



# utah

## ENGINEERING



### BIONIC-POWERED PARTNERSHIP

PROSTHETICS COMPANY, OTTOBOCK,  
DAZZLED BY U TECHNOLOGY



# DECADES OF DEDICATION



**D**ouglas Christensen came to the University of Utah College of Engineering as an assistant professor with a clear goal in mind. Disillusioned with the war in Vietnam and a five-year stint in the defense industry, he wanted to find a way to use his engineering skills to improve people's quality of life. And he also missed walking the halls of the university since graduating from the U with a doctorate degree in 1967.

Five decades, more than 30 patents, hundreds of publications, multiple awards and fellowships later, Christensen — who is both a professor of biomedical engineering and electrical and computer engineering — is still at the U helping people.

When asked what has kept him at it for so long, Christensen's answer is simple: "I enjoy it!"

"You generally are satisfied and enjoy the things you are good at," he said with a chuckle, "and apparently I'm okay with teaching and research."

Given his resume, it's easy to see that as an understatement. In his decades-long academic career, Christensen has not restricted himself to one specialty or area of emphasis. He has straddled the line between biomedical engineering and electrical and computer engineering, working with everything from microwaves to ultrasound while excelling as both a researcher and a lecturer.

He earned a bachelor's degree from Brigham Young University, a master's from Stanford University, and a doctorate from the U

(all in electrical engineering) and conducted postdoctoral work at the University of Washington. After five years in industry, Christensen then became an assistant professor in electrical engineering at the U. In 1974, he was asked to join a newly launched department at the U: bioengineering.

"It's evolved, of course," Christensen said about the department, now known as biomedical engineering. "It's certainly grown in terms of faculty. I think when I joined, there were just four members."

Today the BME department has over 27 faculty members and approximately 550 students.

"It's much larger now and that's been good from the sense of broadening our reputation and broadening our capabilities and what we can offer to the students."

With a joint professorship in two departments, Christensen got to work at the intersection of biology and electromagnetics. Initially his research centered on using microwaves to heat the body (hyperthermia) and subsequently enhance the effectiveness of cancer treatments. He then expanded his focus to an increasingly diverse array of subjects. He co-developed a biosensor that detects heart attacks by using a laser to monitor proteins in the blood, a fiber optic temperature probe, drug delivery devices that are triggered acoustically, and more.

Now, in the past 15 years, he has turned his expertise and experience to the burgeoning field of therapeutic ultrasound.

"Everybody's familiar with diagnostic ultrasound that a pregnant woman gets to make sure the fetus is developing correctly," Christensen explains. "That ultrasound is very low-level to make sure you don't harm any dividing cells, and the FDA has strict limits on power. But it turns out that for some applications in the body, you can turn the power up purposely to destroy tissue. And it only destroys tissue where it's focused, sparing the surrounding normal tissue."

Therapeutic ultrasound has now been used to treat uterine fibroids, prostate cancer, and even essential tremors, by targeting the tiny spot in the brain that's misfiring, without the need for invasive open skull surgery.

And that's the beginning of what therapeutic ultrasound technologies can bring, he said.

"The field has just exploded. This brand-new application of ultrasound in the body is fascinating and has so many possible applications for many diseases," Christensen said.

The future applications of this noninvasive technology go beyond tissue ablation. It could be used to break up blood clots, treat depression through neuromodulation, temporarily open the blood-brain barrier to more effectively deliver Alzheimer's medication, and manage pain.

Yet the noninvasive nature of this technology is not without its difficulties, and that's where Christensen comes in. When the high frequency waves of

an ultrasound go through the skull or other bone and tissue, they are warped. To correct for that and maintain the ultrasound's precision, Christensen has developed a software program that simulates the effect to account for the warping and "phase correct" the focused beam.

"Some of my software has helped to analyze how you build the applicators that go around the skull or the breast," he explained.

While staying at the forefront of his chosen fields, Christensen has also prided himself in excellence in teaching (he's received four teaching awards throughout his career, most recently the "Calvin S. and Jeneal N. Hatch Prize for Excellence in Teaching"). And he doesn't see research and teaching as mutually exclusive.

"They feed on each other. They help each other," he said. "What I do with my research helps me to guide how I present material to students, and then teaching helps your research because you have to explain things and you have to communicate. The only thing that isn't synergistic is the time."

