The University of Texas at Austin
Biomedical Engineering
Cockrell School of Engineering

2021-2022

PULSE

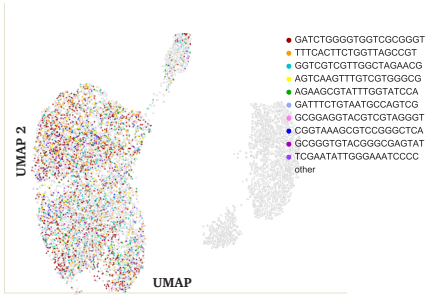
AN ANNUAL PUBLICATION OF THE DEPARTMENT OF BIOMEDICAL ENGINEERING

UNDERSTANDING THE EVOLUTIONARY DYNAMICS OF CANCER

MORE ON PAGE 8

ON THE COVER

FIG. TOP 10 LINEAGES



Barcoding with Amy Brock's ClonMapper technology reveals genetic diversification in tumor cell lineages and clonal dynamics during tumor evolution and treatment.

More on page 8

DEAR FRIENDS, It has been an exhilarating six years to serve as Chair of the Department of Biomedical Engineering and it is with bittersweet emotions that I say farewell, as I have accepted a position at the University of Washington, which I will begin on July 1, 2022.

I am grateful for my time at Texas BME, where I have been continually impressed with this community—with the innovative research our research teams pursue, with the enthusiasm and curiosity of our students, and with the stellar support of our staff. I am especially grateful for the flexibility, compassion and grace that I have witnessed within our community over the last two years as we have navigated challenging times.

This last fall, with virus transmission rates decreasing, we continued with in-person instruction, and it felt good to see many of our students studying in the lobby of the BME Building and in our research labs.

As you will see in this latest issue of Pulse, Texas BME continues to thrive.

» **Associate Professor Amy Brock** is advancing our understanding of cancer in the area evolutionary dynamics with her ClonMapper platform, which tells researchers how cancer cells change over time.

» This year we added three new faculty members: **Adam Bush**, **Edward Castillo**, and Texas BME alum **Stephanie Seidlits**. Respectively, they are working in the areas of novel MRI, medical imaging analysis and processing, and clinical therapies for nervous system injury and disorder. I'm excited to see how our students will learn from them and how their work will transform health care.

» Our students continue to innovate, finding engineering solutions to medical needs. I encourage you to read about one team of students who are proposing a simulator that physicians can use to better train in the area of needle procedures for maternal fetal medicine.

» And, I'm so proud of our alumni who are changing the world, some of whom you'll read about here, promoting food safety, shining a light on a lack of diversity in STEM journals, and exercising their entrepreneurial skills in startups that will change how we diagnose and treat disease.

I look forward to following what happens next in Texas BME and am confident that the Cockrell School of Engineering leadership and community will select a successor who can build on our department's strong foundation.

Thank you for reading, and thank you to all of our students, faculty, staff and alumni for your support!

SHELLY SAKIYAMA-ELBERT
Chair, Department of Biomedical Engineering
Fletcher Stuckey Pratt Chair in Engineering
Cockrell Family Chair for Department Leadership #1

WHAT STARTS HERE IS CHANGING HEALTH CARE

BioHouston and Rice Alliance for Technology and Entrepreneurship recognize startups headed by Texas BME alumni.

CORVEUS MEDICAL is developing a novel, catheter-based device that performs a targeted sympathetic nerve ablation to treat heart failure. The startup is co-founded by **Tyler Melton (B.S. 2013)**, who also serves as the start-up's CEO.

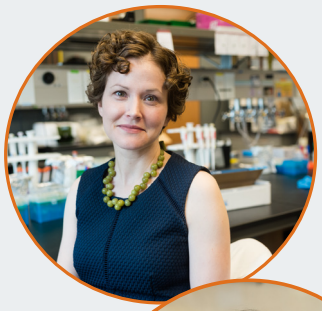
DYNAMIC LIGHT is a software company integrating with microscopic and robotic systems to provide better visuals to surgeons and health care providers to reduce medical errors, radiation and costs. The startup won BioHouston's Michael E. DeBakey Memorial Life Science Award, and alum **David Miller (Ph.D. 2018)** serves as vice president of engineering.

VIVIFI MEDICAL is developing the first suture-less laparoscopic technology that enables connection of two vessels together for Variacocole and men's health issues. **Tushar Sharma (Ph.D. 2012)** is the startup's CEO and co-founder. ■

FACULTY UPDATES

Our faculty are gaining recognition for their innovative research and contributions to the field.

AARON BAKER was promoted to full professor this year.



JEANNE STACHOWIAK was elected to the American Institute for Medical and Biological Engineering (AIMBE) College of Fellows.

The Society for Biomaterials (SFB) recognized LAURA SUGGS with their Clemson Award for Contributions in Literature.

The American Association of Pharmaceutical Scientists recognized NICHOLAS PEPPAS with their Global Leader Award. Peppas was also elected president of Sigma Xi, the Scientific Research Honor Society, an international society for science and engineering. ■

IMPACTING COMMUNITY

"FOLLOW YOUR PASSIONS, TAKE ON OPPORTUNITIES THAT PUSH YOUR COMFORT ZONE; THINGS WILL WORK OUT IN MORE INCREDIBLE WAYS THAN YOU COULD HAVE BELIEVED FROM THE START."

As a Texas BME undergraduate student, ***James Salazar (B.S. 2013)*** *was an active participant in his education. Beyond engineering coursework, he volunteered with a number of student organizations, such as the Biomedical Outreach and Leadership Team (BOLT), and conducted research with Mia Markey in her Biomedical Informatics Lab and in various summer research programs.*

His post-UT Austin career also reflects someone with a robust motivation to explore all facets of health care. He has earned both an MD and master's in clinical research from the University of California San Francisco (UCSF).

UCSF has provided him with many opportunities, including serving on the editorial team of JAMA Internal Medicine, a peer-reviewed medical journal published by the American Medical Association. Earlier this year, Salazar published a survey study of editors at 25 leading scientific and medical journals in JAMA Internal Medicine bringing to light the lack of diversity among editorial teams at these impactful journals. He stresses the importance of diversity in medicine and science in the pursuit of excellence in research innovation and patient care, and he took the time to answer questions about the subject and his career path.

