Focus on Students

We felt that it was important for us to focus the 2008 issue of Creating Tomorrow on our exceptional students. We’ve sought out undergraduates, graduate students, and recent graduates to relate their experiences—mostly experiences that take place outside the classroom—that have enhanced their knowledge and understanding of their chosen area of engineering.

You’ll meet Libbie Linton, an extraordinary high school senior when we first met her in a biological engineering lab; Steve Anderson who, with his teammates, paddled a concrete canoe to victory in Colorado; John Parrish, a member of the rocket launch team that brought the grand prize home from Alabama; and Daniel Morgan, who captained a team that built the #2 unmanned autonomous aircraft in the nation. The honors garnered by our cadre of excellent students grow almost daily. We couldn’t be more proud of each one of them.

Another cadre in the College that brings us prestige and honor consists of our alumni, national advisors, and financial supporters. Their efforts brought to fruition the David G. Sant Engineering Innovation Building. Built on the site of the Peterson engineering classroom building, the new 38,000 square foot laboratory facility was dedicated June 13, with David, his wife Diann, members of their family, and honored guests in attendance.

While eliciting chuckles with many of this remarks, Sant, who earned his bachelor’s and master’s degrees in electrical engineering at USU, capped his comments by saying, “There is no better way to give back than to support the institutions that equipped me for my career.”

I want to take this opportunity to thank our enthusiastic faculty members who donate untold hours outside the classroom and laboratory in order for our students to achieve greatness. Without their willingness to mentor students, and their constant drive to attract the funds necessary to conduct research and support graduate students, we could not have published this student issue of the magazine.

Now, please get to know some of the students who make our careers so worthwhile—the students who admire, inspire, and demand the best from the College of Engineering.

H. Scott Hinton
Dean
hinton@engineering.usu.edu

Bidding for Graduates

After spending countless hours in classes, study carrels, and research labs, a graduating engineer is finally ready to leave academia and enter the workplace. But first, he or she needs to market him-or herself. Or do they?

David Wolffenden, who just received his PhD in mechanical and aerospace engineering, is one of numerous outstanding engineering graduates whose training and potential caught the eye of industry recruiters. Wolffenden was vigorously recruited by a variety of firms, including Aerospace Corporation and Lockheed Martin. He was able to choose among the bidders for the job, location, and benefits that best suited his lifestyle.

His major professor, David Geller, describes Wolffenden as an outstanding individual who possesses tremendous engineering skills, writing and presentation skills, and is also desirable for his maturity—as both an engineer and a person. Geller states, “the research David conducted at USU will help us...”

Women Engineering Students, as well as Dean Hinton and a proxy recipient, celebrate receiving Corbett Scholarships at Scholars Day. This spring, 19 entering freshman women engineering students won the Don M. Corbett Scholarships, courtesy of Don and Melba Corbett, whose goal is to encourage women to pursue careers in engineering.
The opportunity to select from more than one job offer is a bonus that many graduating engineers are given.

What is at the crux of this opportunity? A need for qualified and innovative engineers.

H. Scott Hinton, dean of the College of Engineering at Utah State University, comments, “In today’s world, for our faculty and students to be viewed as successful, and leaders in their professional communities, they have to demonstrate that they can create new technologies and services that will help provide future high-paying jobs for citizens of both Cache Valley, the State of Utah, the United States, and the world.”

The College of Engineering continues to produce graduates who are innovative engineers looking to create a better tomorrow!

We’re Recognized Campus- and Worldwide

In this issue we present awards, honors, projects, and professors that have worldwide impact. But, it’s nice to know that our colleagues and others in the campus population know we’re top notch as well.

Each spring the university honors its best researchers, scholars, teachers, and team players at Robinson Awards. This year, members of the College of Engineering family nearly swept the academic honors.

Scholar: Kaitlin Neville, Civil and Environmental Engineering

Graduate Teaching Assistant: Andrew Deceuster, Engineering and Technology Education

Professor: Timothy Taylor, Biological and Irrigation Engineering

Faculty Researcher: Jagath Kaluargchchi, Civil and Environmental Engineering

Professional Advisor: Kathy Bayn

bring in additional research grants from both government and industry.”

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Dedication of the
David G. Sant Engineering Innovation Building
June 13, 2008
David G. Sant, 70, died Sunday, July 27, 2008, in San Jose, California, of cancer. David is the son of Arnold and Deene Sant, deceased. He grew up in Preston, Idaho, along with his brother, Lynn. He is survived by his wife, Diann (Larsen), son, Jeffrey D., daughter, Jennifer D. Bermudez (Steven), grandsons, Jake and Sam, and brother, Lynn (Leann).

David served in the United States Air Force. Afterward, he attended Utah State and earned both his bachelor’s (’62), and master’s (’64) degrees in electrical engineering. He went on to earn his MBA from Santa Clara University in California. David had a successful career for more than 35 years in the telecommunications and computer industry, working first at IBM as a diagnostic computer programmer after graduating from Utah State, then on to Rolm, VMX, and Stracom. He founded several start-up companies, specializing in voice and data communications, and built some 12 national sales organizations.

David once said, “I wanted to give back to the community. There is no better way to do that than to support the institutions that equipped me for my career.” David and his wife Diann donated more than $7.5 million to Utah State. The new David G. Sant Engineering Innovation Building was dedicated on June 13, 2008, with David as the honored guest. College of Engineering students, faculty, and staff are grateful for the privilege of working with David to share his vision of the power of innovation to transform the world through this state-of-the-art facility.

His generous gifts: the Sant Franklin County Engineering Scholarship, Sant General Engineering Scholarship, Sant Graduate Fellowship, Sant Undergraduate Corporate Research Scholarship, and the Thomas Berghoff Memorial Scholarship (in honor of his good friend), will help hundreds of students receive scholarships at Utah State in the College of Engineering.