After more than 50 years at the University of Utah, what is Christensen most proud of regarding his career? "It's a part that I can't measure and don't know for sure," he said. "But I assume my biggest impact has been on students down the road over the years. Probably as much as my research."

"I hope what I've taught students over the years has paid off for them," he added. "That would be my greatest reward."

## JACOBSEN TOWER COMPLETION

Stephen C. Jacobsen was an engineer, roboticist and biomedical pioneer. A Distinguished Professor of Engineering at the University of Utah, he was at the forefront of robotic and biomedical device design. In honor of his legacy and thanks to a generous leadership gift from The Stephen C. and Lynda M. Jacobsen Foundation, the College of Engineering dedicated this latest addition to the Rio Tinto Kennecott Building to him and his wife.

A dedication ceremony Sept. 30 for the Stephen C. and Lynda M. Jacobsen Tower included members of Jacobsen's family and remarks from his sister-in-law, Sharyn Rash, and his daughter Genevieve Jacobsen Boyles.

A pioneer of technology commercialization, Jacobsen was happiest working on research and development projects that were grounded in engineering, medical, and scientific principles, but generated products that could be used by people.

His legacy includes an array of systems and products for national laboratories and for more than 200 governmental organizations and commercial clients worldwide.

"You didn't need to spend much time with Steve to know that he was a genius," College of Engineering Dean Richard B. Brown said

during the ceremony. "Steve helped put the University of Utah on the map. That was certainly true for the College of Engineering."

Lynda (Lynn) Jacobsen graduated Summa Cum Laude from the University of Arizona and completed an MFA in Theater at the U. An accomplished pianist, she was passionate about arts and culture, and served on the Salt Lake Arts Council, The Utah Natural History Museum and Red Butte Garden boards.

The new four-story Jacobsen Tower in the Rio Tinto Kennecott Building is the final phase of a 10-year project, adding 22,600 square feet to the center of the structure for senior design, mechatronics courses, freshman design, and several new research labs and offices.

The Jacobsen Tower, with its hands-on student labs, is the new hub of the undergraduate experience. Through a sequence of project-based courses, mechanical engineering students work on real-world problems. In Mechanical Engineering, how students learn is just as important as what they learn.

For the faculty, the addition includes new labs that help turn ideas into reality including assistant professor Tomasso Lenzi's HGN Lab, sponsored by Ottobock; and associate professor Bart Raeymaekers' Nanotribology and Precision Engineering Laboratory.



# BIONIC-POWERED PARTNERSHIP



Researchers at the University of Utah's Bionic Engineering Lab have developed the "Utah Bionic Leg," the most advanced bionic leg ever created. Now, the university has forged a new partnership with the worldwide leader in the prosthetics industry, Ottobock, to license the technology behind the Utah Bionic Leg and bring it to individuals with lower-limb amputations.

"The largest prosthetics manufacturer in the world has committed to use the highest level of technologies available in robotics and AI to bring this prosthetic leg to those who need it as soon as possible," said University of Utah mechanical engineering associate professor Tommaso Lenzi, who is the lead researcher on the Utah Bionic Leg project.

A ceremony and press conference announcing the partnership were held Wednesday, Oct. 5, in Lenzi's Bionic Engineering Lab in the Rio Tinto Kennecott Building on the University of Utah campus. Attending the ribbon-cutting ceremony were Professor Hans Georg Näder, owner and Chairman of the Board of Directors of Ottobock; Georgia Näder, Ottobock Supervisory Board Member; College of Engineering Dean Richard B. Brown; and Lenzi. Alec McMorris, an above-knee amputee who has spent years working with the lab, demonstrated the functions of the leg.

Lenzi's Utah Bionic Leg uses motors, processors, and advanced artificial intelligence that all work together to give amputees more power to walk, stand-up, sit-down, and ascend and descend stairs and ramps. The extra power from the prosthesis makes these activities easier and less stressful for amputees, who normally need to over-use their upper body and intact leg to compensate for the lack of assistance from their prescribed prosthetics. The Utah Bionic Leg will help people with amputations, particularly elderly individuals, to walk much longer and attain new levels of mobility.

"If you walk faster, it will walk faster for you and give you more energy. Or it adapts automatically to the height of the steps in a staircase. Or it can help you cross over obstacles," Lenzi says.

