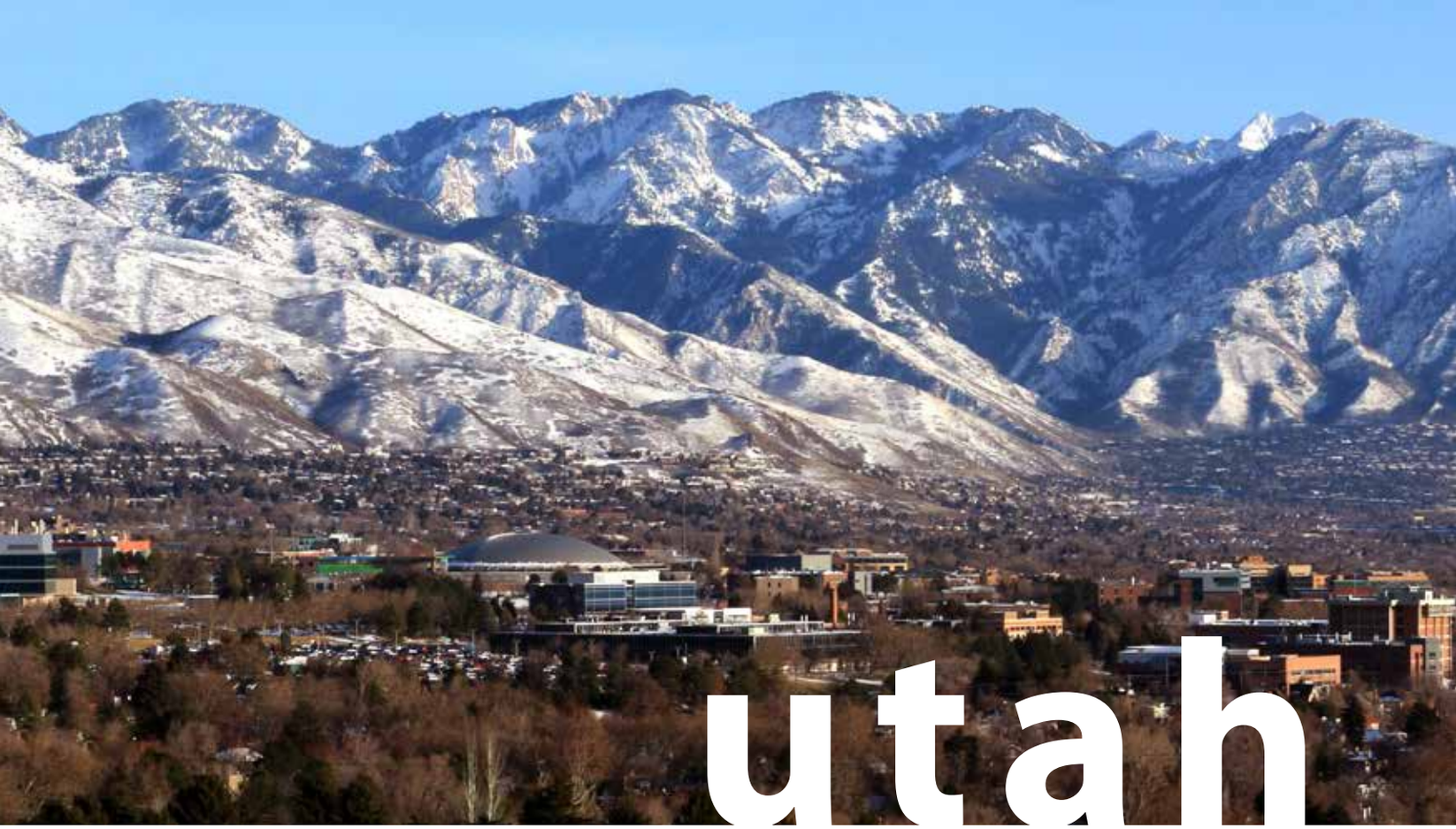

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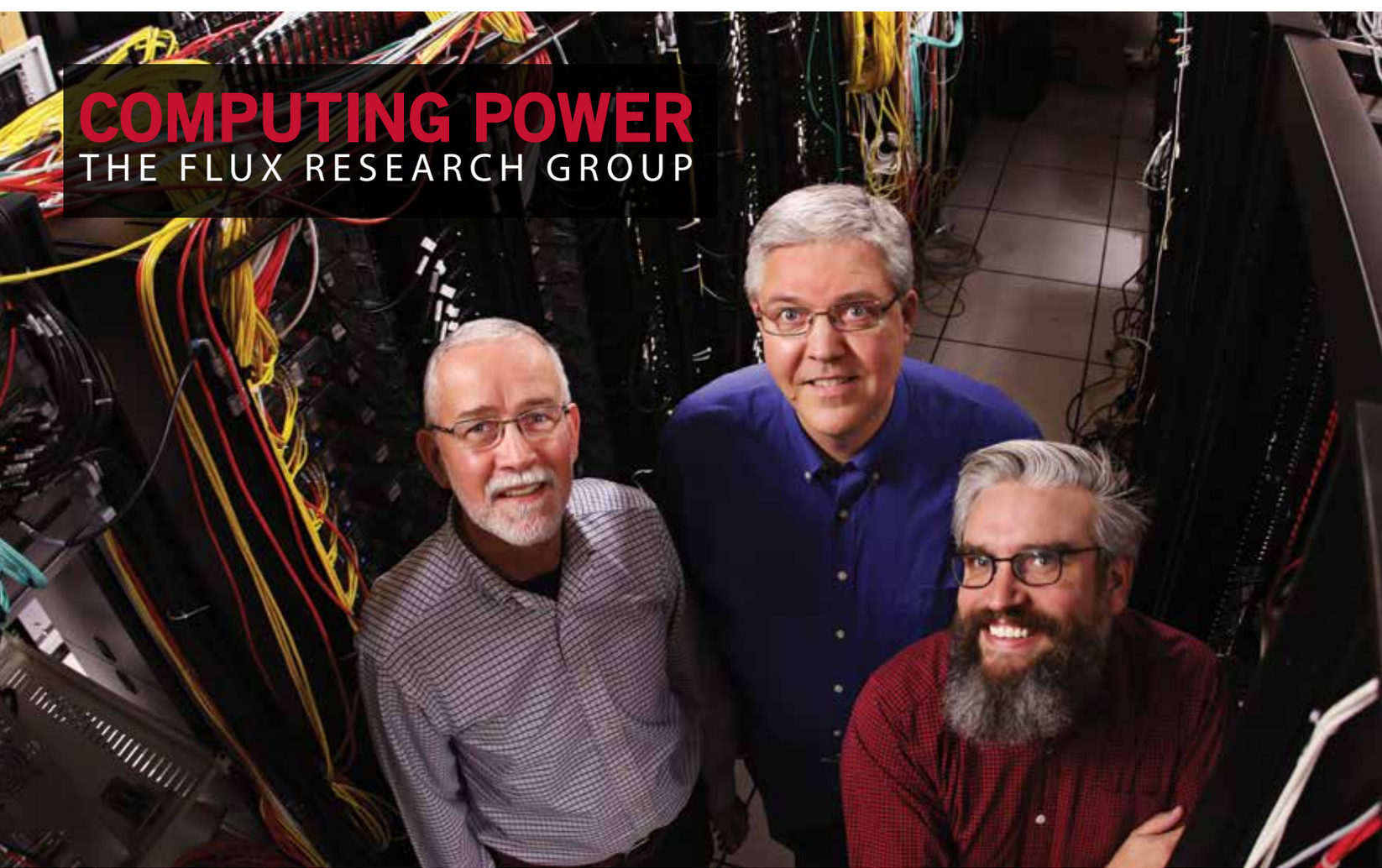


COMPUTING POWER
THE FLUX RESEARCH GROUP

THE UNIVERSITY OF UTAH • COLLEGE OF ENGINEERING NEWSLETTER

WINTER 2018

CONSTANT STATE OF FLUX

Advances in the computer world move as fast as the electrons in a processor. That's why the University of Utah College of Engineering's Flux Research Group adopted its name — this is a research team that must constantly move forward to be ahead of the technology curve.

"As a whole, the Flux Research Group is about research into networks, distributed systems, middleware, operating systems, security and a large number of other topics," said University of Utah School of Computing research associate professor Robert Ricci, one of the group's co-directors. "But 'Flux' represents that idea of shifting what we are working on over time."