David and Diann also contributed generously to the library in Preston, Idaho, renamed the Larsen-Sant Public Library after both of their mothers.
Nine students mentored by three faculty members have spent the summer searching for a whiz-bang affirmative answer to the question “Can we build biological systems using standard, interchangeable, biological parts?” Their creation will compete against 83 other team attempts at the 2008 iGEM (International Genetically Engineered Machine competition) Jamboree at the Massachusetts Institute of Technology (MIT) in November.

The USU iGEM team is designing and building standardized biobricks to produce and analyze bioplastics. These plastics are produced by bacteria rather than processed from petroleum chemicals. The two plastics have similar properties, but the bioplastics are biodegradable.

“The team will convert genes for bioplastic production into biobricks and express them in E. coli and other bacteria,” explains Charles Miller, a new member in the Biological and Irrigation Engineering Department. “Then, the team will generate biosensors for bioplastic production using various reporters (indicators), including green and red fluorescent proteins that can be...
measured and used to indicate that the bacteria are producing high concentrations of intracellular bioplastic materials for harvesting.

In addition to Miller, BIE Department Head Ron Sims, and Dean of the College of Engineering Scott Hinton are working with the students. Eight biological engineering majors participate on the team. They are sophomore Rachel Porter; master’s students Dan Nelson, Trent Mortensen, Kirsten Sims, Steve Merrigan, Elisabeth Linton, and Joseph Camire; doctoral student Junling Huo; and high school junior Garrett Hinton.

“This is the first iGEM competition in which USU students have participated,” Miller notes. “What began in 2005 with 13 teams has grown to 84 international teams. All teams participate in the iGEM Jamboree at MIT for the opportunity to interact with iGEM members from other schools and countries and to become familiar with their projects.”

Teams are judged on an oral presentation as well as a poster presentation. Each team also has a wiki (web) site that they continually update throughout the course of the experimental stages of their projects. Information in the wiki site will also be used in the judging process.

The broader goals of iGEM are to enable systematic engineering of biology, to promote the open and transparent development of tools for engineering biology, and to help construct a society that can productively apply biological technology.

Miller points out that the iGEM experience introduces students to genetic engineering and synthetic biology where they gain an appreciation for genetic manipulations and their importance in bioreactor development and bioprocessing.

Team member Stephen Merrigan, whose interests lean toward pharmaceutical and biochemical production, adds that he has “gained valuable skills that I’ll take into industry and use in laboratory research. Having experience on the cutting edge of genetics will make me more marketable. Much of the industry is moving toward molecular biology.”

To that, teammate Trent Mortensen says “this project has made me much more comfortable with basic laboratory techniques and allowed me to get a much better grasp on aspects of molecular biology. I’ve learned at an accelerated pace this summer by working closely with experienced professors and having my hands on the actual procedures. And, it has opened my view to the logistical side of research—from ordering and managing supplies to planning and timing experiments. I would recommend this experience to anyone interested in the field.”

daniel.nelson@aggiemail.usu.edu
charles.miller@engineering.usu.edu

Omega-3 Extraction Research Wins National IBE Symposium Session

Dan Nelson took his senior project to the poster session of the national Institute of Biological Engineering Symposium this year in North Carolina and came home the winner. After studying Nelson’s graphic presentation and interviewing him, judges deemed his work Number One. Nelson says judges were looking for evidence of sound scientific ideas and research methodology, coupled with evidence of progress toward the goal of the project and practical application/commercialization.

Nelson estimates 50-60 universities were represented at the poster session and some brought more than one project.

Research shows that Omega-3 fatty acids are essential for brain development, especially in infants, and help maintain brain function in adults. They also have some cancer-preventing properties.

Fish is a major source of Omega-3 but some people don’t like to eat fish and for others it’s expensive,” Nelson says. Some people complain of an unpleasant aftertaste when they use fish oil gelcaps to boost their Omega-3 intake.

“I’m trying to develop large quantities of Omega-3 in a bioreactor, using a marine algae-fungal species that produces Omega-3 cellularly,” he explains. “Purified Omega-3 fatty acid is being produced commercially, but the increased market demand is higher than what is currently available.

“My focus is on finding other organisms and manipulating ideal conditions in the bioreactor for coaxing more Omega-3 from each organism to make production more economical,” Nelson continues. The second half of the research is to develop a cost-effective extraction method so the purified Omega-3 is affordable as a food supplement or pill.

“Conducting my own research is a unique experience that most students don’t have as early and as intensely as I have,” Nelson believes. “Some of the more dedicated students are able to get in labs later on as undergraduates. I feel like I’ve learned a lot by directly applying chemistry, biology, and engineering I learn in class to my lab work.”

daniel.nelson@aggiemail.usu.edu
Take a look around and you might be surprised by how many things are made of plastic. Paints, adhesives, prostheses, brushes, and furniture to name just a few. Since plastic was created about 150 years ago, it has become one of the most commonly manufactured materials in society. About 200 billion pounds of plastics are produced annually worldwide.

Libbie Linton, a Utah State University senior majoring in biological and irrigation engineering, has been researching bioplastics as an alternative to conventional plastics since 2004.

Finding alternatives to petroleum-based products such as plastic will help to increase sustainability. In the United States alone, some 60 billion pounds of plastics are discarded annually, and more than 90 percent of the waste is not yet recycled.

Bioplastics could easily be substituted for regular plastics because they can be molded and the strength can be adjusted just like regular plastics, Linton said. Bioplastics are biodegradable and aren’t derived from oil, making them a much more sustainable product.

“When I began working with Libbie the summer before she started college, she really dug into the details of the organisms, processes, and previous research by..."
others concerning bioplastics,” said Ronald Sims, head of the Biological and Irrigation Engineering Department. “By the time she started college, she was well into research and discovery in the laboratory.”