The Utah Bionic Leg uses custom-designed force and torque sensors as well as accelerometers and gyroscopes to help determine the leg's position in space. Those sensors are connected to a computer processor that translates the sensor inputs into movements of the prosthetic joints. Based on that real-time data, the leg provides power to the motors in the joints to assist in walking, standing up, walking up and down stairs, or maneuvering around obstacles.

Ottobock's sponsorship of the Bionic Engineering Lab will fund a state-of-the-art motion analysis system that includes a force-sensing treadmill and force-sensing staircase, 3D motion-capture cameras, and other equipment to help analyze how the Utah Bionic Leg benefits users and to discover new ways to improve their technology.

In exchange, Lenzi's Bionic Engineering Lab will officially be called the Hans Georg Näder Laboratory, or HGN Lab. Ottobock will also gain joint ownership with the University of Utah for future technologies produced in the lab.

"This sponsorship will make the HGN Lab one of the best — if not the best — equipped lab in the world that is focused on assistive technologies and prosthetics," Lenzi said. "And we have a development agreement where engineers in my lab and from Ottobock's research-and-development division will work together to go from the current prototype of the Utah Bionic Leg and create a leg that will hopefully go on the market soon."

# PAKISTAN EDUCATORS TOUR U CAMPUS

A group of eight university vice chancellors from Pakistan recently spent a week training at the University of Utah as part of the Higher Education Systems Strengthening Activity (HESSA) – a USAID-funded, U-led project. During their one-week visit in July, organized by Civil and Environmental Engineering Chair Michael Barber, the education leaders toured U facilities and learned more about U.S. university management.

Pakistan's population is the youngest it's ever been and readying that influx of youth for a successful transition to the job market is paramount to the country's long-term success. However, Pakistani employers report gaps in graduate preparedness. That's why the \$19 million USAID's HESSA project is aimed at boosting Pakistan's higher education ecosystem and better preparing graduates to meet the needs of the modern workplace.

In 2021, the University of Utah was selected as the lead implementation partner of USAID's HESSA, thanks in large part to the U's experience with educational capacity building in Pakistan. Partner institutions include the University of Alabama and the Institute of International Education. Over the course of five years, the trio will work with 15 universities in Pakistan to strengthen their leadership practices; approach to curriculum, research, and industry partnerships; and student life initiatives.

"We were able to exchange ideas, showcase what makes the U a world-class institution, and continue to build partnerships that will advance the caliber of our respective universities and graduates," said Barber, who is also principal investigator for USAID's HESSA.

While on campus, the vice chancellors attended workshops and meetings with U administrators, research faculty, student life professionals, and state legislators.



# SEVEN NSF CAREER AWARDS



Researchers from the University of Utah's College of Engineering continue to develop forward-thinking projects that one day could help people around the world. This year, seven faculty members from the college received the prestigious National Science Foundation's Faculty Early Career Development Program (CAREER) Awards.

These highly competitive \$500,000 grants are given to early-career faculty members "who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization."

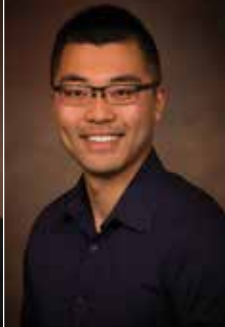
Here are this year's recipients of the award from the College of Engineering. Go to [coe.utah.edu](http://coe.utah.edu) to learn more about their projects.



**TSUNG-WEI HUANG**  
ELECTRICAL & COMPUTER ENGINEERING



**MINGYUE JI**  
ELECTRICAL & COMPUTER ENGINEERING



**MINGXI LIU**  
ELECTRICAL & COMPUTER ENGINEERING



**MOSTAFA SAHRAEI-ARDAKANI**  
ELECTRICAL & COMPUTER ENGINEERING



**HUIWEN JI**  
MATERIALS SCIENCE & ENGINEERING



**BEI WANG PHILLIPS**  
SCHOOL OF COMPUTING



**JASON WIESE**  
SCHOOL OF COMPUTING

# IN BRIEF



## SPEAR NAMED U PRESIDENTIAL SCHOLAR

University of Utah mechanical engineering associate professor Ashley Spear was one of four faculty members named as Presidential Scholars at the University of Utah for 2022.

The annual awards recognize excellence and achievement for faculty members at the assistant or associate professor level and come with \$10,000 in annual funding for three years to support their scholarship and enrich their research activities.

