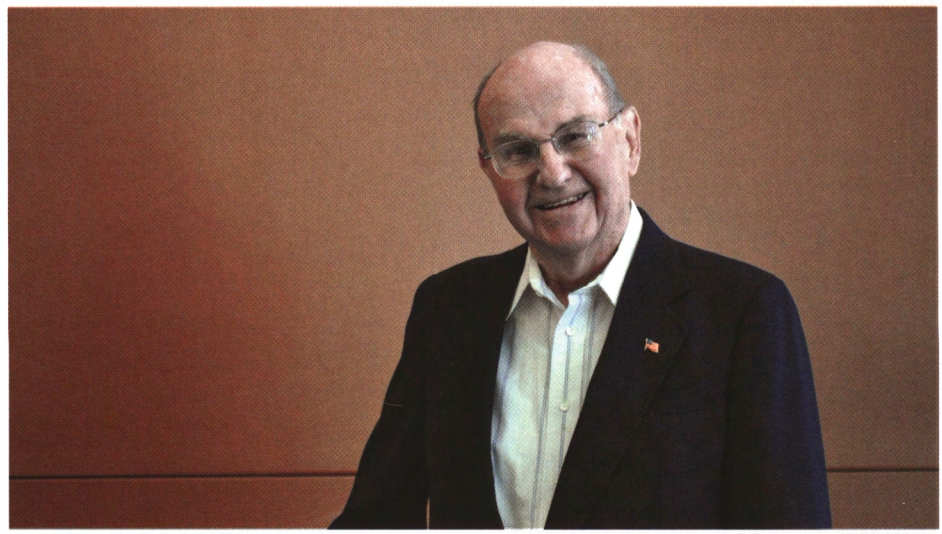
But his orders were not what he expected. Within seven days, he reported to Harvard University for 10 weeks of accelerated training on "a new thing called radar." From there he went to MIT for three months of advanced training and then on to Drew Field for five months to complete his training.

While training at Harvard, he married Georgana Page, the college sweetheart he met on a blind date to a Sadie Hawkins dance held at MU.

"She was quite a gal. I thought, 'Oh hell, she's popular and I'm not,' but it worked out," Buehler said of their first meeting. "She was a very pretty, blue-eyed Irish girl."

By New Year's Eve, Buehler and his men were on a troop ship in San Francisco Bay, waiting for the escort ships to take them to the South Pacific where he then spent two months training. As a radar officer, he was the commander of a platoon of 35 men on remote islands tracking enemy movements of aircraft and ships — friends and foes.

Once discharged, it took Buehler only three months to complete his degree at MU.



Charles Buehler, BS ME '46, established the Charles A. Buehler Memorial Scholarship Fund in Mechanical Engineering with a gift of $100,000.

"When I graduated in 1946, I had four good jobs waiting for me," he said. "I was able to pick and choose and went with Western Electric for five years."

The bulk of Buehler's career was with Monsanto, where he worked first as a plant engineer in a variety of situations, and then got into equipment design work. He then went to corporate headquarters in Creve Coeur.

Buehler served on national committees for American Society for Mechanical Engineering, American Petroleum Institute, Safety Design and Equipment. He retired in 1981 after working nearly 30 years for the company.

At 94, Buehler has started to take things at a slower pace. Georgana died in 1990, and his second wife, Jean, passed away in 2008. Buehler moved to Friendship Village in Chesterfield, Mo., in 2009. His driver's license expires on his birthday, and he plans to give his car to his granddaughter.

He said it was his attendance at the Mizzou Alumni Association's Gold Medal Reunion honoring the 50th anniversary of his graduation that started him thinking more about doing something for Mizzou.

"I was so impressed with all of the equipment and how much was going on. I don't see how students can work and go to school," he added. "There's so much more that's being done today."

Buehler began making annual donations of $1,000 to the Scorah scholarship in honor of his mentor, and to the Mechanical Engineering Department.

"I got to thinking about it, and decided I could do better than that. I know what it costs these days and it blows my mind," he said. "I talked to my daughters, Jan and Amy; I could afford it and they were 100 percent behind me. I thought, 'Oh heck fire. I'm going to do it.'"

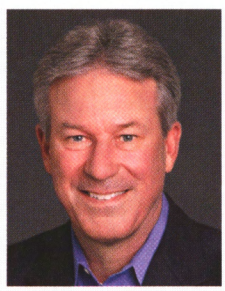
Buehler surprised a student who called him on behalf of the Mizzou Annual Fund by saying that instead of his $1,000 pledge, he'd like to make a $100,000 gift.

The Charles A. Buehler Scholarship Fund in Mechanical Engineering was established in April 2012.

"If it will make a difference for somebody to attend college — if I can make that difference — it's worth it to me," Buehler said.