Bioplastics are made from a compound called polyhydroxyalkanoate, or PHA, she said. Bacteria accumulate PHA in the presence of an excess carbon source, similar to how humans accumulate fat deposits on their bodies after consuming excess food.

The major problem with producing bioplastics on a large scale is cost. Presently, bioplastics are around 2.5 times more expensive than plastics produced from oil, Linton said. But as the cost of oil increases, that gap gets smaller and smaller.

The sources for the production cost include the carbon used to help bacteria produce PHAs, the purifying process, and operation costs, such as tanks to house PHA-producing bacteria.

Linton’s project focuses on ways to eliminate or reduce one or more of these costs. To make this green idea even greener, she aims to optimize naturally occurring environments and use byproducts from other production processes.

During her junior year, a research group Linton was affiliated with was awarded a grant from the Utah Science, Technology and Research (USTAR) initiative for the study of biodiesel produced from algae.

Anaerobically digested dairy waste is used to grow the algae used for biodiesel production. Bioplastic production can be integrated into this process by using the carbon- and nutrient-rich dairy waste to harvest PHA-producing organisms that occur naturally in the dairy waste.

“Using wastes to make bioplastics solves two problems at the same time,” Sims said. “It provides sustainable waste treatment and avoids polluting the environment. Second, by adding a high-value product like bioplastic to the biodiesel production process, the cost of both products can simultaneously be lowered.”

Linton has developed and validated a method for quantifying PHAs in a sample and has successfully detected PHA-producing bacteria in the waste. Now, we have to look for ways to optimize this partnership between biodiesel and bioplastic production to get a lot of PHA for a good price, she said. “If there’s anything I’ve learned while working on this project, it’s that everyone has to work together,” Linton said. “No one can know everything, so you have to team up with experts from various disciplines to get the best results.”

During the 2008 USU Undergraduate Research Week poster display, Linton claimed the award for “Best Poster” in the engineering category. She has also presented her research at national conferences, including the Inland Northwest Research Alliance Conference in Big Sky, Mont., in 2005; the Institute of Biological Engineering in Tucson, Ariz., in 2006; the Institute of Biological Engineering in St. Louis, Mo., in 2007; and the Institute of Biological Engineering in Chapel Hill, N.C., in 2008.

Linton plans to stay at USU to get her master’s degree while continuing this research with Sims. “I’d like to shift to a systems integration emphasis for my master’s degree,” Linton said. “I want to design a system for bioplastic production that can be incorporated into the commercial agricultural waste treatment process without compromising biodiesel production.”

e.linton@aggiemail.usu.edu
rcsims@engineering.usu.edu

Two new faculty members have joined the BIE Department to expand the current biological engineering program. They are Jixun Zhan and Charles Miller.

Jixun Zhan was selected for the metabolic engineering position. Most recently an assistant professor at Mount Sinai School of Medicine in New York, Zhan’s PhD is in biochemical engineering. He worked previously at the University of California, Los Angeles, and at the University of Arizona. His area of expertise is in the biosynthesis of bioactive natural products. Zhan will teach undergraduate and graduate level courses in the area of metabolic engineering for the production of new biological-based products.

Charles Miller was selected for the cellular engineering position, specifically in the area of synthetic biology engineering. Miller’s PhD degree is in biochemistry from North Carolina State University, and he has conducted significant previous research in the areas of genetic engineering of procaryotes (bacteria). He will teach undergraduate and graduate level courses in the area of synthetic biology engineering for the production of new biological-based products that include bio-plastic materials as sustainable replacements for petroleum-based plastic materials.
The True Blue Canoe team from USU’s Civil and Environmental Engineering Department paddled its way to third place in the races and fourth place overall at the Rocky Mountain Regional Conference of the Concrete Canoe Competition in Golden, Colorado, this year. The competition, sponsored by the American Society of Civil Engineers, included a written paper, oral presentation, final product, and races. To be eligible to race, their canoe had to be able to float...after it was filled with water! Steven Anderson, team member, said in order to make it float “…you have to make a really light concrete mix, or install foam bulkheads at each end.”

The competition officially began in 1988, although some of the first concrete canoes were built in the 1940s. The 13 participating universities take turns hosting the annual regional and national competitions. Next year they’ll compete at Brigham Young University in Provo, Utah. The Aggies are scheduled to host the competition in 2013.

Just shy of 20 feet long, the True Blue Canoe weighed 300 to 350 lbs, one of the lightest, but as Anderson pointed out, weighing a concrete canoe can be rather difficult. The Mechanical and Aerospace Engineering Department loaned the team a trailer for the 10-hour drive to Colorado.
ADVENTUS AMERICAS AWARD COMES TO ENVIRONMENTAL ENGINEER

Erik Dettenmaier, an environmental engineering doctoral student working with William Doucette, won the 2008 Adventus Americas Award for Best Student Platform Presentation at the annual meeting of the Association for Environmental Health and Sciences. The award carried with it a $500 cash prize.

Dettenmaier presented part of his dissertation research titled “Re-examining the Relationship between Root Uptake of Organic Chemicals and the Octanol/Water Partition Coefficient.” His research models the potential for organic compounds such as BETX, MTBE, DDT, and PCBs to be taken up and translocated to above-ground tissue in plants.