WHAT TYPE OF WORK HAVE YOU BEEN DOING AT UCSF?

After medical school, I completed my internal medicine residency, an NIH-sponsored clinical research fellowship, and am now completing a cardiology fellowship. In the future, I plan to further specialize within cardiology to focus on heart rhythm disorders (electrophysiology). Alongside my clinical training, I've continued my development as a researcher to investigate clinical problems and inform patient care. One area of interest has been sudden cardiac death, which are deaths due to a fatal arrhythmia (abnormal heart rhythm), and a leading cause of death worldwide. I have had the fortune of working with a unique autopsy cohort of patients that died suddenly in San Francisco. Using this cohort, we have shown that many sudden deaths presumed to be cardiac in origin are not actually due to arrhythmias. We've developed models to distinguish patients who actually die of an arrhythmia and might have benefitted from a cardioverter-defibrillator from those who die suddenly from non-cardiac causes, such as stroke.

WHAT WAS YOUR PATH TO GAINING AN EDITORIAL POSITION AT JAMA INTERNAL MEDICINE?

The editor-in-chief at JAMA Internal Medicine, Dr. Rita Redberg, is a cardiologist at UCSF. The journal started a fellowship program for selected residents to participate as junior editors over a 2-year appointment. In this role, I attended weekly manuscript meetings and participated in the review, development, and selection of manuscripts. It was a unique opportunity, early in my career, to have such an active role at a high-impact journal.

HAVE YOU ALWAYS BEEN INTERESTED IN DIVERSITY?

From an early age I've known diversity matters. Austin and UT Austin are vibrant and diverse spaces – growing up in Austin, going to UT, and being Hispanic myself, I grew up thinking about diversity a lot.

I've been involved with and benefited from equity efforts along the way. My dad wanted to be a doctor but didn't have the resources growing up as an immigrant from Mexico, making his way from poverty. I'm grateful for opportunities I've been given and have always wanted to give back. These instincts were further honed during a variety of undergrad experiences including my time as Jackie Robinson Foundation (JRF) Scholar. Jackie Robinson was a baseball player who broke the color barrier. As a JRF Scholar, I was flown to New York where the JRF provided brilliant career training and a strong foundation in the importance of diversity, equity, and inclusion.

I didn't know when I arrived at JAMA Internal Medicine that I would work on this paper. But, the question of diversity naturally came up. Diverse representation is necessary in all aspects of research and medicine. As my fellowship with the journal progressed, I knew I had to look at this subject, especially off the heels of the police killings of George Floyd, Breonna Taylor and too many other Black people.

WHAT ARE YOUR FUTURE PLANS?

The cardiology fellowship is three years long, and I'm grateful to also be continuing work with my mentor on the fatal arrhythmia research. I anticipate doing an electrophysiology fellowship and ultimately, hope to work in academic medicine, where I can teach trainees, treat patients, perform procedures such as putting in pacemakers or ablating portions of the heart to stop arrhythmias, and also pursue research.

IF A STUDENT WERE INTERESTED IN MEDICAL SCHOOL OR CARDIOLOGY, WHAT ADVICE WOULD YOU GIVE?

Texas BME is a launchpad for so many career paths. One of the degree's main strengths is flexibility. As an undergrad, I could never have imagined how my career was going to play out. I knew about cardiology from my physiology course, for instance, but I didn't know about sudden cardiac death. By participating in the Biomedical Informatics Lab I developed problem solving skills and learned how to apply what I learned in the classroom to real-world problems, but I never would've thought I'd be doing autopsy research. You can't predict what opportunities will inspire you, but BME training prepares you for any challenge that interests you. My main advice is to take advantage of all the flexibility the BME program affords – follow your passions, take on opportunities that push your comfort zone; things will work out in more incredible ways than you could have believed from the start. ■

MEET OUR NEW FACULTY

ADAM BUSH joined UT Austin as an assistant professor of biomedical engineering in January 2022. His research develops, validates, and applies novel MRI methods to explore human pathophysiology and make imaging safer, particularly for children. He completed his postdoctoral research in the Radiology Department at Stanford University, earned his Ph.D. and M.S. degrees in biomedical engineering from University of Southern California, and received a B.S. in physics from Loyola Marymount University.

WHAT DREW YOU TO UT AUSTIN?
As a translational imaging scientist, UT Austin is the place to be! Between the new Dell Medical School, the ever-expanding Dell Children's Hospital and the growing Texas Center for Pediatric and Congenital Heart Disease, I am excited to build imaging tools that will be used in actual patients. I think there are a ton of opportunities to collaborate with clinicians here, and that's really exciting to me.

WHAT ARE YOUR IMPRESSIONS OF CAMPUS AND LIVING IN AUSTIN?
Austin's perfect! It has great weather, demographics, outdoor activities and a unique feel. I guess that's why so many people from California are moving here. It will be interesting to see how we Austinites can step to the plate and solve the new challenges that migration is posing.

HOW DO YOU LIKE TO SPEND YOUR TIME OUTSIDE OF WORK?
I grew up in Kansas City, so I'm a huge BBQ fan. Living in Cali, I had to learn to make my own BBQ to survive. That said, I have learned to infuse lots of California flavors and style into my own BBQ, and I'm excited to taste what Austin has to offer. You'll have to see what I can do at my next lab BBQ party!

WHAT EXCITES YOU ABOUT DOING RESEARCH AND EDUCATING THE NEXT GENERATION OF BIOMEDICAL ENGINEERS?

> I WAS FORTUNATE TO HAVE GREAT MENTORS THAT INSPIRED ME DURING GRADUATE SCHOOL, MY POST-DOC BUT ALSO EVERYWHERE ELSE ALONG THE WAY. IF I CAN LIGHT A MATCH UNDER SOMEONE ELSE TO BLAZE THEIR OWN TRAIL, WHAT'S BETTER THAN THAT?
>
> -Adam Bush

EDWARD CASTILLO joined the Department of Biomedical Engineering as an associate professor in the fall of 2021. He previously was an associate professor in the Department of Radiation Oncology at the Oakland University William Beaumont School of Medicine. Castillo's research focuses on the theoretical development, implementation, and clinical deployment of numerical methods for medical image analysis. He received his Ph.D. and M.A. degrees in computational and applied mathematics from Rice University and a B.S. in mathematics from St. Mary's University in San Antonio.