Tucked into a corner of the Merrill Engineering Building on the College of Engineering campus, the Flux Research Group of three faculty members, eight research staff members, and dozens of graduate students is developing computer technologies for the future. The lab is led by Ricci, School of Computing research assistant professor Eric Eide, and School of Computing associate professor Kobus Van der Merwe. These are just a few of the projects in development:

CLOUDLAB — This project that develops new features for cloud computing recently received a new $9.7-million award from the National Science Foundation to expand and extend its operations for another three years. Cloud computing, in which shared data and content are stored and processed in central servers for large numbers of people (a technique used by services from Facebook to Netflix), has become a hot buzzword in computing and data storage.

CloudLab consists of three networked computer facilities at the U, Clemson University in South Carolina, and the University of Wisconsin-Madison, with a combined total of more than 1,000 servers. Researchers and students can test their software and applications' cloud-based features on CloudLab as well as use the facility to develop new features for cloud computing. The project's current phase will involve developing technologies that give researchers more control over the servers as well as new security features.

EMULAB — When researchers need to test their computer systems in a highly controllable environment, Emulab is the place to do it. It is a 500-server network testbed that recreates a wide range of computing environments so scientists can develop, evaluate and debug their systems. While it can help those in the development of software, Emulab also is used in education to aid faculty and students.

COVER PICTURE:
(Left to right) Kobus Van der Merwe, Eric Eide and Roberet Ricci

PHANTOMNET — Cell phone networks today are built to handle just the traffic of mobile phones. But the rise of the "Internet of Things" — the networking of other devices such as smart appliances, cars, home security systems and more — could pose a serious problem for cell networks when they become more popular and clog up data traffic. The Flux Research Group is investigating faster, more robust technologies in wireless networks that will be radically different than today's 4G cell systems.

DISTRIBUTED COMPUTING — Researchers are also looking into more efficient ways to use memory so data that is retrieved frequently can be positioned for faster access while other data can be spread out more evenly among a system's servers. This could be especially beneficial for online services such as Facebook or LinkedIn that need to access smaller bits of data more quickly.

The Flux Research Group began more than 25 years ago when Jay Lepreau, who was then the Assistant Director of the Center of Software Science in the U's Department of Computer Science, received an award from DARPA to investigate "Fast and Flexible Mach-based Systems," according to Eide. But Lepreau convinced the Department of Defense to support not just engineering on the existing Mach operating system but also research on a new operating system called Fluke — and with that, the Flux Research Group was born.

Lepreau led the group until his death in 2008. Today, Ricci, Eide, Van der Merwe, and their team are dedicated to working with other academic and government researchers as well as private companies to test and develop new evolving computer systems. The Flux Group has received tens of millions of dollars in government and corporate grants since its inception.

The group has contributed to a number of digital features that are in use in products today. For example, all Android smartphones have security features based on "Flask," the Flux Advanced Security Kernel, which limits the ability of apps to access protected files and resources. Members of the Flux Group also worked on the Mach microkernel, which today is a part of Apple's iOS operating system for its iDevices.

INNOVATION LAB OPENS

University of Utah chemical engineering associate professor (lecturer) Tony Butterfield has always believed that one learns best by doing.

That's the concept behind the newly-opened Peter and Catherine Meldrum Innovation Laboratory, a 2,300-square-foot makerspace in the basement of the Merrill Engineering Building where students can conduct hands-on work on engineering projects from building a spectrophotometer and photobioreactor to designing components of drug-delivery systems. The $1 million lab took about a year and a half to design and build.

The hub, which houses a 3D printer, drill press, band saw, laser cutter, computer controlled router and other high-tech equipment, was built specifically for first-year students for Butterfield's Chemical Engineering Innovation and Design class, though all students can use it. It also provides the kind of environment where students can work on team-based projects and replicate the work flow of real-world research centers.

"This hands-on-based learning is much more effective than just sitting in front of someone who is talking," said Butterfield (pictured above, far left), who helped design the lab. "The big picture is to bring this kind of learning throughout our curriculum, and to do that we need a dedicated space."

