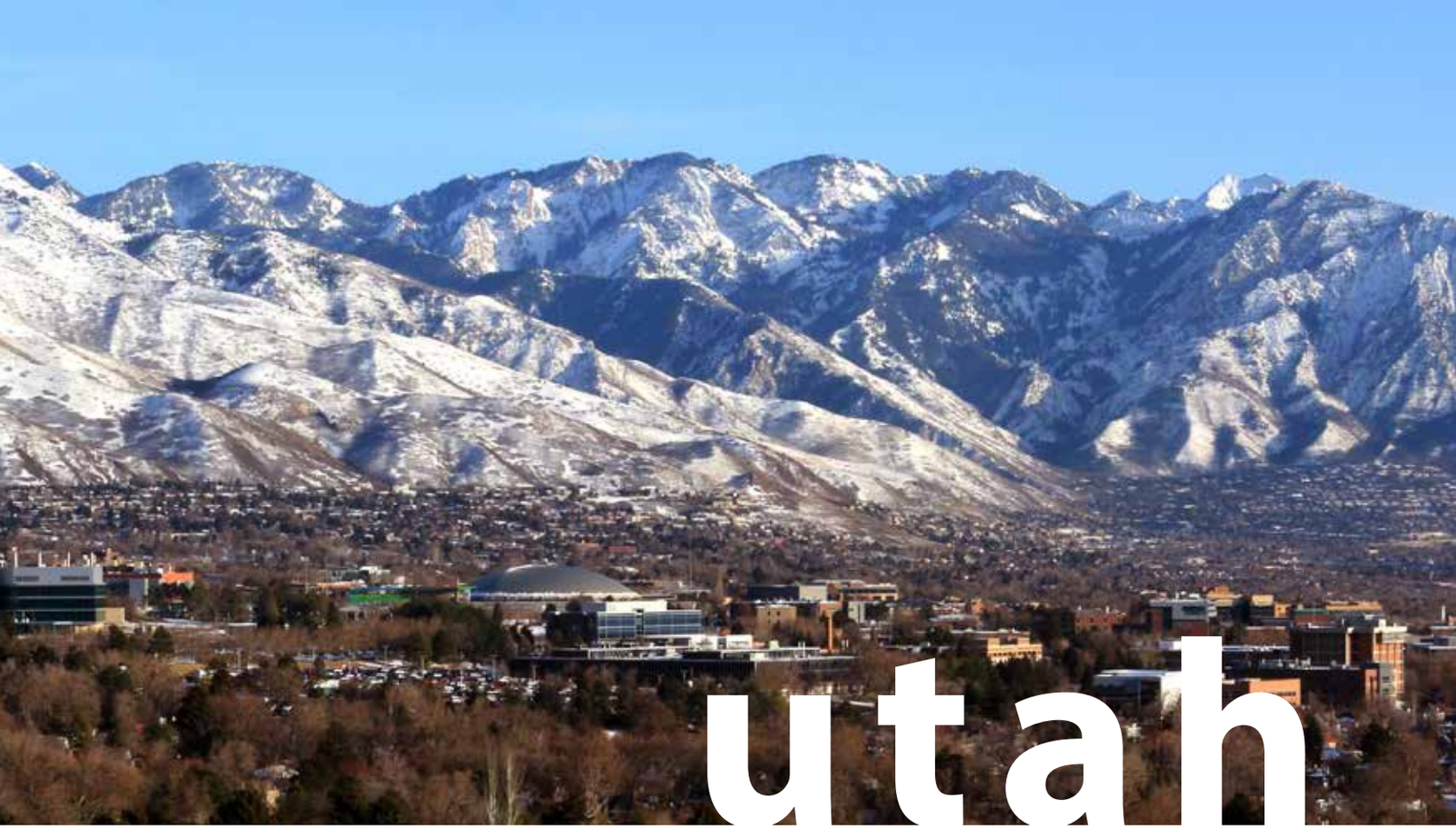


utah ENGINEERING

THE UNIVERSITY OF UTAH • COLLEGE OF ENGINEERING NEWSLETTER

WINTER 2015

BUILDING A NEW BEGINNING

University of Utah Mechanical Engineering Department Chairman Tim Ameel proudly pats his hand on the metal sign hanging on the wall next to his office in the newly-refurbished Rio Tinto Kennecott Mechanical Engineering Building. The placard touts new improvements to the building, which is the home to his department.