Loyd Wright, BS EE '76, MS '77, of Encinitas, Calif., gave a presentation titled "Reliable Power for America: Challenges and Future Plans for Nuclear Power," at the University of Texas San Antonio for the Texas Sustainable Energy Research Institute. Wright is the manager of the San Onofre Nuclear Generating Station in Southern California. A 34-year veteran of the energy industry, he is an active member of the American Nuclear Society (ANS) and also has served on the national board of directors as the national treasurer and chair of the Operations and Power Division.

John Pullen, BS ME '78, of Austin, Texas, opened CMIT Solutions of West Austin, a branch of CMIT Solutions, an Austin-based, information technology support company that offers computer consulting, professional and product services to small business owners across the U.S. Since graduating from MU, Pullen has worked for other IT companies, including IBM and Houston-based BMC Software.



1980s

Joseph E. Payne, BS EE '83, of Bremerton, Wash., joined Seattle-based naval architecture and marine engineering firm Guido Perla & Associates, Inc. as the electrical department manager and chief electrical engineer. Payne is responsible for the design and integration of all the main and emergency power, lighting, HVAC controls, hazardous area classification, interior communications and alarm systems. He is a former U.S. Navy nuclear submarine officer, a graduate of the Naval War College and a retired engineering duty officer.

Andrew J. Rapoff, BS ME '83, of Niskauuna, N.Y., was recently named the director of engineering at Union College in Schenectady, N.Y. Rapoff is also an associate professor in the Department of Mechanical Engineering, where he teaches courses in mechanics, design and biomechanics. His research areas are in physical anthropology, orthopedic biomechanics and biomimetics.

Jesse Sherwood, MS EE '85, of Stilwell, Kan., earned his doctorate in electrical engineering and is now an instructor in the Department of Computer Science and Electrical Engineering at the University of Missouri-Kansas City. He has owned Executive Helicopter Solutions, in Olathe, Kan., since 2003 and is on the board of directors of the Missouri Society of Professional Engineers Western Chapter, a member of the Kansas Society of Professional Engineers and a senior member of the Institute of Electrical and Electronics Engineers.

Capt. Brian C. "Nick" Nickerson, BS EE '86, U.S. Navy, completed a deployment as the commander of Destroyer Squadron 40 (CDS 40, DESRON 40). Nickerson spent the last 19 months in this position, supporting and leading the mission of DESRON 40 with forward, sea-based command and control. In addition to his bachelor's degree, Nickerson also holds a Master of Science in telecommunications systems management from the Naval Post Graduate School.

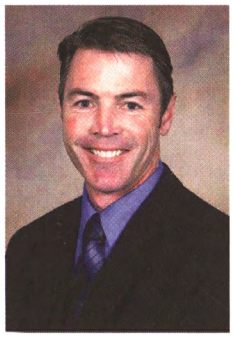
Michael Pishko, BS ChE '86, MS '87, of College Station, Texas, joined the Department of Biomedical Engineering in January as professor and holder of the Stewart & Stevenson Professorship II at Texas A&M University. He previously served as department head and Charles D. Holland Professor in the Department of Chemical Engineering at Texas A&M. He has authored more than 100 peer-reviewed publications and proceedings and is a co-inventor of more than 22 U.S. patents. He received his doctorate in chemical engineering from the University of Texas at Austin.

James Edwards, BS ME '89, of Eldon, Mo., won a seat on the School of the Osage Board of Education, located in the Lake of the Ozarks, in the April 3 election. Edwards, who graduated from the School of the Osage school district in 1984, had previously served on the board, and was one of three candidates vying for two non-incumbent seats. He has been employed by the Missouri Department of Corrections since 1992, and is currently the general services manager for the department.

1990s

Jody L. Carlson, BS CiE '92, of St. Joseph, Mo., has been named the new director of public works and transportation for the city of St. Joseph. He received this appointment in November 2011. As public works director, Carlson will oversee

administration of aviation, engineering, landfill, street and sewer maintenance repair, water protection and transit divisions. With nearly 20 years of experience in the public sector, he previously worked for the Missouri Department of Transportation, overseeing operations in northwest Missouri.



Brad Scrivner, BS EE '92, of Tulsa, Okla., was named the president and CEO of Valley National Bank in March. He earned a Master of Business Administration from William Wood University in 1998. He previously worked for UMB's Tulsa Market, Merrill Lunch and Xerox Corp.

Rick Kaufmann, BS CiE '94, of Columbia, Mo., at right, and **Wes Bolton, BS CiE '02, MS '07,** of Mexico, Mo., at left, accepted the 2010 Project of the Year award from the St. Louis section of the American Society of Civil Engineers. The award was given for the City of Columbia's Vandiver Drive Extension Project. Kaufmann works with the City of Columbia Public Works. Bolton works with Allstate Consultants LLC.