WHAT DREW YOU TO UT AUSTIN?
It was a couple of factors. I'm originally from San Antonio and moving to Austin brought us closer to the family that still lives there. I also had been looking for collaborators and visited the BME department on a few occasions to give talks. The students

and faculty I met were amazing. The sheer amount of brilliance walking around the halls of the BME Building is just incredible.

WHAT ARE YOUR IMPRESSIONS OF CAMPUS AND LIVING IN AUSTIN?

The city is definitely much bigger than it was when I was growing up next door in San Antonio. Despite that, it still has much of the same creative and cultural energy. I didn't realize this until I moved here, but Austin is a great place for families. The area is beautiful and there's still lots to explore.

The energy on campus is inspiring. I brought my kids to see the lab the other day. They're only 6 and 8 years old, but they thought it would be fun to pretend to be UT students. The real UT students we ran into all joyfully played along with them.

HOW DO YOU LIKE TO SPEND YOUR TIME OUTSIDE OF WORK?

Most of that time is spent with the family, shuttling the kids to and from their various events. Since I spend a significant amount of time staring at a computer screen, I try to make sure I exercise. Once upon a time, I played in a garage band. Maybe I'll pick it up again now that I'm living in the live music capital of the world.

WHAT EXCITES YOU ABOUT DOING RESEARCH AND EDUCATING THE NEXT GENERATION OF BIOMEDICAL ENGINEERS?

I remember the first time a software I had developed was used to alter a patient's care. It was a little terrifying, but so very exciting. All the work developing the models, implementing the methods, and testing the codes went on to improve patient outcomes. Written on a white board or on PowerPoint slides, the research seems abstract. But we have the opportunity to solve real clinical problems. We can make a difference in someone's life. I'm excited to show students how I approach these types of problems, and looking forward to seeing how they improve upon it, make it their own.

STEPHANIE SEIDLITS joined Texas BME as an associate professor in January 2022. Seidlits, a UT alum and Cancer Prevention & Research Institute of Texas (CPRIT) Rising Star, was previously an assistant professor of bioengineering at UCLA. Her research seeks to develop clinical therapies for central nervous system injury and disorder. Seidlits trained as an NIH NRSA F32 postdoctoral fellow in chemical and biological engineering at Northwestern University and received her Ph.D. and M.S.E. degrees in biomedical engineering from UT Austin, and a B.S.E. in bioengineering from Rice University.

WHAT DREW YOU TO UT AUSTIN?

The short answer is the people! I joined the third class of graduate students here when the department was still new. I greatly appreciated the faculty, students, and community. Since I graduated in 2010, Texas BME has continued to develop into a world-class department with faculty that are doing cutting-edge science and deeply care about education and the UT community.

WHAT ARE YOUR IMPRESSIONS OF CAMPUS AND LIVING IN AUSTIN?

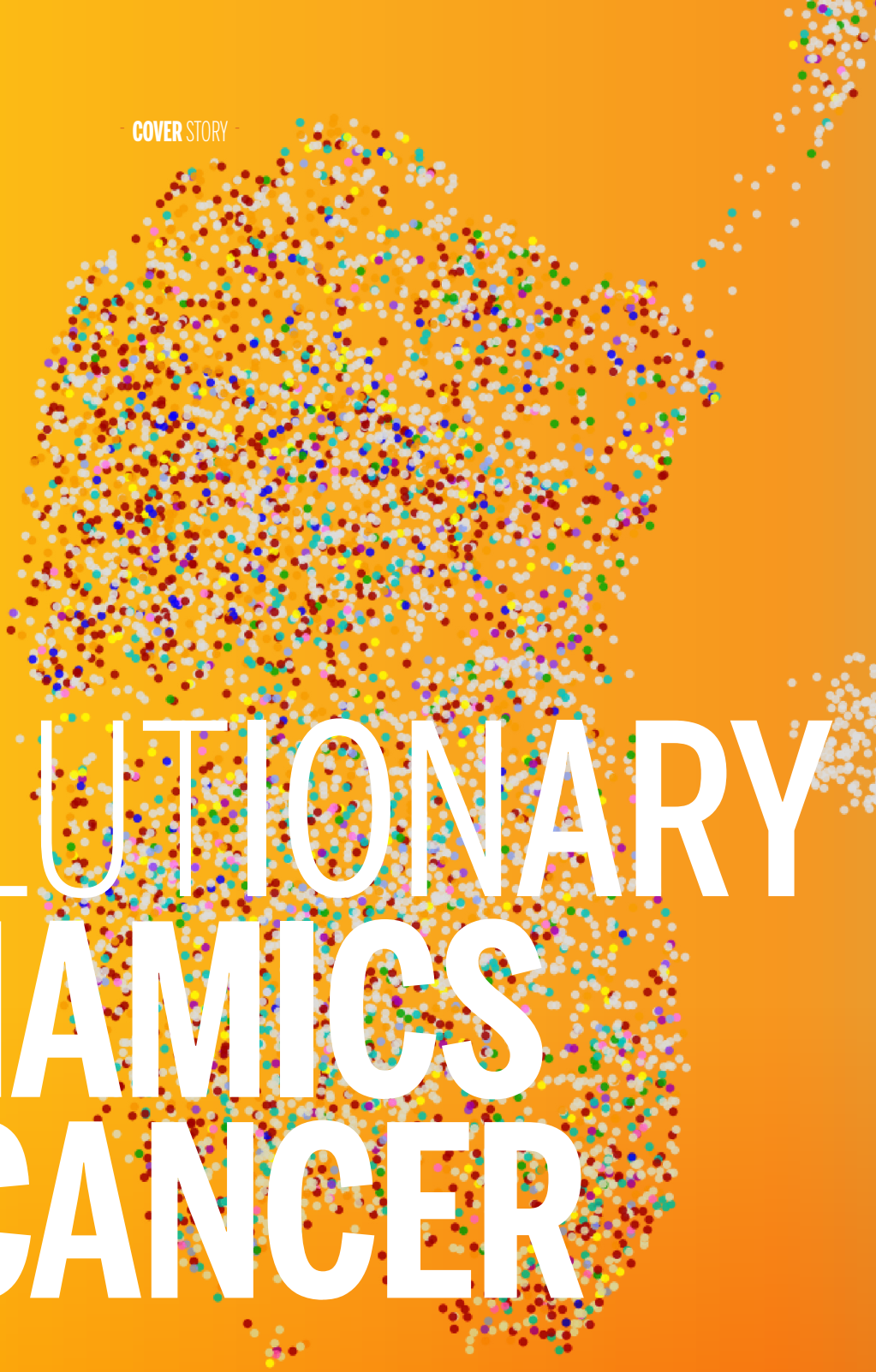
I am excited to be back in Austin after 12 years! While some things have changed, the energetic, unique, and innovative vibe of the community is still going strong. This spirit is even more apparent in the clear vision and drive exuded by students. Engaging with students keeps me motivated to continue improving education and experiences at UT and excited to see what the next generations will accomplish.