In addition to Spear, the 2022 recipients include Lauri Linder, associate professor in the Acute and Chronic Care Division of the College of Nursing; Luisa Whittaker-Brooks, associate professor in the Department of Chemistry; and Marcel Paret, associate professor in the Department of Sociology.

"I am so proud of the work these scholars are doing in the classroom, and in their field of study," said U Interim Senior Vice President for Academic Affairs Martell Teasley. "As educators at the U, they are positioned to guide their students and impact our whole community. I'm excited to see what the future holds."

Spear received her bachelor's in architectural engineering from the University of Wyoming and a doctorate in civil engineering from Cornell University.

She has won multiple awards including the department's professor of the year in 2021, the Early Career Teaching award in 2018, the NSF Faculty Early Career (CAREER) Award in 2019, and the Outstanding Researcher Award in 2020. During her less than eight years at the U, Spear has generated more than \$6.3 million in research funding, which has supported nearly 20 graduate students in their education.

Her research is focused on characterizing and simulating three-dimensional cracking in metallic structures, 3-D finite element analysis, concurrent multiscale modeling, microscale characterization of metallic materials, and high-energy X-ray diffraction microscopy.



## GALE APPOINTED TO PROFESSORSHIP

The University of Utah College of Engineering is proud to announce the appointment of Professor Bruce Gale as the Merit Medical Systems, Inc. Endowed Professor of Engineering.

Gale, who is also chair of the U's Department of Mechanical Engineering, was honored during a ceremony last summer at the University of Utah James L. Sorenson Molecular Biotechnology Building that included College of Engineering Dean Richard B. Brown and University of Utah President Taylor Randall.

"I am grateful to Merit Medical Systems and Fred Lampropoulos for providing this Endowed Professorship. I am excited by the opportunities this will present for me and my team to engage in exciting new research projects," said Gale.

Gale received a bachelor's degree in mechanical engineering from Brigham Young University and a doctorate degree in bioengineering from the U. He arrived at the U as an assistant professor of mechanical engineering in 2001, was named professor in 2013, and became chair of the department in 2018. He also is director of the State of Utah Center of Excellence for Biomedical Microfluidics.

His research is centered on biomedical applications of microfluidics. He also has expertise in biosensors, microarrays, micropumps, and microscale medical devices.

Merit Medical is a leading manufacturer and marketer of proprietary disposable medical devices used in interventional, diagnostic, and therapeutic procedures, particularly in cardiology, radiology, oncology, critical care, and endoscopy. Merit has made it a priority to understand customers, innovate, and deliver life-changing products and services. Merit's founder, Fred Lampropoulos, has been in the medical device industry for more than 30 years. He currently serves as the company's chairman and chief executive officer.



# ALUMNI SPOTLIGHT STEVEN G. PARKER

Like many a computer science graduate, Steven G. Parker's interest in digital graphics began in the dark, crowded halls of the video arcades of the 1980s.

"We had an Atari [gaming console] and played in arcades, which were big in the '80s," he remembered. "I always wanted to understand how they worked. I wanted to know about the hardware. My friends would play the games, but I was thinking, 'How do you make these things work?'"

That insatiable curiosity to understand what made images move on a computer screen would launch a lifelong career trajectory for Parker, one that took him from the hallowed halls of the University of Utah's School of Computing where he earned a Ph.D. in computer science to the office of Vice President of Professional Graphics for Nvidia, one of the world's leading companies in computer graphics and artificial intelligence.

"If I could go back and tell my teenage self that this is what was going to happen, he would be very impressed — even though I don't have the time to play video games anymore," he said, laughing.

While it's true he doesn't have the time to pick up a gaming controller like he used to, Parker is one of the early developers and now a leading evangelist of a rendering technique called "ray tracing," a 3D modeling method to simulate lifelike images with realistic light and shadow characteristics. That process is now the cornerstone of modern video game graphics from the latest "Call of Duty" to "Microsoft Flight Simulator" and the wildly popular "Minecraft." But ray tracing is not just limited to games. It also is what makes CGI-based visual effects in blockbuster movies so realistic, and it also is employed in applications for health, education, marketing, anything that requires convincing computer-generated imagery.