Class Notes continued on page 30

College of Engineering Alumni Events

Curt, BS EE '66 and Bobi Benton hosted an engineering alumni event in Florida on Feb. 21, at which they presented Dean Jim Thompson with a print of Bart Larson's "Tiger on the Quad."

Vaughn and Barbara Yost hosted an alumni dinner on May 5, at Grille 29 in Huntsville, Ala. Dean Jim Thompson and Steve Nagel presented on behalf of the College. Those attending included, back row, l. to r., Linda Pond, Christine Ernst, **Charles Ernst, BS ME '69,** Arlene Merry, **Steve Merry, BS MAE '78,** Barbara Yost, Jim Thompson, Elizabeth Thompson, **Tom Schwaller, BS CiE '67,** Delores Schwaller, **John Ingwersen, BS EE '64,** Lynn Ingwersen, **William Savoie, BS EE '77,** Joanne Savoie and Steve Nagel. Front row, l. to r., **John Pond, BS ME '65, MS ME' 66, James Carter, BS IE '84,** Shawn Poore and **Vaughn Yost, BS ME '59.**

Stay in touch! If you receive this magazine, but not the MU College of Engineering's e-newsletter — published August through May — email us at umcengrdev@missouri.edu to update your email.

MUEAO President Tom Childress congratulates Susan (Hogan) Pasternack, the 2012 recipient of the alumni organization's Citation of Merit Award.

Pasternack awarded Citation of Merit

Susan (Hogan) Pasternack, BS EE '70, was the 2012 recipient of the MU Engineering Alumni Organization's (MUEAO) Citation of Merit Award. She was honored at a banquet on Sat., March 17, during the College of Engineering's E-Week celebrations.

After earning an engineering degree from the University of Missouri, Pasternack pursued a career working in the areas of engineering program management, business profit and loss management, business development and strategic planning. She began working with soldier systems — wearable computing systems that provide real-time, day-night situational awareness and communications — with General Dynamics C4 Systems in 1995. She led business development efforts that resulted in the successful deployment of Land Warrior systems into Iraq combat in 2007, with subsequent system deployments for troops in Afghanistan. She retired in 2009 after more than 32 years with the company. She currently is principal and consultant for Warrior Innovation, representing technology companies with potential markets in the area of defense business.

In remarks following the presentation of the MUEAO annual award, Pasternack said that engineers have a great opportunity to make positive changes by getting involved in organizations such as the MUEAO, and encouraging others to do so.

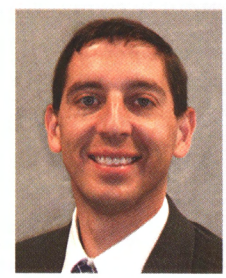
"We can be force multipliers, a Department of Defense term that describes something that gives an advantage beyond numbers," Pasternack said. "We can encourage students, family and friends that engineering is a great degree and that there are so many ways to use it."

Pasternack is the daughter of Joseph C. Hogan, who served as dean of the MU College of Engineering from 1962 to 1967, and is the first woman to receive the alumni organization's award. She is a member of the Dean's Engineering Advisory Council (DEAC) and also serves as secretary for the board of directors of the University of Missouri College of Engineering Foundation.

She and husband, Greg, live in Gilbert, Ariz. They have two children and six grandchildren.

Joseph Langle, BS ME '95, of Kansas City, Mo., was named one of Ingram Magazine's 40 Under Forty honorees. Langle, 38, leads the Engineering Section of MRIGlobal's Kansas City headquarters. His staff includes employees from multiple disciplines of engineering, including civil, chemical, electrical, mechanical and computer engineering. He also received a master's degree from the University of Texas at San Antonio.

Kevin James, BS CiE '96, of Kirksville, Mo., was appointed assistant district engineer for the Northeast District of the Missouri Department of Transportation (MoDOT). He will assist the district engineer, providing leadership and management expertise in MoDOT's operations in the district and the 17 counties it encompasses. He has been with MoDOT for the last 15 years.



Joshua D. Summers, BS ME '96, MS '98, of Clemson, S.C., received the 2012 Clemson University Governor's Award for Excellence in scientific awareness from the South Carolina governor's office and the South Carolina Academy of Science. Summers, an associate professor of mechanical engineering at Clemson, received his bachelor's and master's degrees from MU Engineering and his doctorate from Arizona State University in 2004. Summers' award recognizes his efforts to bring science and engineering learning opportunities to the community.

Brian Faros, BS EE '97, BS CS '97, of Leawood, Kan., was promoted to vice president in the Technology Solutions Delivery Division of the Federal Reserve Bank of Kansas City. In this capacity, he will be responsible for payments-related development initiatives. Faros joined the company in 2009 as a technology manager. He was appointed to assistant vice president in 2010.