“This model is useful for determining the potential for both phytoremediation (using plants to clean contaminated soil) and also for conducting risk assessment analysis of a compound’s potential to end up in food products.”

erik.dettenmaier@aggiemail.usu.edu
“Actually applying my civil engineering education to help others is an awesome experience,” says Christa Jones, the team leader (foreground right) and CEE Junior. Children at the orphanage were sleeping in crowded rooms, some on thin woven mats on the ground. EWB-USU designed a dormitory for the girls that can be built in three stages, leveled the land, and built the first stage (shown in the background) during their trip in June. The children moved in after the doors and windows were installed and 18 triple-decker beds were delivered. Tomas Lindheimer (CEE Junior) said: “This is an experience that you can’t get in the classroom. It forces us to innovate unconventional ways to get things done. We had to modify our design on the fly to accommodate local building customs. It was frustrating at the time but, when I think back, also educational.” EWB teams have also dug a well, installed a solar pump, installed rainwater catchment systems, installed water storage tanks, constructed a kitchen, expanded the medical clinic, and placed concrete floors in classrooms.

Experience Uganda with Engineers Without Borders

EWB-USU does more than build infrastructure. Volunteers used most of their suitcase space to carry donated clothing and more than 300 children’s reading books to the Byana Mary Hill orphanage school in Uganda, East Africa. Bethany Torbensen, MAE Junior, suggested after building the library, that next year they add windows. Teams also have equipped a library for the books, provided knitting machines, installed solar power for lights and computers, installed wireless internet, provided DVD equipment for educational programs, and constructed playgrounds, including swings, climbing areas, and leveled and implemented more than 3,000 square feet for volleyball, netball, and tetherball courts.

After working hard at the orphanage for three weeks, volunteers took a few days to play. They challenged the Class 5 rapids at the head of the Nile River near Lake Victoria. “It was an awesome experience,” Dabney Veater, CEE Junior exclaims. (Photo of the team by the photographer from the Adrift rafting company.) EWB-USU teams have worked in Uganda, Peru, Mexico, and Tibet since students formed the local EWB chapter in 2005. Donations made to the USU Development Office and specified for EWB Uganda are used exclusively for equipment, materials, and other implementation costs—students raise their own money for travel, explains William Grenney, advisor. grenney@cc.usu.edu
Faculty/Student Team Shares Research with Structural Engineers

A seismic isolation technology already employed in thousands of high-rise buildings in quake-ridden Japan has civil engineering researchers and students at Utah State assessing its adoption in this country. The system minimizes damage caused by earthquakes by increasing the overall flexibility and absorbing deformations across an isolation plane.

Keri Ryan, civil engineering professor and director of TIPS—Tools for Isolation and Protective Systems—collaborates with researchers from U.C. Berkeley, State University of New York at Buffalo, the University of Wisconsin Green Bay, and in Japan to remove the practical barriers to the adoption of seismic isolation systems.

“The overarching goal of the project is to address the high cost, complex procedural issues, and performance concerns that cause engineers to shy away from using these technologies,” explains Ryan. “For example, isolators placed on top of the first story of a structure rather than at the traditional foundation level, may prove to be an economical design solution, lowering the cost premium without sacrificing performance.”

“Ryan and new postdoctoral scholar Emrah Erduran together direct students at the undergraduate and graduate level to carry out a variety of tasks for the project.

- By combining seismic hazard assessment, high fidelity structural modeling, and comprehensive response, damage and loss analysis, PhD student Prayag Sayani is carrying out a cost-benefit study that will estimate the expected cost premium for seismic isolation systems, and the expected return on this investment in the form of reduced earthquake losses.
- Master student Desi Larsen is interviewing engineers to understand the design review process for isolated buildings and looking for ways to streamline the process.
- Undergraduate Yolanda Baez is developing the cost models for the cost-benefit study.
- Computer science master’s student Santosh Shirahatti is developing a searchable database with web interface to store test data on isolation and protective devices.
- And, undergraduate Camila Coria is putting data in the database with the help from the team at UC Berkeley.

“The hoped-for outcome is to reduce future losses and disruptive societal impacts associated with earthquakes by promoting widespread adoption of isolation systems in the United States,” Ryan explains. “The TIPS project uses the Network for Earthquake Engineering Simulation (NEES) “collaboratory,” including a nationwide linkage of state-of-the-art facilities for experimental research. NEES and the National Science Foundation sponsor this research to find solutions that will minimize the impacts of earthquakes on society.

kryan@engineering.usu
If an electrical engineering major participating in REU invited you to a foie gras session, would you grab a baguette or your book bag?

The notepad in your book bag will better serve you at this intense learning session, says Todd Moon, one of two faculty members running REU (Research Experience for Undergraduates) projects at USU this summer. Moon’s project is aimed at signal processing, communications, and coding theory. The second project, run by Yangquan Chen, is focusing its attention at robots – in particular, coordinating the movements of multiple robots.

“I nicknamed my first three weeks of intense classroom preparation “the foie gras session,” Moon admits, “because we were ‘force feeding’ a huge amount of graduate-level coding and communication engineering to these students in a very short time. Topics in information theory, signal processing, probability, communication theory, programming, and technical writing – all were covered in about three weeks.”

“While the French force feed to enlarge the goose’s liver and, thus, to produce more paté, we’re enlarging students’ understanding of one aspect of electrical engineering in hopes they produce fresh, unique solutions to real-world problems,” Moon explains.

Eight students hired on to spend the summer focused on coding and communication. After the foie gras beginning, each student chose a specific problem to spend the next 10 weeks trying to solve. Their stipends were better than a burger flipper made, and they had a chance to display their creative skills before the funding agent, the National Security Agency.

“NSA promotes study in technical areas that could help the United States be more competitive; they may actually recruit from this pool of students,” Moon explains. He conceived the model for REU after spending several summers participating in a government think tank.
“The idea is to bring academics and students together to view problems from diverse viewpoints,” he says. “I hired these students in part for the diversity of their majors – while half are electrical engineering (EE) majors, the others are physics, math, and math education majors. Three students are women.”

One of the problems they chose to work on dealt with isolating one speaker in a room filled with talking people; another was finding an easier way to separate reflective signals.”