HOW DO YOU LIKE TO SPEND YOUR TIME OUTSIDE OF WORK?

I spend a lot of time with my five-year-old playing games and reading books. I am a fan of yoga and Pilates and move my body every day. I love hiking, swimming, and camping in beautiful Central Texas. I also spend plenty of time on my couch binge-watching the great shows out there.

WHAT EXCITES YOU ABOUT DOING RESEARCH AND EDUCATING THE NEXT GENERATION OF BIOMEDICAL ENGINEERS?

There are so many exciting and impactful ideas and research directions out there that I expect the next generation of biomedical engineers to accomplish. In research, I love that there are always more questions to be answered and possible solutions to explore. My favorite part of working with students is when they come up with questions and solutions that haven't occurred to me! This experience always reinforces my belief that higher education can bring people together to combine their unique perspectives into innovative solutions that make the world a better place for everyone. ■

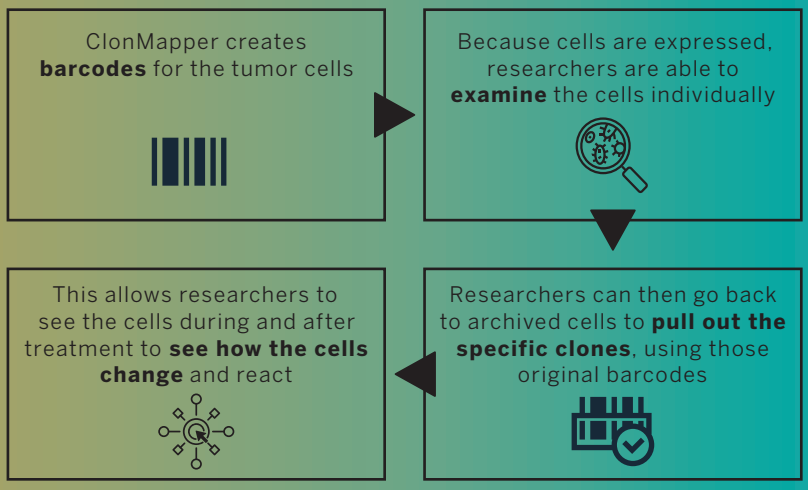


UNDERSTANDING THE

EVOLUTIONARY DYNAMICS OF CANCER

DESPITE TREMENDOUS ADVANCES IN MEDICINE, TUMORS ARE CHALLENGING TO CURE BECAUSE THEY ARE MADE UP OF HETEROGENEOUS CELLS. LIKE HUMAN FAMILIES, THE INDIVIDUAL CELLS OF A TUMOR SHARE SOME COMMON TRAITS AND CHARACTERISTICS, BUT AS THE TUMOR EXPANDS, THE CELLS ALSO DEVELOP THEIR OWN IDENTITIES. AND, AS A RESULT, SOME CELLS ARE MORE RESISTANT TO THERAPY THAN OTHERS AND QUICKER TO ADAPT AND CHANGE.

HOW CLONMAPPER WORKS



SOURCE: *NATURE CANCER* AND MEDICAL XPRESS

A team of researchers at The University of Texas at Austin developed a new way to tag tumor cells to figure out how they evolve and change over time to resist cancer treatments. They studied chronic lymphocytic leukemia (CLL) primarily, but these findings could help researchers learn more about the entire spectrum of cancerous tumors.

“This is a technology that lets you replay the evolutionary history of the tumor,” said Amy Brock, an associate professor in the Cockrell School's Department of Biomedical Engineering and co-lead author on a new paper published in *Nature Cancer*. “We can collect those pre-resistant cells and go back and look at what happened to them. We can try many parallel treatments and measure how specific cells respond and which ones persist."

The ability to essentially "tag" nucleic acids — the genetic information of the cell such as RNA or DNA — to monitor them is not a brand-new technology. However, current capabilities don't paint a full picture of how tumor cells evolve. What this platform, known as ClonMapper, can do that wasn't possible before is look backward and trace how tumor cells change over time. That gives researchers the ability to look at which cells "win out" over less-resistant cells, continue to clone themselves and make the tumor more dangerous. By isolating these cells, researchers can better test which treatments do and don't work against them.

Monitoring changes over time is key to successful transfer treatments. Tumor cells adjust to treatments and become resistant. That's why patients can go into remission, but later experience relapse.

"This is one of reasons cancer treatment is so challenging — we don't have very good ways of predicting ahead of time which cells will be sensitive to a type of drug and which ones will be resistant,” Brock said. “This acquired resistance is a leading cause of treatment failure for many patients with cancer.”

CLL is a low-grade B-cell malignancy that is often monitored for months or even years before it requires active treatment. This "watch and wait" style of treatment relies heavily on accurate monitoring of the patient. In the study, ClonMapper focused on identifying which cells were cloning themselves, how fast this process happened and how it influences the growth rate of surrounding cells over time. This allowed a much more accurate analysis of the cell population and may enable more customized treatment plans for patients. ■