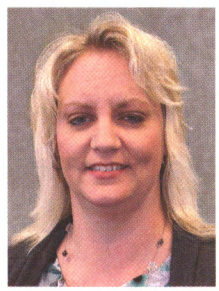
Sherri McIntyre, MS '97, of Kansas City, Mo., was appointed as the director of the Kansas City Public Works Department effective Jan. 1. She had served as the interim public works director since August 2011. She will continue fulfilling the duties of the assistant city manager for infrastructure. McIntyre earned her bachelor's degree in civil engineering from the University of Iowa. She has been a registered professional engineer in Missouri since 1991.

David White, BS CiE '97, of Boone, Iowa, received a medallion commemorating the namesake of his professorship at Iowa State University. White holds the Richard L. Handy Professorship, which was created by former students of Handy, an emeritus professor of the university. White teaches civil engineering at Iowa State, where he received his master's degree and doctorate.

Use the form on the inside back cover to share your news with alumni and friends, or email Editor Jan Wiese-Fales at wiesefalesj@missouri.edu.

2000s

Amy Crawford, BS CiE '00, of La Plata, Mo., was named as the new area engineer for the Northeast District of the Missouri Department of Transportation (MoDOT). In this capacity, she will serve six counties in northeast Missouri as part of an extension office to the district headquarters in Hannibal, Mo. She will also work directly with the Northeast Missouri Regional Planning Commission, MoDOT's planning partner. Crawford has worked for MoDOT for 11 years, previously as a traffic studies specialist.



Anthony DeJohn, BS EE '03, of Alexandria, Va., was appointed director of managed review services at LDiscovery, LLC, an international leader in "end-to-end" E-Discovery solutions. In this position, DeJohn will oversee the company's document review solutions. He received his juris doctorate from DePaul University College of Law. He previously worked as the director of options and vice president of Intellectual Property of an international legal process outsourcer.

Brett Huhman, BS EE '03, MS EE '06, of Derwood, Md., received the U.S. Naval Research Laboratory Award of Merit for Group Achievement for his contributions leading up to the 1,000th shot of the NRL Electromagnetic Railgun Facility. The 25-member group received the award, which was established in 1996 to promote the spirit of teamwork among employees by recognizing group efforts that result in a contribution comparable to one for which individuals would receive a Meritorious Civilian Service Award.

R. Cody Stringer, BS BE '06, MS '07, Ph.D. '10, at left, of Columbia, and **Craig Weilbaecher, BS BE '05, Ph.D. '10,** at right, of St. Charles, Mo., accepted an award on behalf of their company, Emergent Sensor Technologies LLC at the 2012 Stars of Innovation and Entrepreneurship banquet in Jefferson City in January. The Missouri Small Business and Technology Development Centers recognized their company for its contribution to the state's economy through creating jobs and tax revenue.

Anthony J. Gambaro, BS CiE '07, of Florissant, Mo., was named the 2011 Construction Volunteer of the year by the St. Charles Chapter of Habitat for Humanity. Gambaro is a construction inspector for the Missouri Department of Transportation.

Deaths

1940s

Charles L. Shackelford, MS EE '42, of Pennsburg, Pa., died Feb. 6, 2012. He was born Oct. 19, 1918. He earned his bachelor's degree in electrical engineering from Oklahoma A&M, now Oklahoma State University, in 1941. He retired in 1994 as a senior engineer from ITT Electron Tube Division after a 25-year career with the company. He is survived by his son, Charles Jr.

Class Notes continued on page 32

Charles William Morris, BS ME '49, MS ME '62, of Jefferson City, died Feb. 10, 2012. He was born Oct. 2, 1919, in Clifton Hill, Mo. Charles was drafted into the U.S. Army Infantry in May 1941. During World War II, he flew the CBI HUMP in the China-Burma-India theatre. After the war, he attended MU and followed graduation with a move to Jefferson City where he became a material and research engineer for the Missouri Department of Transportation from 1949-1951. He was called back to active military service and served in the Korean Conflict, and retired from the Air Force Reserves as a Lieutenant Colonel. He taught at MU while earning his master's degree in mechanical engineering. He worked for the Missouri Division of Health from 1963 to 1967 and the Public Service Commission from 1967 to his retirement in 1977. He is survived by his wife, Martha, five children, 14 grandchildren and 16 great-grandchildren.

G. Franklin Rothwell IV, BS ME '49, of Naples, Fla., died Dec. 25, 2011. He was born March 30, 1928, in Moberly. After graduating from MU, Rothwell earned his juris doctorate from George Washington University in 1956. Between MU and law school, he served in the Army Corps of Engineers during the Korean Conflict. Rothwell founded two IP specialty firms: a Washington D.C.-based firm known today as Sughrue Mion PLLC and Washington's Rothwell Figg Ernst and Manbeck PC, which he served as a partner for since its establishment in 1981. He is survived by his wife, two sons, one daughter and four grandchildren.