The $1 million laboratory was the result of generous donations from a number of benefactors, led by The Peter and Catherine Meldrum Foundation which gave $500,000 to retrofit the space for the lab (the area was formerly the Utah Nanofab). Peter Meldrum graduated from the U in 1970 with a bachelor's in chemical engineering and later became the co-founder and chief executive of Salt Lake City-based Myriad Genetics.

"Chemical engineering is a remarkably innovative discipline that is addressing some of society's most critical needs in areas such as healthcare, energy and recycling," said Meldrum. pictured above with his wife Catherine. "Cathie and I are pleased to contribute to this exciting creative learning process at the U."

Butterfield plans to bring the first group of students into the lab for the spring semester.

ALUMNUS SPOTLIGHT
DENSEN CAO

For his entire career, University of Utah College of Engineering alum, Densen B. Cao, has been lighting the way to better living.

Cao studied under University of Utah materials science and engineering Distinguished Professor Gerald Stringfellow and is the founder and chief executive of the CAO Group in West Jordan, Utah. Cao has developed several high-tech products with light emitting diodes (LEDs) that helped change the medical, dental, forensics, and lighting industries.

“Jerry was a great mentor,” he said of Stringfellow. “He was really detail oriented and provided great guidance in my research. We made a lot of progress in the field.”

Stringfellow’s groundbreaking research on LEDs would help lead Cao to his own technologies in the field.

In 2001, Cao introduced the first LED dental curing light, a device used by dentists that helps with the hardening of polymers used in filling cavities. With this technology, filling cavities is now faster and easier for dentists to provide high quality care for patients. Prior to Cao’s LED lights, dentists used larger, more cumbersome halogen lamps for the curing of the polymers. Today, nearly all of the LED dental curing light manufacturers have licensed his technology.

A year later, he created one of the first LED light bulbs for home lighting, a product that is now replacing the older incandescent light bulbs. Cao was instrumental in creating one of the first bulbs in which the LED light could shine in all directions, not in just one. LED lights are far more economical because they last longer and use less energy.

Cao also uses his LED technologies in forensic lights that are used on crime scenes to highlight bodily fluids and other evidence such as blood, saliva, urine, bone and fibers. In the past, forensics experts used halogens lamps with special filters to pick up evidence at crime scenes, but LED light allows police to carry smaller, battery-powered lamps that are more convenient and portable. This technology was used in a wide variety of high-profile criminal cases, including those of JonBenét Ramsey, O.J. Simpson and Laci Peterson. “We are the dominant manufacturer in the market,” Cao said of forensic lights. “We help most of the police departments in the country with this.”

After earning his bachelor’s in electronic engineering from Jilin University in China, Cao came to Utah in 1986 where he earned his master’s and doctoral degrees in materials science and engineering working under Stringfellow. In 2000, he founded CAO Group in West Jordan and later launched CAO Medical Co. and Golden Valley Optoelectronics Co., both in Langfang, China. He has more than 160 issued and pending U.S. and international patents in related fields. He has been a member of the College’s Engineering National Advisory Council for two years.

“It was the best experience,” he said of his time at the U. “I had a great professor in Jerry, and we were doing the leading research at that time. A great professor can definitely point you in the right direction.”

IN BRIEF

MASTERING CONSTRUCTION

The U.S. population is always growing, and as University of Utah Civil and Environmental Engineering department chair, Michael Barber, says: "Those people have to live and work somewhere."

That means both residential and commercial construction will continue to boom as the population rises. Construction spending in the U.S. already has been on the increase each year since 2011, according to the U.S. Census Bureau, and it is likely to be an even more important issue as lawmakers look to begin repairing the country's ailing infrastructure.

That's why Barber's department just launched bachelor's and master's programs in construction engineering at the University of Utah, two rigorous programs that focus on the engineering and business-related dynamics of nonresidential construction. Currently, the curriculum is taught on campus, but Barber said the master's program will be all taught online in the next couple of years (as well as some of the undergraduate courses).

"It's a heavy emphasis on commercial construction," said Barber, who began working on the program with local construction experts nearly three years ago. "We're talking about construction involving buildings, highways, bridges — the whole industrial corridor. It requires a high level of engineering competency."