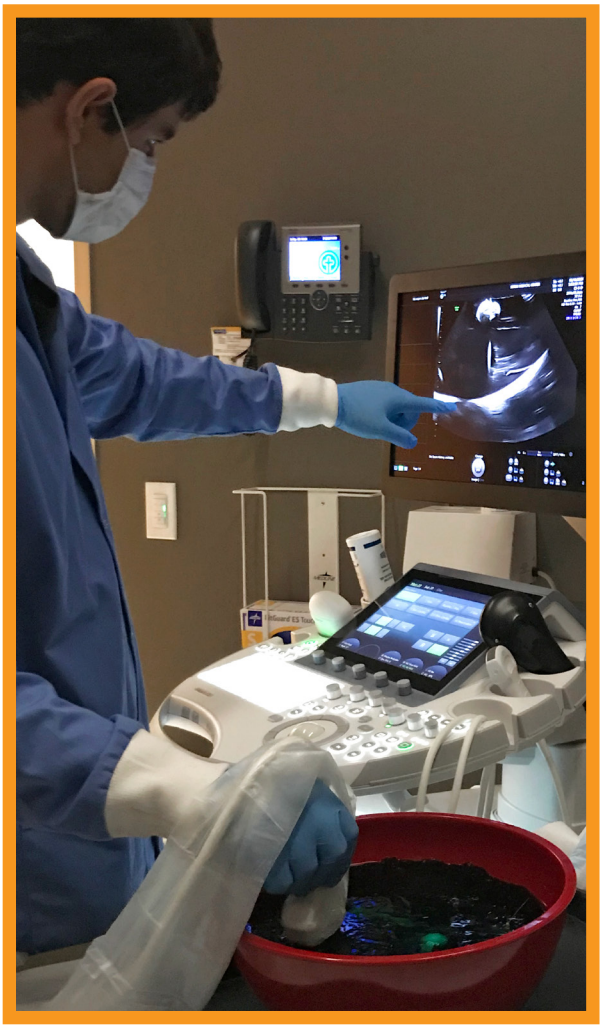
ClonMapper technology is available for licensing. To learn more about opportunities, contact the UT Austin Office of Technology and Commercialization at **licensing@otc.utexas.edu**.

READ MORE IN *NATURE* ABOUT HOW AMY BROCK AND OTHER CANCER RESEARCHERS ARE EXPANDING THE TUMOR BARCODING TOOLKIT

STUDENTS WORK ON A BETTER SOLUTION FOR

MATERNAL FETAL MEDICINE TRAINING

Texas BME students have used a new Imaging Clinical Immersion course to connect with clinical mentors, boost experience in medical device design, and find an engineering solution to a medical need in maternal fetal medicine.



Orhun Davarci, an integrated biomedical engineering master's student, and Aleah Eskin and Naazneen Ibtehaj, two undergraduate students, participated in Texas BME's pilot Imaging Clinical Immersion course, taught by Professors Mia Markey and Grady Rylander. The student team is now developing and pitching an innovative medical device idea that has received support from Texas Health Catalyst, an initiative between Dell Medical School and UT Austin that fosters innovation in health care.

This particular team spent spring of 2021 paired with Dr. Celeste Sheppard who works in maternal fetal medicine at Dell Medical School. They observed clinical needs and assessed various problems, with the aim to solve one specific issue. The issue that seemed most impactful to this student team, who informally refer to themselves as the "Phetal Phantoms," was to tackle training for ultrasound-guided needle procedures such as amniocentesis.

Currently, physicians frequently use non-invasive cell-free DNA testing, a blood test, in order to gain genetic information about a developing fetus. However there are instances where ultrasound-guided needle procedures are necessary. If a DNA test is positive for a disorder, clinicians will want to confirm that information through amniocentesis, cordocentesis, or chorionic villus sampling. These are procedu-

res where clinicians get samples of amniotic fluid from the uterus or tissue around the placenta or umbilical cord.

These needle procedures are less frequent than DNA testing, therefore training opportunities are less available to physicians in training.

"Currently the standard course of training is see one, do one, teach one. Health care workers observe, then practice on a patient and then eventually teach them," says Aleah Eskin. "But training is important for these needle procedures because there is some risk involved in having them performed."

To solve this issue, the student team is proposing a simulator that physicians could use for training purposes. Their proposed simulator would be modifiable to provide clinical variation, would be able to be used for all three needle procedures, and would mimic different anatomies. Using this type of simulator, physicians could gain experience to benefit a large variety of patients.

^ Left to right: Naazneen Ibtehaj, Orhun Davarci, Aleah Eskin and Dr. Celeste Shepphard.

While working on a solution, the team interviewed fellows and physicians to discover what improvements can be made on current simulators, which are often over-engineered and too expensive or under-engineered and not effective.

Master's student Orhun Davarci practices an ultrasound-guided needle procedure with a low-fidelity Jello mold under supervision of Dr. Celeste Sheppard to gather information that will help create a simulator for improved training.

Seeing promise in this simulator device proposal, Texas Health Catalyst awarded the team with a Phase 1 Consulting Award, which has allowed the team to connect with and work with an industry advisor, Douglas Stoakley, co-founder and president of ClearCam, a medical equipment manufacturer in Austin (co-founded by Texas Engineering's Dr. Chris Rylander).

They have also applied for funding, to entrepreneurship bootcamps, and pitch competitions, making it to the semi-finals in the DisruptTexas Pitch Competition.

The students credit this newest design course for the mentorship opportunities they've received and access to resources.

"This was probably my favorite class at UT Austin," says Naazneen Ibtehaj, a senior biomedical engineering student.

> "I DON'T THINK WE COULD HAVE MADE THIS CONNECTION WITH DR. SHEPPARD OR ANY PHYSICIANS WITHOUT THIS IMAGING CLINICAL IMMERSION COURSE," SAYS ESKIN, ALSO A SENIOR.

The students' next steps, after determining market viability with help from Texas Health Catalyst mentors, are to explore creating a device they hope to commercialize and that could be used for training in other specialties that require ultrasound-guided needle procedures such as urology and breast oncology. Once they are ready, the team will use lab space through Texas Inventionworks in the EER to build a prototype. ■

A LESSON LEARNED AT UT AUSTIN

“How to look at a seemingly overwhelming problem and break it down into steps.”

THE ERIN BROCKOVICH OF FOOD SAFETY

HOW ONE TEXAS ENGINEER IS CHANGING THE WORLD

Azita Sharif is concerned with what we eat. But she wasn't always. This Texas Engineering alumna has had a long career that has taken her to New York, Boston and San Antonio, and prepared her with experiences that have put her in a prime place to address one of the great challenges we face: food safety.

After earning her B.S. and M.S. from UT, where she studied cryogenic preservation cell design with one of her mentors biomedical engineering professor Ken Diller, she began her career in research and development in the semiconductor industry. She continued working in technical support and product management before completing an exclusive venture capital fellowship, which she was recruited for by her other UT mentor, Dale Klein, a professor in the Walker Department of Mechanical Engineering, with whom Sharif studied heat transfer.