Some of these enhancements include the first regenerative elevator on the U campus, the first atrium with a horizontal fire-rated shutter, the first chilled beam system, and it is the first major remodel to achieve the U's new energy standard.

"We have a lot of unique features," Ameel said. "And we feel really good about that given where we started."

What began as a soot-filled, seismically-unsafe structure is the standard the rest of the university campus is sure to follow. The building was originally built in the 1950s and used as Kennecott Utah Copper Corporation's research facility. Ultimately, the university took possession of the building in the 1990s and began making upgrades to certain systems. But the actual $24 million renovation began in 2011, resulting in a 76,000-square-foot facility with nearly 60 offices, 11 student study areas, five conference rooms and 12 research labs. The project was completed using all non-state and private funds, including a lead gift from Rio Tinto Kennecott.

The building was dedicated during a ceremony Oct. 9 that included U College of Engineering Dean Richard B. Brown, U President David W. Pershing and Nigel Steward, managing director for Rio Tinto Kennecott.

"As I walked through the new Rio Tinto Kennecott Mechanical Engineering Building, it's hard to even imagine its former incarnation," Brown said during the ceremony.

The building also is more student-friendly. A new tutoring center is now open with five study areas, and the academic advising center is more centralized with both the undergraduate and graduate advisors in the same area. There is a computer lab with more than 30 machines that doubles as a teaching lab, and the Quartzdyne Café is open for business.

Ameel said he expects the building to receive a LEED Gold certification from the U.S. Green Building Council thanks to the building's new structural improvements.

MAJOR ENHANCEMENTS INCLUDE:

- Energy-efficient elevators — The building has two KONE EcoSpace elevators, special cars that use smaller motors with less horsepower than regular hydraulic elevators. The cars generate and store electricity every time they go down and save about 30,000 kilowatt-hours of electricity per year.
- Chilled beam system — Instead of standard air conditioners, the building uses a "chilled beam system" in which cold water moves through pipes that cool the warm air. The system uses 53 percent less energy than a standard system.
- Heating system — The building has boilers that are 95 percent efficient, much higher than standard heating systems.
- Tighter envelope — The building has a tighter seal to prevent air from leaking out and therefore requiring less energy to heat or cool. The new areas of the building also have a "rainscreen," a gap in the walls that prevents heat and moisture from penetrating.

- Earthquake stabilization — The building is constructed with shear walls – thick, rigid concrete walls that can withstand more shock from an earthquake. “Building restrained braces,” special diagonal braces that are designed to absorb vibrations from an earthquake, were also installed.
- Horizontal fire shutter — In the building’s four-story atrium is a horizontal shutter designed to close automatically in the case of a fire. When closed it prevents fire and smoke from spreading to the rest of the floors and allows the building to meet fire code without using giant circulating fans that require much more electricity.
- Walkway — A new pedestrian walkway was constructed over North Campus Drive that connects the building to the rest of the campus to provide a safe crossing.

“It’s thrilling to be here. We love the design of the building, and we love that it’s open,” Ameel said. “And we did our part. We did the very best we could to try and minimize its use of energy, and that’s the right thing to do.”

CRACKING UNDER PRESSURE

No wonder millions of people are afraid to fly. The thought of cruising 40,000 feet above the ground, wondering if the airliner is going to rip apart under the stress of the wind's force can be unnerving.

But University of Utah Mechanical Engineering assistant professor Ashley Spear is devoting her research to making sure such a tragedy never happens. She is studying how cracks occur in certain materials such as aluminum alloy in aircraft and spacecraft and is finding new ways to examine them with high-tech tools and software.

Spear said the reason for understanding how aerospace materials form cracks and fractures is threefold: to save lives by improving the maintenance practices of aircraft, to save money by better estimating when aircraft should be retired, and to help create better materials in the future to enable more resilient and more reliable products.

"If we understand how cracks form in materials, that opens the door to redesigning materials and to leveraging what we know," she said.