The master's program, which begins in the spring 2018 semester, will include courses on building construction as well as highways, bridges and other roadway construction; facades; cost estimation; project scheduling; business law; environmental regulations; and construction safety. Classes taken for the College's new Entrepreneurship Certificate also can count toward the construction degree. It will require 30 credit hours and is being taught both on campus and online. Meanwhile, the department already has started a bachelor's in construction engineering program this fall semester, a 126-credit-hour curriculum that includes two years of construction engineering courses.

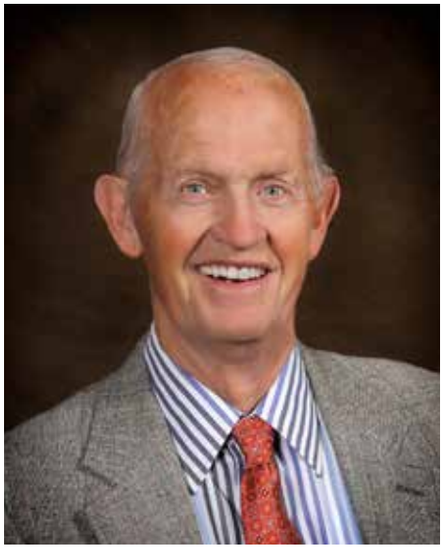
The degree can be especially valuable in the construction field when working with architects, engineers and contractors because the courses provide well-rounded expertise. "We want to educate the kind of person who can be on the ground, who understands engineering and construction and can blend those two disciplines together," Barber said.

Two students from the University of Utah's College of Engineering and an ophthalmology resident at the John A. Moran Eye Center were awarded graduate scholarships at the 8th Annual ARCS Foundation Utah Scholar Awards Luncheon Tuesday, Oct. 17. The event was held at the John A. Moran Eye Center auditorium.

This year's recipients include: (pictured, left to right) Chantel Charlebois (bioengineering), Samuel Sprawls (materials science and engineering), and Bradley Jacobsen (ophthalmology/John A. Moran Eye Center).

ARCS Foundation Utah Chapter is part of the national nonprofit women's organization throughout the country which helps U.S. students completing degrees in science, engineering and medical research. The Utah chapter supports students in doctoral programs at the University of Utah and is dedicated to bringing the brightest students to Utah to help with their education.

IN MEMORIAM: DAVID A. DUKE



David A. Duke, a University of Utah graduate, former chief technology officer with Corning Inc. and an inductee in the National Academy of Engineering, passed away Monday, Oct. 9 of natural causes. He was 81.

Duke graduated with a bachelor's in geology and geophysics in 1957 and a master's and doctorate in geological engineering in 1959 and 1962, respectively, and was a fierce supporter of the U's College of Engineering throughout his career. He was a member of the College's Engineering National Advisory Council for 13 years and was a generous benefactor, providing financial support for the construction of the Warnock Engineering Building as well as for the David A. and Hanne J. Duke Scholarship in Materials Science and Engineering.

Upon graduation, he started working for Corning as a research scientist, a company he would stay with for 34 years. During that time, he was awarded 10 patents, most for Corelle dinnerware. During his tenure with the company, he attended Harvard Business School's Professional Management Development program and then was put in charge of several of Corning's businesses, including those involving science products, Radomes, catalytic converter substrates, and telecommunications/optical waveguides. In 1988, he was elected vice chairman and chief technical officer of Corning and was a member of its board of directors. He retired from the company in 1996.

"David Duke was an engineering giant whose inventions and leadership had a huge impact on people's quality of life in areas ranging from dinnerware to optical communications and air quality," said Richard B. Brown, dean of the U's College of Engineering. "He was recognized as a global technology leader, and honored with the highest awards given in the engineering profession. I appreciate his remarkable vision, judgement and support as a member of my National Advisory Council."

SOLZBACHER NAMED ECE CHAIR

University of Utah electrical and computer engineering professor Florian Solzbacher, who has been with the University of Utah since 2004, officially assumed the position of department chair beginning Wednesday, Nov. 1.

Solzbacher replaces outgoing chair, Gianluca Lazzi, who has taken a position as Provost Professor of Ophthalmology and Electrical Engineering at the University of Southern California. Lazzi, was chair of the department since 2009.