"That phone call from Dale Klein changed the course of my professional career," says Sharif, "I did 21 interviews in four different locations. Nine months later I was selected as one of 12 fellows in the charter class of this fellowship, which still continues today, 26 years later."

After completing the fellowship, Sharif worked as a principal investor at a venture capital firm in Boston, analyzing other people's business plans. It was through this experience that Sharif decided she wanted to become an entrepreneur herself. She spent the next three years earning an MBA at Harvard Business School and a degree in diplomacy from the Fletcher School of Law and Diplomacy.

She then combined all she had learned in engineering at UT Austin, in design and problem solving from her experiences in the semiconductor industry, in business from her life as a venture capitalist and Harvard MBA and in diplomacy from the Fletcher School to ultimately form her own biotech company: DSI.

DSI provides technology services beneficial to both the organ transplant and biobanking sectors. The company has created a platform that allows medical professionals to track transplant tissues from a living donor all the way through transplantation, which helps keep everyone involved compliant with medical regulations.

On the biobanking side, DSI has a platform that

serves researchers. Specifically, providing oncologists and pathologists with data that enables precision medicine in the effort to determine the cause of and find a cure for cancer.

It is through this exposure to oncology data collection that Sharif took an interest in a public policy initiative: improving public access to healthy food in Massachusetts, where she currently lives, and eventually expanding these efforts nationwide.

"Unfortunately, in the U.S. right now, there's not a person who hasn't either experienced cancer themselves or known somebody who has it," says Sharif. "I started thinking about how in the 50 years since President Nixon signed a National Cancer Act the problem has actually gotten worse, not better. Much of our research has been on figuring out cancer treatments, but we often overlook environmental factors such as the air we breathe and food we eat."

Sharif says we focus on healthy food being low in fat and sugar because obesity has been a problem, but she wanted to know what's really in the food we're eating and how that may play a role in cancer.

"I go to a grocery store, and I pick up a strawberry, but do I know what's in the cellular structure? Strawberries have the tendency to absorb whatever is in the soil, but do I know what's really in the soil and what I'm consuming?"

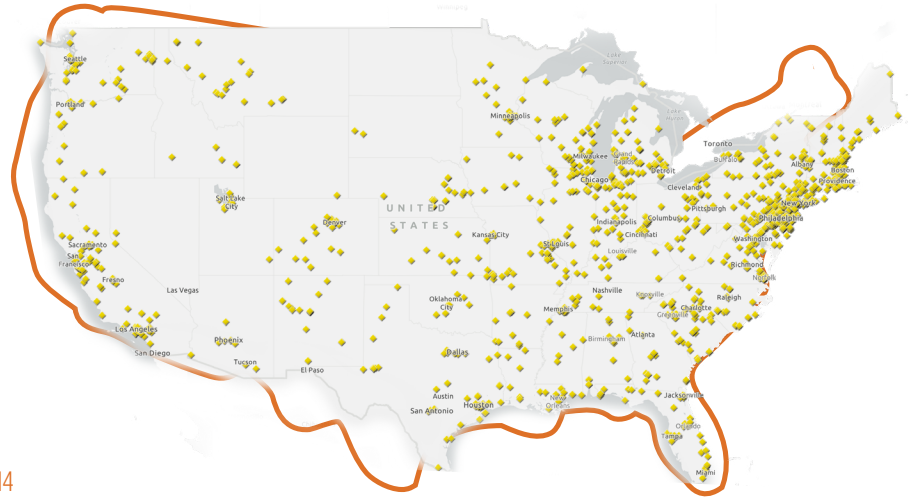
Sharif did what any engineer would—she hooked up a strawberry to a mass spectrometer.

To find out what is in our food, Sharif recruited farmers in both Texas and Massachusetts to collect data. She found that many of the farms that produce our food are located near Superfund sites. Superfund sites are dormant locations that once hosted manufacturing facilities or chemical laboratories, anything from an old shoe factory to a nuclear engineering laboratory. There are 1400 Superfund sites in the U.S., which have been designated by the Environmental Protection Agency as "mini Chernobyls." Farms, houses, and parks can't be built on Superfund sites because of pollution and toxicity. However, in her assessments, Sharif discovered that many of the farms where she was evaluating produce are located near Superfund sites.

"When I saw this data, the engineer in me began thinking about diffusion phenomena. How do I know that the arsenic that is in the Superfund site isn't diffused through rainfall and water sources? Through the pure mechanics of motion, how do I know that the arsenic contained in nearby soil isn't absorbed by a strawberry I'm eating that was grown down the road?"

Sharif says that like many people she tends to eat the same types of fruits, likely grown from the same sources. While our immune systems may prevent us from reacting to trace carcinogens, years of exposure to toxins that our bodies cannot excrete will eventually lead to cancer.

"Do I know what's really in the soil and what I'm consuming?"



SUPERFUND SITES ON EPA.GOV (2022)
There are 1,400 Superfund sites in the U.S., which have been designated by the Environmental Protection Agency as "mini Chernobyls."

> "I CALL THESE TRACE CARCINOGENS OUR INVISIBLE NEIGHBORS," SAYS SHARIF. "WE KNOW THAT A TUMOR THAT BECOMES DETECTABLE DIDN'T START GROWING YESTERDAY. IT TAKES 15 YEARS FOR THAT TUMOR TO BECOME DETECTABLE, SO WHERE IS IT COMING FROM? I BELIEVE IT'S LIKELY IT COMES FROM THE FOOD WE EAT, AND WE JUST DON'T KNOW IT."

Sharif is using her skills in diplomacy to enact public policy. She has filed a bill in the Massachusetts legislature called H.1012, “An Act to Improve Public Access to Healthy Food.” If passed, the law will give consumers information about food origin and whether or not the source had clean soil or water. Consumers will have more information about their food and be able to make choices based on that.”

The bill is currently co-sponsored in the Massachusetts legislature by several representatives and senators with either medical backgrounds or who have been touched by a family member who died of cancer or lived near a Superfund site.