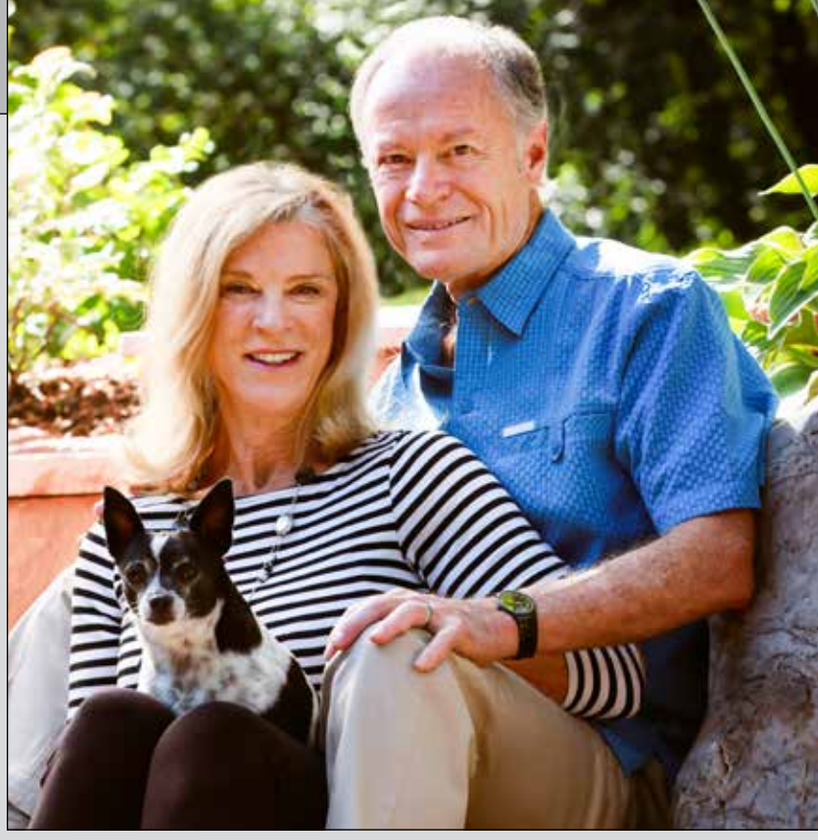
Spear has formed the Multiscale Mechanics and Materials Lab, a team of Spear and both graduate and undergraduate students that looks at various structural materials, including aerospace alloys and non-traditional materials like open-cell metallic foams. These metallic foams — which look like shiny sponges — serve as lightweight, multifunctional materials that can be used on the exterior of a space vehicle or as a heat sink or battery because of its open network of pores and conductivity of the metal. The foams can be superior to other common materials because they are extremely lightweight and can absorb impact better than fully-dense metal. Spear is specifically studying these foam materials to determine how and when cracks might form.

"We combine computational tools with advanced experimental tools to try and understand how materials deform and damage and fail by cracking," she said, adding that the team is studying the material properties on a microscopic scale as well as in three dimensions.

Spear's journey into the area of "fracture mechanics" actually began when she thought she was going into medicine. As a student at the University of Wyoming, she was first interested in biology and communications. But her acumen in math, coupled with her father as a role model — who also is an engineer — set her on a different path. Ultimately, she received a bachelor's in architectural engineering and a Ph.D. in civil engineering at Cornell University in Ithaca, New York.

"It's very likely that I would have gone into some other field if it weren't for my dad. My dad was critical," she said about her father's influence. "It's critical for young people now to have someone who serves as a role model and who can provide them with the information and encouragement to explore STEM fields."

BERT BUNNELL



Bert Bunnell never got into the business of designing and building his special infant ventilator for the money. He did it for the 21-year-old man from Philadelphia who once walked up and told him that being on his ventilator for just one hour saved his life. And he did it for the University of Utah bioengineering student who told him how the machine saved her life when she was born prematurely.

“She said, ‘I just want to shake your hand. I was on your machine in 1995,’” Bunnell remembers.

“It’s priceless,” he said about those chance meetings with past patients who used his machine.

But Bunnell’s journey from University of Utah engineering student to entrepreneur with a lifesaving medical device was an arduous path. While an undergraduate student at the U in chemical engineering, Bunnell was diagnosed with melanoma, a form of skin cancer, and was forced to do a month of studying while lying in a hospital bed. Bunnell beat the cancer and graduated in 1969. With the guidance and support of his advisor, then professor Noel deNevers, he moved on to the Massachusetts Institute of Technology where he received a Doctor of Science in chemical engineering. He then taught at MIT and the Harvard/MIT Joint School of Health Science and Technology.