1950s

Jerry Epple Jr., BS CiE '50, of Kansas City, died May 1, 2012. He was born Dec. 25, 1926, in Fayette and moved to Columbia in 1927. After graduating from MU in 1950, he worked in his family's business, John A. Epple Construction Co., with his father and brother. They built several well-known buildings in mid-Missouri, including Boone Hospital Center and Missouri United Methodist Church, and on the MU campus, including the south wing of Memorial Union, and the renovations of Jesse Hall and University Hospital. He was a U.S. Army veteran, serving during World War II and a member of several civic organizations. He is survived by his wife, Jeanne, four children and eight grandchildren.

John L. Evans, BS ME '51, of Kansas City, died Oct. 31, 2009. He was born April 9, 1928.

Ted Albrecht, BS CiE '52, of San Ramon, Calif., died Feb. 12, 2012. He was born March 24, 1929 and was a U.S. Army veteran, serving in the Korean Conflict.

Ned Hendrix, BS EE '54, BS BA '50, of St. Louis, died March 8, 2012. He was born Sept. 24, 1924. In addition to his two degrees in business and electrical engineering, Ned was a World War II and Korean Conflict veteran, earning a purple heart and bronze star for the former. He worked for Emerson Electric and spent more than 30 years with McDonnell Douglas. He is survived by his wife, Joyce, three children and five grandchildren.

Alvin M. Frager, BS EE '56, of Leesberg, Va., died Sept. 3, 2011. He was born Sept. 11, 1933 and is survived by his wife, Sandra.

Charles Hooper, BS ChE '57, of Clarinda, Iowa, died March 2. He was born Sept. 26, 1935, in Maitland, Mo., and grew up in the Maryville, Mo., area. He earned his master's degree from New Mexico Highlands University. He taught chemistry, science and math at Iowa Western Community College in Clarinda for several years, later working as a chemist for Nature's Plant Food, Inc., and then the Occupational Safety and Health Administration for 23 years. He is survived by four sons.

John "Jack" Madden Jr., BS ChE '59, of Owasso, Okla., died Jan. 21, 2012. Originally from Moberly, he followed graduation serving in the U.S. Navy and was honorably discharged as a Lieutenant Junior Grade in 1968. His career as a chemical engineer took him across the U.S. and world, with jobs in the Philippines, Japan and Tennessee. After retirement, he prepared taxes with H&R Block. He is survived by his wife, Irene.

1960s

Jack D. Potts, BS MAE '60, of Overland Park, Kan., died March 16, 2012. He was born April 23, 1930, in Mexico, Mo., and served eight years in the U.S. Army before graduating from MU, where he was a member of Pi Tau Sigma. He worked for Hallmark and also during tax season for H&R Block. He volunteered with the Heartland Presbyterian Center and, with his wife, was active in Mariners in Mission. He was survived by his wife, Hazel, two daughters and five grandchildren.

Robert "Bob" Scott James, MS '68, of Westwood Hills, Kan., died Jan. 30, 2012, at his home. He was born Dec. 14, 1936, and grew up in Topeka and Leavenworth, Kan. He earned his bachelor's degree in civil engineering

from the University of Kansas in 1958. Following his graduation from Mizzou, Bob worked as a civil engineer for the next 47 years, at various organizations and companies, including the Federal Aviation Administration and Kivett and Myers architectural firm. He was a co-founder and partner of Devine James Labinski Myers architectural firm and last worked at BNIM Architects before retiring in 2006. He is survived by his companion, Patricia L. Hogan, two sons, two stepsons, six grandchildren and three great-grandchildren.

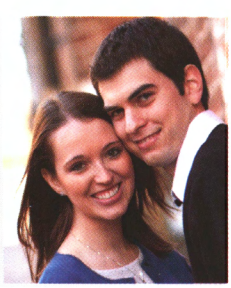
2000s

Scott Johnson, BS ME '09, of Columbia, died Feb. 29, 2012, in Columbia. He was born April 14, 1970, in Elmhurst, Ill. He was a teaching assistant in the MU Department of Mechanical Engineering. He is survived by his wife, Jun Ma, and a daughter.

Engagements

Stephen Finkbiner, BS MAE '08, of the Kansas City area, will marry Emily Lay, BS BA '09, on Sept. 22, in Columbia, Mo. Finkbiner is an engineer for Enercon Services in Overland Park, Kan. Lay is a financial analyst for Hallmark Cards in Kansas City.