Chen’s project, Mobile Actuator and Sensor Network (MAS-net), adds node mobility and a closed-loop control concept to the field of Wireless Sensor Networking. The project tries to use a new robot design (MAS-mote) acting as a sensory and/or actuating node to model and ultimately control a diffusion process.

MAS-net results can contribute in anti-terrorism and environment protection. “Chemical, biological, radial, and nuclear weapons are considered the next potential threat to the society,” Chen explains. “Robots will likely be used to detect and dispose of these weapons.”

The REU participants chose from topics such as micro-unmanned aerial vehicles as mobile sensors for environment monitoring, bacteria as mobile sensors – quantification of bacterium chemotaxis behavior using videomicroscopy, and MAS-net mobility platform enhancement.

Why spend the summer in the engineering lab rather than catching rays at the beach?

A sophomore math major from Brigham Young University says, “I’ve been wondering what to do with math. This is one way to see applications that solve real problems.”

A USU electrical engineering senior admits, “I needed a job. I have no experience in EE except in class so I thought this was a good way to see what I might do some day.”

A third participant, also an EE senior sums it up: “The is the perfect way to go to school. Small classes. Faculty members focused on me. And, I get paid!”

A senior from a university in the state of Washington says he “was surprised by the flexibility of the REU program and the fact that we are allowed to research any project of our own choosing.” He chose to work on upgrading the current hardware of the MAS-net system to a more reliable design, in hopes it will be more user friendly for future students and researchers.

“There are very few opportunities like this where students are handed time, money, and resources to pursue our own ideas,” he continues.

A senior computer science/physics major from the University of Wisconsin-River Falls likes the limitless possibilities available and his interaction with graduate students has helped him decide if graduate work is for him.

A University of Puerto Rico senior thinks it’s great to learn by doing. “You learn to think creatively and expand your vision as you apply technologies to real-world problems.”

todd.moon@usu.edu
yangquan.chen@usu.edu

Moon Lists Priorities

Todd Moon’s one-year interim leadership of the Electrical and Computer Engineering Department became permanent this spring with the approval of the Board of Trustees. It’s a time for sprucing up the physical setting to make it more attractive for visitors and students. And, attracting students is a job Moon works very hard to accomplish.

He’s looking for ways to get the word out that engineers make the modern world what it is. “Engineers have an opportunity to make a positive difference in the world,” he says. “I think women are particularly interested in making the world a better place; I want to appeal to women to choose engineering using that premise.”

Moon also wants to strengthen the department’s involvement with industry by learning more about engineering problems that industries face and using those problems for senior design projects. “Also, we want to offer students more internships while they’re in school,” Moon adds.

A major challenge facing Moon in his new role is to help the department’s young, untenured faculty members find the research needed to ensure a productive and secure career.

“If we fail to keep our young, bright faculty members, we can never rise in stature as a department,” Moon explains. “It takes a lot of time to build a research program. With the youngest faculty in the College of Engineering, time needs to be spent mentoring and shepherding new professors. They have the energy and motivation, I just need to help point them in the right direction.”

todd.moon@usu.edu
Young Professor Wins NSF CAREER Award

Wei Ren, who received his PhD in 2004 and began teaching in USU’s ECE Department in 2005, received the prestigious National Science Foundation CAREER Award this spring. Ren’s primary research focuses on cooperative control of multiple autonomous vehicles, autonomous control of unmanned robotic vehicles, and nonlinear control theory and applications.

“Think of a squadron of robots that could be sent into battle knowing how to work together effectively,” says Ren’s department head Todd Moon.

“The five-year research stipend that accompanies the CAREER Award will go a long way toward drawing great students to work with Ren,” Moon adds.

The project will focus on both theory and applications in distributed coordination and control of multiple autonomous vehicles, where collective group behavior is achieved through local interaction.

wren@engineering.usu.edu

Don’t Tell an Aggie He’s an Underdog

A team of electrical engineering majors took their two-foot wingspan mini-stealth bomber to the Association for Unmanned Vehicles Systems International competition this summer in St. Inigoes, Maryland.

Not only did USU bring home second place, it garnered the second highest score in the history of the competition. With the kudos came $8,000 prize money and a lot of bragging rights.

While USU was definitely the underdog, the first-time competitors believe some blissful naivety may have contributed to their winning design.

“Among the 13 competing teams, several had spent upwards of $20,000 to build their aircraft, dwarfing USU’s
$2,000 budget,” Morgan notes. “Without money for bells and whistles, we had to simplify everything. We hadn’t seen their models and hadn’t bought into some of the design work they incorporated, which let us think outside the box.”

Part of the competition required that the aircraft identify man-made targets using onboard sensors. USU’s model, built in the Department of Electrical and Computer Engineering with support from the Utah Water Research Laboratory, has been part of an ongoing project to help farmers monitor moisture levels in fields. Therefore, it is equipped with a computer, GPS system, onboard intelligence for monitoring the environment, and infrared and visual spectrum cameras.

[For details about the irrigation aspects of the project, ask the College of Engineering for a copy of the 2007 issue of Creating Tomorrow.]

Team members are already toying with improvements for next year’s competition and a shot at taking top honors away from this year’s winner Mississippi State University.

“The other teams have peaked; we’re just getting warmed up,” Humphreys says. “We have a lot of ideas for improvement.”

Team members in addition to Morgan and Humphreys are Christopher Hall, Di Long, Cal Coopmans, Austin Jensen, and Halyang Chao. Team mentor is Yangquan Chen.

yangquan.chen@usu.edu
daniel.morgan@aggiemail.usu.edu
As a kid, Mark Mandy took toys apart to see how they worked. Unlike other kids, however, he didn’t make his parents proud by putting toys back together again. Instead, he frustrated his parents by collecting assorted pieces and scraps with the intention of turning these scattered remains into something totally different.

And, he’s still at it.