Bunnell focused his research on the development of infants’ lungs. In the 1970s, doctors were using ventilators on premature babies to simulate normal breathing. “And the machines were just tearing up their lungs. They were too crude,” he said.

He encountered two research papers that gave him a new idea — instead of pushing one big pulse of air into the lungs once every one or two seconds, how about 10 smaller amounts every second, much like panting? Based on that concept, he created a ventilator that was much less harmful to babies’ lungs, and he started Bunnell Inc. with help from the University of Utah in 1980.

But it wasn’t an easy launch. Bunnell’s company ran into multiple obstacles including government regulatory politics and personnel problems that threatened the early shutdown of his company. Eventually, however, Bunnell received FDA approval in 1988 for what has now become the Life Pulse High Frequency Jet Ventilator, a device that has saved more than 120,000 newborns in the U.S. and Canada, Bunnell said.

Today, Bunnell is mostly retired from the now employee-owned company he started but still serves as its president and board chairman. He and his wife Kate — who earned her Master’s from the U in health, education and promotion — started the Sarah Beth Coyote Foundation, which contributes to charities in healthcare, medical research, education, and community support. Both generously support the U.’s bioengineering department through scholarships and have established a new endowment. Bunnell currently serves as an adjunct associate professor in bioengineering and is a member of the department’s Industry Advisory Board.

Looking back, Bunnell said he wouldn’t change a thing about the evolution of his company, despite its many pitfalls.

“In the end . . . if I had just been successful early on, we would have been acquired by another company, and they would have shut us down when they discovered what a small business we will always be. I would have been wealthy but bitter,” he said. “My primary motivation all along was saving babies.”

IN BRIEF

NSF ON THE FUTURE

As the director of the National Science Foundation's Engineering Directorate, it's part of Pramod Khargonekar's job to peer into a crystal ball and see where technology is going. What he sees is explosive growth in the world's population and how people consume energy, and it's up to researchers to tackle the inherent problems that will arise with change.

Khargonekar (pictured below) was the 2015 William R. and Erlyn J. Gould Distinguished Lecture on Technology and the Quality of Life. The event was held Tuesday, Nov. 10, at the J. Willard Marriott Library on the University of Utah campus.

His presentation, "Engineering for the 21st Century — A Perspective from the National Science Foundation," touched on the evolution of technology in the last 200 years, including the advancement of electricity, the mechanization of agricultural labor and the impact of the automobile.

By 2050, the Earth's population will rise to 9.6 billion people, and the middle class as well as the older population will become even larger. "Almost every part of the world will be impacted," he said.

In the future, there will be six technological trends to focus on, he said: ubiquitous computing and communications, systems science and engineering, nanoscale science and technologies, biomedical/medical technologies, behavioral/economic/cognitive sciences, and the art of design and aesthetics. The agency has been funding projects in clean energy technology, cyber-physical systems, resilient infrastructure systems and processes, and in smart communications. He added that the agency also is investing more in broadening the diversity of students in engineering.

Research at the University of Utah's College of Engineering continues to get international recognition as faculty tackle new problems. Here are some milestones in research that have gotten global attention recently. You can read more about them at www.coe.utah.edu/.

MAPPING THE BRAIN

A team led by Valerio Pascucci (pictured above), a professor in the University of Utah's School of Computing and researcher at the Scientific Computing and Imaging Institute (SCI), has developed software that can create a 3-D model of an animal's brain that is much quicker and requires less computer power and system memory. Working with Alessandra Angelucci, U professor of ophthalmology and visual science, Pascucci's software can more accurately create a view of the brain's network of neurons. This can help medical researchers understand how the brain's connectivity is disrupted in mental and neurological conditions such as schizophrenia, depression, anxiety and autism.

PROGRAMMING AND PREJUDICE

Can computer code be prejudiced? A team of researchers led by Suresh Venkatasubramanian, an associate professor in the University of Utah's School of Computing, have discovered a technique to determine whether an algorithm used for hiring decisions, loan approvals and other such tasks could be biased like a human being. And if so, they also have determined a method to fix these potentially troubled algorithms.

AWARDS

RICHARD B. BROWN

Richard B. Brown, dean of the College of Engineering, was elected a fellow of the National Academy of Inventors, making him one of 582 leaders of invention and innovation at research universities and institutes recognized with NAI fellow status. He is also a recipient of this year's Governor's Medal for Excellence in Science and Technology for the College of Engineering's significant growth in size and quality during his tenure as dean.