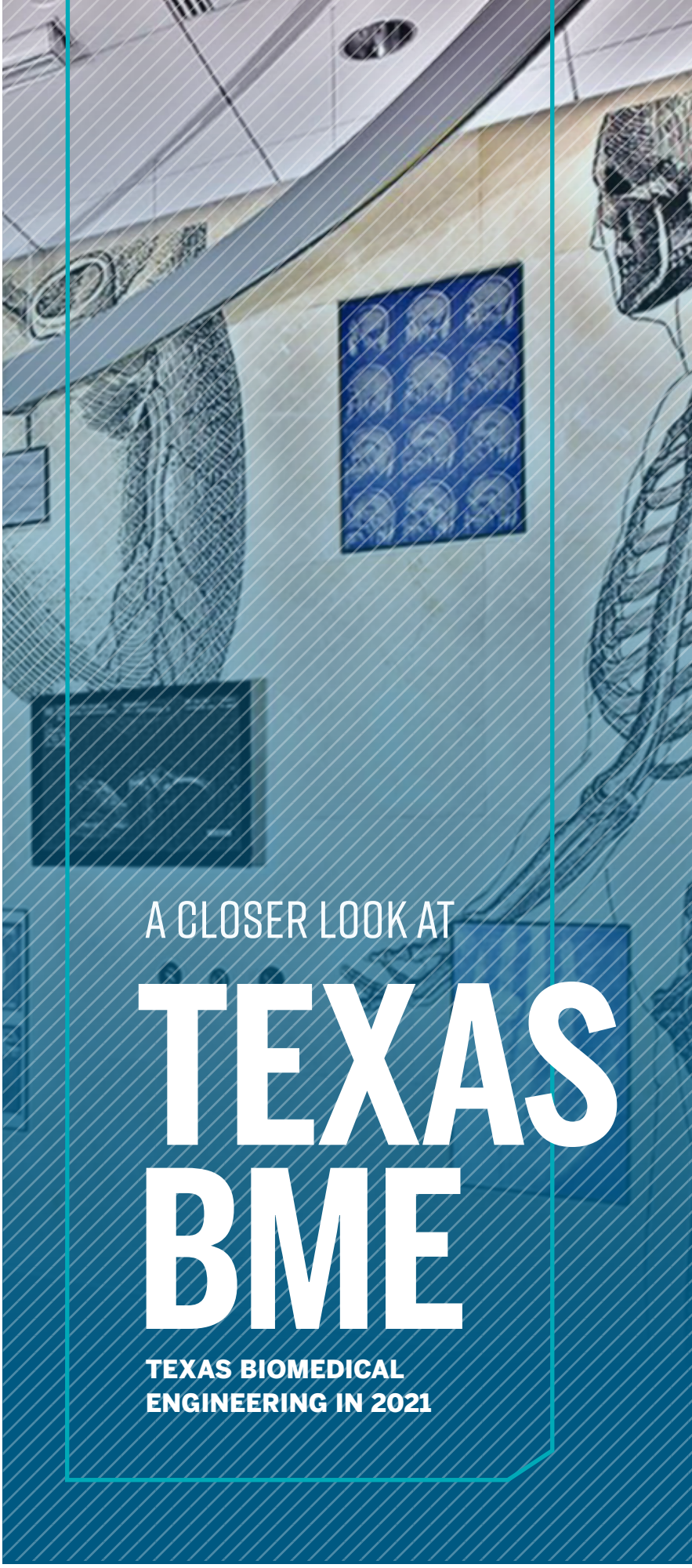
Sharif’s ultimate goal is to bring this initiative to the federal government.

“In the 20th Century, our country enacted a Clean Water Act and a Clean Air Act,” says Sharif. “I think it’s also time we create a Clean Soil Act and a Clean Food Act.”

As she runs her biotech company, Sharif continues to work with legislative sponsors in Massachusetts and in the federal government. And when she’s not doing that, she’s on farms collecting samples to back up her work in food activism, for which she has been called a 21st century Erin Brockovich.

Sharif credits her education at UT Austin for helping her get where she is today and says the best asset education provides students is how to look at the world’s challenges and develop solutions.

“My education at UT Austin taught me how to look at a seemingly overwhelming problem and break it down into steps. Every professor of mine had us write down the problem statement, boundary condition, known facts, and assumptions,” says Sharif. “I can tell you that UT Austin does this incredibly well, and I’m privileged to have been a part of that.” ■



A CLOSER LOOK AT

TEXAS BME

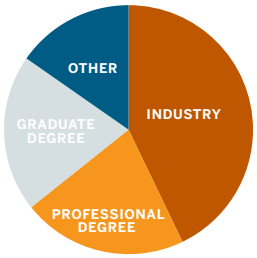
IN 2021

STUDENTS

UNDERGRADUATE

552	enrolled undergraduate students
1442	average SAT score of admitted students
54%	participate in internship programs
79%	participation in research groups or labs
32%	participate in study aboard programs
137	degrees awarded in 2020

AFTER GRADUATION



$76,496	average starting salary
42%	pursue jobs in industry
21%	pursue professional degrees
20%	pursue graduate degrees
16%	other

OUR B.S. GRADUATES ARE ACCEPTED TO TOP SCHOOLS, INCLUDING

- **Georgia Tech University**
- **MIT**
- **Rice University**
- **UC Berkeley**
- **UC San Diego**
- **University of Illinois—Urbana-Champaign**
- **University of Michigan**
- **Northwestern**
- **Texas A&M**

GRADUATE

552	enrolled Master's students
3.74	average GPA of admitted students
8	National Science Foundation fellows
24	Master's degrees awarded in 2021
16	Doctoral degrees awarded in 2021
23	have major university or external fellowships

$100%

of Ph. D students receive full funding

STUDENT NEWS

Graduate student **William Meador** received Acta Biomaterialia's Acta Student Award.

Meador

Merchant

Undergraduate student **Aditi Merchant** received the Texas Exes' Edward S. Guleke Student Excellence Award.

Graduate student **Andrew Robinson** and undergraduate students **Adrian Jeyakumar** and **Morgan Owens** received Student Leader Awards from Engineering Student Life in recognition of supporting Cockrell School student organizations.