Christopher M. McCrate, BS MAE '08, of Cedar Rapids, Iowa, will marry Rachel K. Riley, BS BJ '07, JD '10, at



the First United Methodist Church in Kirksville, Mo., June 23. Christopher received his master's degree in aerospace engineering from Texas A&M University in 2010 and is currently working as a systems engineer at Rockwell Collins in Cedar Rapids. Rachel is a family law attorney with Gray, Stefani and Mitvalski, P.L.C., also in Cedar Rapids.

Christopher Adrian, BS CiE '12, of DeWitt, Mich., will marry Amanda Bradley in the fall 2013. Christopher earned his bachelor's degree this spring. Amanda earned her degree in international business and marketing from Grand Valley State University in Allendale, Mich., in 2011. She is a marketing specialist with the Missouri Department of Economic Development in Jefferson City.

Joseph G. Stone, BS CiE '12, of Jackson, Mo., will marry Melanie H. Loehndorf, BS HES '12, on July 14, in Germantown, Wis. Joseph and Melanie earned their bachelor's degrees in civil engineering and nutritional science, respectively, last spring.

Weddings

Kate Snider, BS MAE '03, and Jeff Thrailkill, of Kansas City, were married Feb. 11, in St. Louis, Mo. Kate is currently employed as a consulting engineer for Burns and McDonnell in Kansas City. Jeff earned his degree from Northern Kentucky Technical College and is currently a field service engineer for R.A. Jones, in Cincinnati, Ohio.

Kellen Burkett, BS ChE '06, and Craig David, BS BA '93, BS Acc '95, of Columbia, were married Feb. 11, at Caesars Palace in Las Vegas. Kellen is a production team leaser at Schreiber Foods Inc., in Clinton. Craig is a lead accountant in the Office of Research at MU.

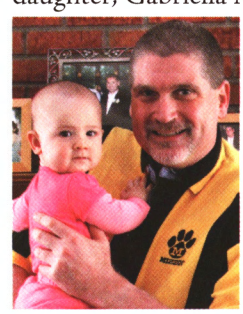
Michael Lupardus, BS MAE '06, and Anne Bernreuter, of North Carolina, were married May 5, in Bradenton, Fla. Michael is employed as a product manager for Honeywell in Raleigh, N.C. Anne earned her bachelor's degree in nursing from Florida State University in 2006. She is employed as a pediatric RN at the University of North Carolina Children's Hospital in Chapel Hill, N.C.

Jacob J. Wildt, BS EE '09, and Jamie L. Overschmidt, of Washington, Mo., were married March 17, at Our Lady of Lourdes Catholic Church in Washington. Jacob is an electrical engineer at Monsanto. Jamie earned a bachelor's degree in art education from Missouri State University and teaches art at Marquette High School.

Paul Varner, BS ME '11, and Brittney Jacaway, BS BA '10, of Seattle, Wash., were married Dec. 2 at Sacred Heart Catholic Church in Columbia. Paul is an equipment engineer at Boeing, and Brittney works as a Key Center Manager at Key Bank N.A. The couple will reside in Washington.

Births

Alan, BS MAE '91, and Gina Canfield, of Panama City, Fla., welcomed a new daughter, Gabriella Marie, on June



15, 2011. The baby weighed six pounds, 11 ounces. Alan also obtained a master's degree in mechanical engineering from the University of Florida in 1999. Gina earned her bachelor's degree in chemistry in 1995 from Rensselaer Polytechnic Institute, her master's degree from Texas A&M University in 1997 and her doctorate from Florida State University in 2010.

Three MU Engineering Alumni receive Missouri Honor Awards

In March 2012, three College of Engineering alumni were recognized for their professional accomplishments, commitment and ideals with Missouri Honor Awards, the college's highest honor. Excerpts from their acceptance remarks follow their profiles.

Pamela and Jon Conway

John T. Conway, BS CiE '71, MS PA '86, served as a location manager for Bartlett & West, a consulting firm for project development and funding, hydraulic analysis, regional water system design, pumping systems and contract administration, from 1996 until he retired in December 2010.

Conway served in the U.S. Army Reserves from 1971 to 1977. Prior to working at Bartlett & West, he spent 24 years working for the USDA's Missouri Farmer's Home Administration, where he played a key role in the development of countywide rural systems. For the past 17 years, he has worked as an engineering consultant to champion the mission of safe drinking water.

An active member of the MU Engineering Alumni Organization for 10 years, and in 2011, he received the MUEAO's Citation of Merit Award, and also was inducted into the MU Department of Civil and Environmental Engineering's Academy of Distinguished Alumni.

Conway and his wife, Pamela, live in Columbia.

"Thank you for this opportunity and thanks to the University of Missouri for the impact it has had on my professional life.

My parents would be quite proud to know that one of their 12 children received distinction from the prestigious University of Missouri College of Engineering. I was the fortunate one of the 12 who had an opportunity to go to college to pursue an engineering degree.