Parker became interested in ray tracing in its earliest days when he discovered a book about it in the engineering library of the University of Oklahoma, where he earned his bachelor's in electrical engineering. "At that time, ray tracing was considered too slow for anything. It was interesting but it was not what people did," he said. "That was why I wanted to go to the U, to learn more from their graphics program."

The University of Utah's School of Computing is renowned for its legacy in the development of computer graphics during its "Camelot" era. That was the early 1970s when luminaries such as Pixar's Ed Catmull, Adobe's John Warnock, Atari's Nolan Bushnell, and graphical user interface pioneer Alan Kay were just a few of the legendary graduates who ushered in modern-day computer graphics while at the U.

Parker would be a second generation of pioneers at the U who pushed graphics to new heights. He, along with School of Computing Distinguished Professor Christopher Johnson, would launch the U's Scientific Computing and Imaging Institute (SCI), which develops new computing simulations for science and medicine. Parker served as a research professor for SCI from 2000 to 2007 and was involved with research for high-performance computing. He was also head of the computer science division of C-SAFE at the University of Utah, the Center for Simulation of Accidental Fires and Explosions, a center created by then Dean of Engineering, Distinguished Professor David Pershing.



In 2008, Parker joined Nvidia in Salt Lake City to develop ray tracing as a rendering technique for real-time computer graphics as well as to develop faster high-performance computers for simulations. "That's a pretty unique combination of skills," he said. "When I joined Nvidia, it was for ray tracing, but during my time I also got involved in high-performance computing, building the first (graphics processor unit-based) supercomputer at Oak Ridge National Laboratory."

Parker said he owes a lot of his success to his education at one of the best computer science schools in the country. To give back to the U, he is now a member of the University of Utah College of Engineering's Engineering National Advisory Council where he helps shape the future of the college.

"It was incredibly inspiring. The history there was great," he said about his time learning and teaching at the U's School of Computing. "A handful of us grad students were very much of the mind that we were going to change the world and do something new. There was an energy and purpose to invent the future in different areas in scientific computing and computer graphics. A lot of us have gone on to be very successful."

Follow us:

 @UtahCoE

 facebook.com/utahcoe

 @UtahCoE

# STUDENT FELLOWSHIPS 2022 - 2023

*Congratulations to this year's recipients of 2022-2023 College of Engineering graduate fellowships. This group is just one example of the exemplary students who attend the college to pursue an education from the state's top engineering and computer science institution. And much appreciation to those individuals and organizations who have donated to the fellowships to ensure these students have a successful education. To read more about these recipients, go to [www.coe.utah.edu/fellows](http://www.coe.utah.edu/fellows).*



## FELLOWSHIPS:

### **Ian Bales**

*Mechanical Engineering*  
John Zrno Fellowship

### **Trey Blackwell**

*Electrical and Computer Engineering*  
Gary S. and Patricia Watkins Fellowship

### **Jade Bookwalter**

*Biomedical Engineering*  
Ernst R. & Marianne M. Friedrich Fellowship

### **Paul Cardon**

*Materials Science and Engineering*  
Greg McKenna Fellowship

### **Colleen Chemerka**

*Electrical and Computer Engineering*  
Gerald & Barbara Stringfellow  
Endowed Fellowship

### **Austin Eiting**

*Chemical Engineering*  
Blaine Leonard/UDOT Fellowship

### **Dallin Hansen**

*Electrical and Computer Engineering*  
Achievement Rewards for College  
Scientists (ARCS) Fellowship

### **Cordelia Latham**

*Mechanical Engineering*  
Campbell Endowed Graduate Fellowship

### **Mitchell Lewis**

*Biomedical Engineering*  
Campbell Endowed Graduate Fellowship

### **Nathan Meigs**

*Nuclear Engineering*  
Gary M. Sandquist Endowed Graduate  
Fellowship in Nuclear Engineering

### **Benjamin Orkild**

*Biomedical Engineering*  
Ernst R. & Marianne M. Friedrich Fellowship

### **Colin Pronovost**

*Computer Science*  
Shane & Robin Robison Fellowship

### **Sophia Remick**

*Chemical Engineering*  
E.B. Christiansen Endowed Fellowship

### **Liam Sullivan**

*Mechanical Engineering*  
Achievement Rewards for College Scientists  
(ARCS) Fellowship

### **Claire Ticknor**

*Mechanical Engineering*  
Achievement Rewards for College Scientists  
(ARCS) Fellowship