While sitting in a turbine class at Utah State University, Mark mentally took apart the turbine and reassembled it in a totally new way. Instead of spinning turbine blades to compress air—which is grossly inefficient—why not spin the air to create speed and use it to produce pressure?

“Think of a toilet bowl,” Mandy indelicately suggests. “The water is pushed sideways to get it swirling to create pressure to clear the bowl. Why not push air horizontally to accelerate it and use that speed to push it into the combustion chamber, eliminating very costly, meticulousiy machined turbine blades?”

“I estimate that my engine, which has no moving parts and is much lighter, will cost 1/16th as much as a traditional turbine engine to manufacture,” Mandy continues, admitting that no one has built or tested such an engine, so there is no literature to aid him in determining angles, energy needs, air speeds, or a hundred other calculations.

Mandy proposed building his static engine for his senior design project. Faculty members raised eyebrows but gave the nod to Mandy’s out-of-the-blue design idea for which he had already addressed important physics and math problems and created CAD drawings. Today, there’s a working prototype in the USU jet engine test cell in the Technology Building that this pioneering undergraduate admits is nowhere near ready to fly. But he’s figuring out what to adjust next and will continue working on the engine in his spare time.

This North Dakota native came to USU four years ago with an associate degree in aviation technology and his professional pilot ratings. He will sit for the Aircraft Air Frame and Power Plant exam this summer while continuing to work as a flight instructor for USU’s Professional Pilot Program.

walkerco_26@hotmail.com

Tandem Teaching and Researching

Cody J. Reutzel, center, graduate student in the Department of Engineering and Technology Education (ETE), taught two sections of Digital Electronics this past year at InTech Collegiate High School (InTech) in Logan. This “student-teaching-students” opportunity was possible as a result of the partnership formed in 2007 between InTech and ETE.

Reutzel gained essential teaching skills that he takes with him to a secondary-level teaching post in Lincoln, Montana, and, at the same time, collected and analyzed research data for his master’s thesis. His research, in collaboration with ETE faculty member Gary Stewardson, studied aspects of the Project Lead The Way (PLTW) program, a junior high/high school curriculum to prepare students for engineering and science study at the college and university level. The number of PLTW programs nationwide has rapidly spread since its inception in 1997.

Partnership teams are a mandatory element of PLTW programs. The team focuses the knowledge and counsel of community members, industry leaders, and university personnel, in guiding PLTW programs.

Reutzel and Stewardson conducted a Delphi study to identify effective practices in the development and use of PLTW partnership teams. The study involved experts in the West, Midwest, Northeast,
Sriruk Srithongchai

Sriruk Srithongchai, University of Rhode Island, spent spring semester 2008 doing post-doctoral work with Ning Fang in the Department of Engineering and Technology Education. She taught a module on graphical interface design in a manufacturing course and comments that she learned a new appreciation for the importance of hands-on experience for effective learning, particularly in science and engineering. Fang comments, “Dr. Srithongchai is an outstanding researcher who possesses solid technical skills that greatly help not only in her own engineering research but also in engineering education at our university.”
MAE Seniors Dominate Student Launch Contest

It took all five fingers to count their awards; good thing the co-captain was there to accept the $5,000 prize that came with their grand prize finish.

The mechanical and aerospace engineering team invited by the National Aeronautics and Space Administration (NASA) to compete in the 2008 rocket launch in Huntsville, Alabama, walked away with five of the seven categories: grand prize, best manufacturing and quality control, most innovative payload design, best design documentation and presentation, and best team spirit.

Alliant Techsystems Launch Systems donated the $5,000 grand prize which allows the team to attend a space shuttle launch at the Kennedy Space Center.

“The competition was a great experience because we got to interact with students from other universities and see what ideas they had for their rockets,” says John Parrish, co-captain of the team with Matthew Fifield.

Other members of the Senior Design Team responsible for the rocket were Dustin Braithwaite, Tyler DeSpain, Jacob Haderlie, James Kelsey, Dennis Lazaga, Mike Lewis, Nathan Lodder, Bowen Masco, Jed Peters, Michael Phillips, Jeff St. Clair, David Winget, and Shane Robinson.

Parrish attributes much of the team’s success to graduate student-mentor-and-instructor Shannon Eilers, who spent the year working with the students. Professor Tony Whitmore taught many of the classes that helped students reach this stage of understanding, and also was available to the students.

“These students are seeing practical applications for the whole spectrum of their math, science, and technical classroom work,” said Tammy Rowan, manager of NASA’s Marshall Space Center Academic Affairs Office. “They’re managing complex science and technolo-
The 2008 winners website showed a tie for first place between USU’s customized air vents team and USU’s custom car door handle team. The only other team mentioned, the runner-up, was USU’s third entry that created custom hood ornaments. Where were the rest of the competitors?

It turns out all other competitors, mostly from Europe, had to simply sit back in awe this year.

For the 2008 competition, students were invited to design innovative aftermarket automotive peripheral, which exploit the geometric capabilities of digital design manufacturing (DDM) to the fullest. DDM (or rapid manufacturing) has the unique capability of being able to produce virtually any shape of component, no matter how complex.

Designs had to be a fully working prototype, so any internal electronics or mechanics had to be specified and packaged within the product. According to competition rules, the geometry of the design had to have been defined within a CAD system that was capable of producing robust STL files. (A CAD system is 3-D geometric modeling software capable of digitally defining the shape of a product.)

The co-winning team of Reid Archibald, Erik Ostler, and Thomas Shupe, designed car door handles using selective laser melting (SLM) from stainless steel. “A handle with virtually any three-dimensional geometry is possible using the SLM process. Names, pictures, or unique designs are possible with a simple re-programming of the equipment.