JOHN GREENHALL

John Greenhall, a Ph.D. student in mechanical engineering, received the NASA Space Technology Research Fellowship (NSTRF) for understanding how ultrasound waves can be used to create patterns of nanoparticles in a photopolymer resin, which will then be cured using a stereolithography 3D printing process. The award is given to students who can help NASA create innovative new space technologies.

CARINA HAHN

Carina Hahn, a combined bachelor's and master's student in the University of Utah's Materials Science and Engineering department, was selected for the Society of Women Engineers (SWE) Outstanding Collegiate Member award. This award is given to SWE members nationally who have made outstanding contributions to the organization, the engineering community and their university.

PRECIOUS CANTU

Precious Cantu, a graduate research assistant in electrical and computer engineering, received a Fulbright U.S. Student Award to Switzerland (also known in Switzerland as The Swiss Government Excellence Scholarship). She is one of six U students who have been accepted this year to study abroad through the Fulbright program for 2015-2016 and the only one from the U's College of Engineering. Cantu currently is conducting research at École Polytechnique Fédérale de Lausanne.

TIMOTHY AMEEL

Timothy Ameel, professor and chair in the Department of Mechanical Engineering, was named a 2015 fellow of the American Society of Mechanical Engineers (ASME), the organization's highest membership grade. He was named for his outstanding achievements and leadership in microfluidics and nanofluidics.

ROSS WHITAKER

Ross Whitaker, University of Utah School of Computing chairman, has been elected to the American Institute for Medical and Biological Engineering (AIMBE) College of Fellows. The AIMBE College of Fellows represents the most accomplished and distinguished medical and biological engineers responsible for innovation and discovery.

ARCS ADVANCING SCIENCE IN AMERICA

This year, the ARCS Foundation Utah Chapter has given new scholarship awards to three University of Utah engineering students and a medical researcher to help them pursue their degrees.

This year's recipients are (left to right): Jocelyn Todd, a graduate student in bioengineering; Cecinio "Nikko" Castillo Ronquillo Jr., a researcher with the Moran Eye Center; Amanda Reynolds, a graduate student in bioengineering; and Aniqua Z. Baset, who is researching computer security in the U's School of Computing.

ARCS Foundation Utah Chapter is one of 17 chapters of the national nonprofit women's organization throughout the country, which helps U.S. students completing graduate degrees in science, engineering and medical research at 53 research universities across the nation.

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STUDENT LIFE

HITTING THE GROUND RUNNING

As things get tough, University of Utah bioengineering doctoral student Jocelyn Todd starts to run. She's not running away, but rather she's running for success, both in the lab and on the track and field.

The 22-year-old St. Louis native is a first-year graduate student at the U working toward her bioengineering Ph.D. While studying biomechanics, Todd also was on the university's first cross country team to qualify for the NCAA Division 1 National Cross Country Championships, held this year in Louisville, Ky. Next semester, she'll continue to run on the college track and field team, competing in the 5K and 10K races.

"It's nice to a have balance," Todd said about competing for the University of Utah while studying engineering. "Some engineers can get too focused on studying all the time. But it's good to get out and talk to other people and relax and break out of the bubble."

In the lab, Todd is using computational simulations of human tissue to better understand them. She is researching the mechanics of cartilage in the hips and the damage that can result when it is overworked. Such defects, she said, can lead to conditions like arthritis.

"I think a lot about biomechanics from a performance and efficiency standpoint," she said about how her interest in athletics relates to her study of engineering.

Todd received her bachelor's degree in bioengineering at the University of Iowa in Iowa City before arriving at the University of Utah where she is now working with her advisor, professor Jeff Weiss, in his Musculoskeletal Research Laboratory. She also was named a 2015 National Science Foundation Graduate Research Fellow, and she received a scholarship from the Utah chapter of the ARCS Foundation, a non-profit organization that offers financial awards to students completing degrees in science, engineering and medical research.

Because both of her parents are engineers, she said she is "in a comfort zone with engineering" and plans to either conduct research, work for an engineering consulting firm or teach at a university. Meanwhile, she will continue to run for the university's track team.

"There's definitely a correlation between running and studying engineering where you're working hard and just chipping away everyday, putting your nose to the grindstone," she said. "I make time for what I care for, and I just make it work."