I would like to suggest to the students here tonight that you consider your core values and how they might serve you as you begin your engineering careers. Some that served me throughout my career are doing what was right when doing so was difficult, delivering quality through self improvement, and service to others, whether they were clients, fellow employees or my those in my community.

Be lifelong learners to become the best possible problem solvers and to also grow your human capacity.

It was always important in my career and profession that I achieve the distinction of becoming a licensed professional engineer and that I always stood ready to carry out that professional responsibility. In addition, I pursued the Order of the Engineer to reinforce the professional pledge and responsibility of being an engineer.

Finally, I'd like to stress the importance of maintaining a connection to our great College of Engineering by being an active participant in the MU Engineering Alumni Organization. The college needs you and your support."

Joyce and Paul Hollrah

Paul R. Hollrah, BS CiE '62, is a senior fellow at the Lincoln Heritage Institute and currently writes a weekly political column as contributing editor for the National Writers Syndicate and the New Media Journal.

He designed and built pipeline and marine terminals throughout the Midwest, pioneering the use of aircraft-style bottom loading for transport trucks. He served as a project engineer for Cities Service Oil Company in New York and Tulsa, and as a senior project engineer for Sunray DX (Sun Oil Company) in Tulsa.

In 1970, Hollrah transitioned from an engineering career to a career in the political world, serving as director of state relations for Sun and 15 operating subsidiaries.

Taking early retirement in 1984, he served as deputy campaign manager in the presidential exploratory committee of former defense secretary Donald H. Rumsfeld. He has served two terms in the U.S. Electoral College.

Hollrah and his wife, Joyce, live in the lakes region of eastern Oklahoma.

"After graduation [from high school] in 1951, I did what most people in St. Charles did: I went to work at McDonnell Aircraft — on the assembly line. I was drafted in 1953 during the Korean War, and after returning from overseas in 1955 I went back to work on the assembly line, [eventually taking] a job selling sewing machines and vacuum cleaners door-to-door in St. Louis.

It was a terrible job, but that dark cloud turned out to have a silver lining because it made me realize that I was going to have to get serious about finding my niche in life. So, in the summer of 1958, at age 25, I drove to Columbia to enroll in the College of Engineering.

My wife and I loaded our meager possessions into a U-Haul trailer and, with our year-old son, moved to Columbia. We lived in one of those old World War II single story tarpaper shacks that used to sit across the road from the football stadium. We paid $27 dollars a month rent, had a food budget of 60 cents a day, and I started attending classes.

During my four years at Mizzou,I averaged about 3½ hours of sleep a night, and when I graduated in 1962 I was just over 6 feet tall and weighed 116 pounds. If I turned sideways you couldn't see me.

The men and women who taught me — my professors — stood behind me, supported me, challenged me, encouraged me, and simply refused to let me fail. It was they who put me on the path to what has been, for an engineer, a most unconventional career, but a wholly satisfying one. I owe them all a tremendous debt of gratitude.

I have been so richly blessed, and this award is truly the icing on the cake. I appreciate it very much."

Constance Vaught, David Poe and Chloe Poe, David's mother

David Russell Poe, ME '70, is a partner in the Washington, D.C. office of the international law firm of Dewey & LeBoeuf LLP with clients in the energy and communications industries. His legal career of more than 35 years has focused on the application and limits of government authority with respect to the business structures and underlying technologies of these industries.

After graduating from the University of Missouri, Poe went to work for Southwestern Bell Telephone Company (now AT&T) in St. Louis, Mo. He later attended Duke University Law School in North Carolina, and upon graduation became an associate lawyer in New York City at the firm of LeBoeuf, Lamb, Leiby & MacRae. He became a partner at the LeBoeuf firm in 1983.

Poe is a member of the New York, North Carolina and the District of Columbia bars. A member of the Federal Energy and Federal Communications Bar Associations, he is a former chair of the American Bar Association's (ABA) Section of Public Utility, Communications and Transportation Law and, as such, has represented them in the ABA House of Delegates since 2005. He is a Sustaining Life Fellow of the American Bar Foundation.

Poe and his wife, Constance Vaught, live in Washington, D.C.

"For the last 37 years, I have been a practicing lawyer, first on Wall Street in New York City and later in Washington, D.C.

It turned out that my undergraduate engineering degree was an excellent preparation for my career in the law. Not that I ever got very far from engineers. I have been hired by them, and fired by them. I have defended them and cross-examined them. And it turned out that my son-in-law is an engineer.

I have never strayed very far from my roots here in the College of Engineering. That should surprise no one because what I learned here became the foundation for my later legal career. I learned about problem solving. I also learned about technology, why things work and how they are designed. More significantly, I learned about the processes by which technological change occurs, how creativity and perseverance combine to produce and improve the machines that touch practically every aspect of human existence.