The air vent cover team of Nathan Fuller, Nathan Donahue, and Prasad Gankanda showed how they could add pizzazz to interior dash design by customizing designs with car logos, college logos, flame designs, names— the possibilities are limited only by the imagination. The geometry of the process allows the design to be adapted to any vehicle vent profile and other features can be embedded in the design— such as compartments for replaceable air fresheners.

The runner-up team of Jared Campbell, Cormac McCarthy, and David Williams set out to add flare to cars with imaging technology that can create hood ornaments of people’s faces, hobbies, or interests. DDM brings costs down and consolidates the required assembly parts.

In addition to showing how their design would be made, teams had to produce a cost-benefit analysis showing that the product could be manufactured at an acceptable price to consumers.

“In general, the entries from USU were much more detailed and responsive to the entirety of the competition rules,” notes Brent Stucker, whose MAE students created the prototypes in his “Non-Traditional and Additive Manufacturing” class.

brent.stucker@usu.edu

PAVE THE MOON? Not likely, but Jeff Boulware, MAE doctoral student, and Cade Charlton, graduate student in business management and administration, were invited to detail their idea for a near-waterless concrete at the 8th Continent Project competition in Golden, Colorado. They suggested using moon rock and dirt, chemicals to cure the concrete, and moisture melted from ice crystals to pave areas of high traffic on the Moon to keep down space dust, a major problem. Though they didn’t win—those honors went to Harvard and MIT— the entrepreneurs were invited by the Space Resources Roundtable to present their plan at their joint meetings with the Lunar Exploration Analysis Group and the International Lunar Exploration Working Group at Cape Canaveral, Florida. Those meetings are in October.

j.c.boulware@aggiemail.usu.edu

Lunar Exploration Working Group at Cape Canaveral, Florida. Those meetings are in October.

j.c.boulware@aggiemail.usu.edu
The impacts of climate change on water resources are high on research agendas worldwide. Changes in magnitude, variability, and timing of the main flow events are among the most frequently cited hydrologic issues because river basins often cross national boundaries and multiple countries compete for the water. Stakeholders often have different economic, political, and social backgrounds, which can complicate negotiations between those upstream and downstream.

A typical example is the Nile River Basin that consists of the White Nile and the Blue Nile. The upper Blue Nile River Basin is located in the Ethiopian Highlands and comprised of six sub-basins. The river originates in Lake Tana and flows to the Sudanese Border to eventually meet the White Nile River at Khartoum, Sudan. The Nile flows across 10 riparian countries with a total population in excess of 300 million people.

Many places on the globe are vulnerable to climate change impacts, and the Nile basin is no exception. Any negative impacts due to climate change can heavily affect the already poor and vulnerable population of Ethiopia who depend on rain-fed agriculture.

"Climate change can affect multiple features of water resources; e.g., quantity and quality, high- and low-flow extremes, timing of events, and water temperature," notes Ungtae Kim, whose doctoral work in USU’s Civil and Environmental Engineering Department received international financial support and interest. "All these aspects affect livelihoods in the basin but have not yet received attention in planning for future water allocation and design of water infrastructure.”

Due to the interest of the International Water Management Institute (IWMI) located in Colombo, Sri Lanka, Utah State University researchers Jagath Kaluarachchi and Kim investigated multiple impacts of climate change on water resources of the Upper Blue Nile River Basin. Kim, now a post-doctoral researcher at the University of Tennessee’s Institute for a Secure and Sustainable Environment, also worked with IWMI’s Principal Scientist in Hydrology and Water Resources Vladimir Smakhtin.

Kim collected relevant data from the various government ministries and research institutions in Addis Abba over a period of six weeks. He approached the analysis in a 3-step process where he first performed a detailed precipitation analysis to develop the precipitation pattern under climate change for the years leading up to the 2050s. Kim then used this information to predict the runoff behavior during these future years and the applicability of various regionalization methodologies to predict the hydrologic characteristics of ungauged sub-basins. This step is considered important to future work of this basin because very little data exists here due to lack of monitoring.

In the last step, Kim analyzed the changes of the runoff generation of the overall water resources such as vulnerability to drought, flow duration characteristics, and impacts of hydropower generation at potential future sites on transboundary flows.

The results from six general circulation models (GCMS) suggest on a
weighted average basis that there is a 2.3 °C average increase in temperature in the region with increased precipitation in the northwest region and decreased precipitation in the southwest part of the region by the 2050s. Although precipitation increased in the agriculture-dominated northeast region, the higher temperature will cause increased evapotranspiration reducing the net increase of precipitation.

The results also found that the hydro-power generation potential of the basin is high and proposed dams can be operated without affecting the transboundary flows that are ruled by the 1959 agreement between the riparian countries.

Overall, the results suggest that the water resources of the upper Blue Nile River Basin may not be adversely affected by climate change, unlike many other regions in the world. In general, (1) climate in the northeastern part of upper Blue Nile River Basin may become wetter and warmer while the southwest may become drier in the 2050s (2040-2069); (2) low flows may become higher and severe, mid-to-long-term droughts are likely to become less frequent through the entire basin; and (3) potential future dam operations for power generation are unlikely to affect the water availability to Sudan and Egypt, based on predicted outflows from six GCMs and many dam operation scenarios. Results suggest that the region has the future potential to produce hydropower, increase flow duration, and increase water storage capacity without affecting outflows to the riparian countries in mid-century.

The results of this study will soon appear in journal publications and a Research Report of IWMI.

jkalu@engineering.usu.edu
ukim2@utk.edu
Why My Education Is So Important

Editor's Note: Abedalrazzq Khalil earned master’s and doctoral degrees in USU’s Department of Civil and Environmental Engineering, finishing in May 2005. Following a one-year post-doctoral experience at Columbia University, Khalil accepted a post with a reinsurance company in New York City where financial risk transfer mechanisms are devised to mitigate the vagaries associated with the water cycle (i.e., droughts, floods, frost, excess or lack of snow, shortfall in agricultural yield, heat waves, etc.). What follows are Khalil’s responses to questions posed by Creating Tommorrow, as well as comments from his major professor for both degrees, Mac McKee, director of the Utah Water Research Lab. Khalil worked on lab projects worldwide.