Solzbacher joined the U in 2004 as an assistant professor of electrical and computer engineering after earning a doctorate in electrical engineering at Technische Universität Ilmenau in Germany. He was named an associate professor at the U in 2009 and a full professor in 2012. He was the associate chair for the department's academics and special initiatives since 2016. He is also co-director of the Utah Nanotechnology Institute at the University of Utah and was director of the Utah Nanofabrication Laboratory. He has launched or been involved in several businesses, and is founder, president and chairman of Blackrock Microsystems Inc. in Salt Lake City, which provides tools for neuroscience, neural engineering and neuroprosthetics research.

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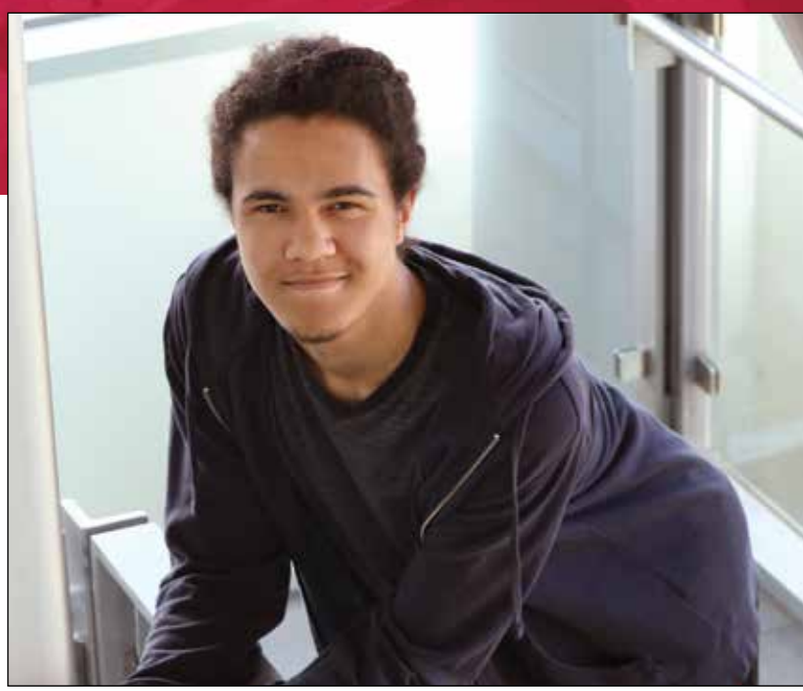
STUDENT LIFE
EDWARD BARROWES



A tragic 2015 semi accident in Wyoming left many victims: the motorist who was killed, a truck driver who landed in prison, and the truck driver's son whose future began to unravel from the aftermath.

But the son, then-17-year-old Edward Barrowes of Salt Lake City, was determined to not let his truck driver father's tragedy interfere with his own dream of going to college. With financial help from longtime University of Utah College of Engineering benefactors, David and Annette Jorgensen, Barrowes is now successfully enrolled in the College's bioengineering program.

Barrowes' father fell asleep while driving his semi on Interstate 80 one April morning, causing the truck to veer off the road, striking and killing a motorist on the side of the road. The father was sent to prison, leaving Barrowes, his mother and his younger brother facing a challenging future. "He was the primary income for our household," Barrowes said about his father. "Then all of a sudden, we were stricken with the possibility that college wasn't an option for myself."

Barrowes, who was attending West High School at the time, began to let his studies slip. His mother, who was working on a master's degree in special education and instructional design, didn't know how she would finish school. But when his father went to prison, "it was like a big wakeup call for me," Barrowes said. "That realization kicked me into high gear in my studies."

He and his mother both worked fulltime as cashiers at the same Salt Lake City grocery store to make ends meet, but the prospect of going to college seemed dim. His last year in high school, however, Barrowes' received a one-year scholarship to attend the University of Utah, and he became interested in biomedicine after a visit to a medical-device conference. "I saw some amazing stuff there that totally lit up my mind and my imagination," he said.

He later received a scholarship from the Jorgensens, part of a program that currently provides $6,000 to $7,000 to 24 U engineering students based on grade point average and financial need. "It just blew me away," Barrowes said. "This was a scholarship that essentially covered my entire education for my undergraduate degree."

Today, Barrowes is working toward his bachelor's in biomedical engineering and wants to one day work on neuroprosthetics and brain-machine interfaces. "It's been a steady upward climb," Barrowes said of his journey so far. "But I'm sure that if I pace myself and work really hard, I can achieve my goals."