Much of our nation's commerce depends upon laws that define and regulate various technologies, from the extraction of raw materials from the earth, to the manufacture of equipment, to the provision of services that prolong and enrich our lives. Without these laws, much of what we take for granted simply would not exist. It is crucial that such laws be developed and administered intelligently by people who understand the technologies to which they are to be applied. That means that those who fundamentally understand technology will be even more critical to our future and must share in the leadership of our society. This is a challenge for higher education generally, but it is also a special challenge to engineering education.

All of this underscores why what goes on here in the College of Engineering is so important. And why I am both humbled and honored to receive this award from an institution and people whom I deeply respect."

Please visit the College of Engineering's website to learn how you can nominate someone to receive a Missouri Honor Award, the college's highest honor.
http://engineering.missouri.edu/alumni/moha

MU Engineering Dean Jim Thompson, at left, reflects on Lex Akers' contributions to the MU College of Engineering. Akers, joined here by his wife, Sally, most recently served as Mizzou Engineering's academic dean and began a new chapter in his career as founding dean of Caterpillar College of Engineering and Technology at Bradley University.

Akers accepts position at Bradley University; bids MU a fond farewell

Lex Akers arrived at the University of Missouri in 2001 to assume chairmanship of the Electrical Engineering Department and became the college's academic dean in 2006. In December 2011, he was named the founding dean of the Caterpillar College of Engineering and Technology at Bradley University in Peoria, Ill. He began that new chapter in his career on May 1.

Reflecting on his tenure as associate dean for academic programs at Mizzou, Akers said it has been "the perfect storm."

"By allowing me to hire people with passion, determination and focus who work together in harmony, we were be able to take the challenges the dean [Jim Thompson] put before us and both meet and exceed his expectations," Akers said.

Just as he joined the administration, the college was beginning to lay groundwork for the reconstruction of the Lafferre Hall's 1922 addition. Working with Mike Klote, manager of engineering technical services, and Marty Walker, engineering's director of administrative services, Akers supervised the reconstruction of 25,000 square feet of outdated lab space into 60,000 square feet of modern, multi-disciplinary undergraduate labs, research facilities, classrooms and offices.

Under his leadership, the college's Student Services Office and its programs were revamped and extended — efforts that include increased recruitment strategies, expanded initiatives to add diversity to the engineering student body and new retention efforts. An innovative and growing international program that includes a long-anticipated study abroad initiative also was launched.

There is a 21 percent increase in enrollment and the quality of our students just keeps going up." Akers said. "Enrollment by minority students and young women also has increased significantly in the last six years."

Efforts to ensure that students have the support and tools they need to be successful as they make the transition into college and as they continue their studies resulted in an increased emphasis on Freshman Interest Group (FIG) living situations whereby engineering freshmen room together in residence hall blocks and take core classes together.

"With the enrichment program, we can rapidly identify students who need help and turn the situation around," Akers said.

Most recently, Mizzou Engineering Student Services has initiated international and study abroad programs.

"We recognized that we needed to internationalize the undergraduate program to help students learn about different cultures through shared experiences and challenges," Akers said. "Study abroad opens students' eyes to possibilities, adds to their maturity and helps with employment when they graduate."

Akers spent all six years as associate dean working on the college's Accreditation Board for Engineering and Technology, Inc., (ABET) accreditation process, meeting regularly with department chairs and faculty. "We know we do a quality job, but we needed to be able to tell that story," he said.

"When I discussed this job with Jim [Thompson] six years ago, he said, 'Here's a wish list. These are the things I want you to do.' He challenged me. He's been a great mentor and role model and we have worked together as a team. It's been enjoyable. Leaving is the hardest thing I've ever done."

Attention Mizzou Engineering Alumni!

HireMizzouTigers.com is a free resource connecting Mizzou students, alums and employers.

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engineering.missouri.edu

has been updated and enhanced.

Stories from each issue are added to the web page at the same time the magazine is being printed.

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Maiden Name_____

Spouse's Name_____

Class Year_____ Spouse Class Year (i/a)_____

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Mizzou Engineering Calendar

JULY 2012

15 Engineering Summer Camp week one begins

22 Engineering Summer Camp week two begins

SEPTEMBER 2012

7 MU Engineering Alumni Golf Tournament
Eagle Knoll, Hartsburg, MO
11 a.m. to 4 p.m.

8 MU Engineering Alumni Organization Board Meeting

14 Chemical Engineering IAB Fall Meeting

OCTOBER 2012

4 Pre-DEAC Reception

5 Dean's Engineering Advisory Council Meeting

12 Civil Academy of Distinguished Alumni

A dogwood blooms on the north side of Lafferre Hall. Photo by Jennifer Hollis