Khalil: How did you choose USU for graduate school?
I grew up in Gaza under very harsh circumstances. Education was my only way out of the cycle of poverty and violence. I always had a goal of continuing my higher education in one of the top schools in the United States and I was always on the lookout for such schools and the best programs. USU has renowned water resources and engineering programs. I did not actually meet Mac McKee [who became my major professor] in Gaza but I heard of him while I was there, given that he worked with many Palestinians.

Khalil: Did you feel that your education at USU prepared you to compete well with graduates from other schools?
Definitely. Our course load and professors’ expectations are no different than any other institute. I had very competent teachers and advisors. In the Water Resources Program, I believe that USU provided an interdisciplinary learning environment that is unparalleled.

My education at USU prepared me with a solid foundation on which to build and advance in both academic and real-world settings. I had a number of opportunities to develop skills from interdisciplinary courses, special seminars, talks, and conferences. I also held research and teaching assistantships. I had an advisor who managed to connect me to these opportunities and encouraged me to develop a coherent education with breadth.

The education and methodology and approach by which we were taught to solve problems and conduct research qualified me to perform well in challenging projects in many parts of the world, including Mexico, India, Vietnam, Nicaragua, Malawi, the Netherlands, and Japan. In all these projects I felt qualified to perform my role.

McKee: Exactly how did the program you helped Khalil follow prepare him for work in the billion-dollar industry of reinsurance?
His water resources engineering training taught him much about hydrology and even more about probability and statistics. Basically, water resources engineers are certain about absolutely nothing. However, if we are lucky we can characterize what we do not know... that is, we can quantify our uncertainty of future states of the hydrologic systems we wish to manage, and with that information we can do a better job of management. Abed (and other students of ours) has developed a very sophisticated understanding of this, backed up by extremely interesting, state-of-the-art models and research.

Khalil: How did McKee and your other professors help you accomplish your academic goals?
All the professors in the department and particularly in the Water Resources Program are passionate about their work and about helping students. On many occasions in our brainstorming and research meetings, Professor McKee would call other professors or we would storm their offices to seek their independent views, advice, or third opinions. This was really good for me to recognize the value of teamwork at an early stage of my career. There was always cooperative synergy between the teachers; I found that to be a very healthy sign of a reputable academic institution.

Khalil: Anything else you’d like to tell us?
My major professor, Mac McKee, is prudent, patient, and above all, graceful with his students. He served as my advisor in both master’s and doctoral work. There are people who shape one’s life considerably and, for me, Professor McKee was this mentor who knew my weaknesses and strengths and did a superb job advising me how to think scientifically and promote academic and real-world skills sets.

McKee: Any final words?
We are very proud of Abed Khalil and the way he has incorporated his education into a high profile career. Khalil is a true gentleman and will continue to bring honor to our institution. This is true of so many of our graduates who today hold positions of importance in cabinets and ministries throughout the world.
Development Update

At the Founders Day event on March 8, 2008, Utah State University President Stan L. Albrecht announced that the University had exceeded its $200 million comprehensive campaign goal only one year after the announcement of the campaign's public phase.

“We have exceeded our initial goal of $200 million, and we’re not turning back,” Albrecht told the audience. He went on to explain that the campaign would continue with a new goal of $400 million and extending the capital campaign through July 2012. He also discussed a plan to increase endowments throughout the university.

The College of Engineering has surpassed its campaign goal of $10 million dollars and is pursuing new sources of funding to achieve the goal of increasing our scholarship endowments and funding endowed chairs and professorships in the college.

This past year has been exceptional for the college with the dedication June 13 of the David G. Sant Engineering Innovation Building. This state-of-the-art engineering lab building has fostered many new industrial partnerships, as well as provided a central hub for many of the research projects that have been generated within all five engineering departments.

The 38,000 square foot building has four floors and accommodates engineering laboratories of various sizes with modular bays that allow labs to grow or shrink as needed. The cost of the building totals nearly $13 million.

David Sant and his wife Diann were guests of honor at the building dedication. They have donated more than $7 million to support both the construction of the new building and to create three new scholarship endowments in the college. They are the Sant Undergraduate Research Scholarship—to be awarded to an undergraduate student on the basis of his or her research proposal, scholastic achievement, and potential for contribution to one of the engineering fields; the Sant Innovation Fellowship—to be awarded to a graduate in the Department of Electrical and Computer Engineering; and the Thomas Berghoff Memorial Scholarship (in honor of a friend of the Sants) – this scholarship will support top two students in mechanical engineering.

A fourth endowment, the William G. and Delma L. Wagstaff Scholarship Endowment, will result in the creation of a scholarship for out-of-state students whose emphasis is manufacturing engineering.

The College of Engineering has received more than $3.8 million in scholarships and endowments this past year. These scholarships support our engineering students and provide the college with the means to recruit the best engineering students to Utah State University.

We appreciate the support we receive from our alumni and friends, including our industrial partners. The Sant Innovation Building is evidence of the continued growth of the College of Engineering. We invite you to tour our facilities. Please visit us soon.

Best Regards,
Val Potter
Executive Director of Development
val.potter@usu.edu
435-797-8012
Recognizing and Appreciating our Donors

July 2003 - July 2008

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On a visit he made in February of this year, David Sant just kept looking at Old Main and mentioned it was a favorite view of his. He was really proud to be a graduate of USU.
This is the same view Jeff and David enjoy in the photo to the right and was taken in May when David and Diann visited campus.