Robinson

Jeyakumar

Owens

ALUMNI

2,015

biomedical engineering alumni around the world

OUR GRADUATES FIND POSITIONS AT TOP COMPANIES, INCLUDING:

- **Amazon**
- **Deloitte**
- **Epic**
- **GE Healthcare**
- **Goldman Sachs**
- **Google**
- **Merck**
- **Proctor & Gamble**

FACILITIES

Biomedical Engineering Bldg

- 106,000 square feet
- LEED Silver certification
- Opened doors in 2008

Engineering Education & Research Ctr

- 430,000 square feet
- Multidisciplinary research labs
- Student project center
- Opened doors in 2017

FACULTY

TENURE/TENURE-TRACK FACULTY

27 core faculty
18 endowed faculty positions
20 affiliated faculty around the world

HONORS AND AWARDS

6 National Science Foundation CAREER Award recipients
17 American Institute for Medical and Biological Engineering fellows
4 American Association for the Advancement of Science fellows
4 National Academy of Inventors fellows
2 National Academy of Engineering members
2 National Academy of Medicine members
1 American Academy of Arts and Sciences member

RESEARCH

RESEARCH AREAS

- Biomedical Imaging and Instrumentation
- Cellular and Biomolecular Engineering
- Computational Biomedical Engineering
- Cellular, Tissue and Molecular Biomechanics

RESEARCH CENTERS

- James T. Willerson Center for Cardiovascular Modeling and Simulation
- Center for Computational Oncology
- Center for Emerging Imaging Technologies
- Institute for Biomaterials, Drug Delivery and Regenerative Medicine

$12.9M
in research expenditures in 2021

PAPERS AND PATENTS

181 research papers and publications in 2021
33 patents filed in 2021

OUR FUNDING SOURCES INCLUDE:

- **National Science Foundation**
- **National Institutes of Health**
- **U.S. Department of Defense**
- **University Fellowships**
- **Diversity Fellowships**

RESEARCH ON THE RISE


Brock

Amy Brock received a five-year **$2.5 million R01** from the NIH to study the "tipping point" dynamics in tumor progression. The project investigates the critical transition from dormancy to proliferation. She also received a three-year $1.1 million R33 grant to develop new technologies for the rapid identification of antigen-specific T cells for cancer immunotherapies.


Parekh

Sapun Parekh has received an **NSF CAREER** grant for a project to better understand the physical, chemical properties of biomolecular condensates to then develop a set of rules to customize them for enrichment of different classes of molecules relevant for drug delivery and industrial catalytic applications.

He also received funding from the Chan Zuckerberg Initiative, Research Corporation for Science Advancement, and Frederic Gardner Cotrell Foundation for a collaboration with Texas BME alum Carolyn Bayer, an assistant professor at Tulane University on a project titled "Machine Learning to Identify Soft Tissue Molecular Signatures." "*Machine Learning to Identify Soft Tissue Molecular Signatures*."


Santacruz

Samantha Santacruz received an **NSF CAREER** award for a project to develop novel interface designs to facilitate fundamental characterization of neurophysiological activity in a neural circuit impacted by anxiety disorders. The project will also present outreach initiatives for K-12 students and underrepresented minorities.


Seidlits

Stephanie Seidlits received a $4 million Cancer Prevention & Research Institute of Texas (**CPRIT**) Recruitment Rising Star Award, which will allow her to continue research into development of biomaterial platforms to study tumor invasion and biomaterial microarrays for personalized cancer treatment.


Zoldan

Janet Zoldan received a four-year $2.26 million R01 grant from the National Heart, Lung, and Blood Institute of the National Institutes of Health to develop innovative hydrogel systems that will facilitate vessel growth to treat peripheral artery disease. ■

ALUMNI UPDATES

MARY CALDORERA-MOORE

M.S. 2007, Ph.D. 2010

Mary Caldorera-Moore, an associate professor and program chair of biomedical engineering at Louisiana Tech University, has been named Executive Editor for the Journal of Applied Polymer Science.

ASHWIN PARTHASARATHY

Ph.D. 2010

Ashwin Parthasarathy, an assistant professor at University of Southern Florida and co-founder of SPKL, LLC, received the 2021 Cade Prize for Innovation for his rbSEE blood flow monitor, which would allow physicians to measure blood flow at the bedside and has potential applications for treating stroke, traumatic brain injuries, wounds, and cancer.

MARISSA WECHSLER

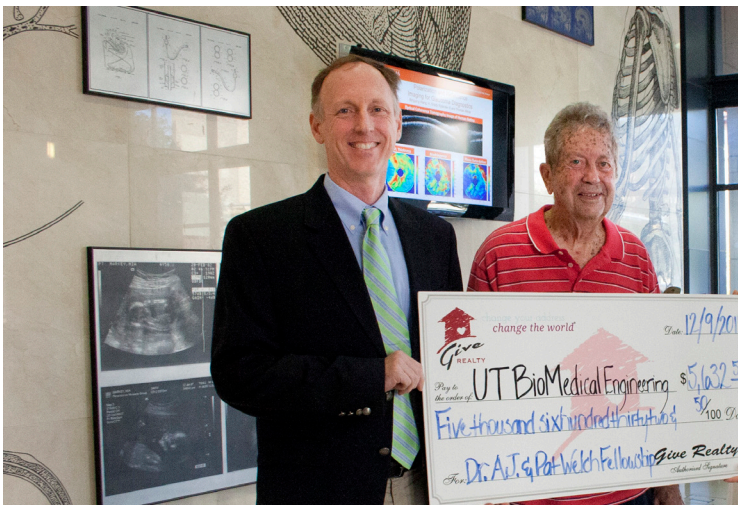
Ph.D. 2019

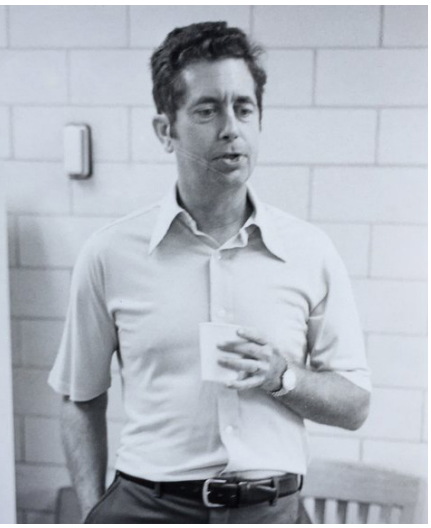
Marissa Wechsler, an assistant professor of biomedical engineering and chemical engineering at The University of Texas at San Antonio was selected as a Young Scientist Award Finalist by iCANx. The award discovers and recognizes a group of young scientists who are active in science and frontier fields and have made outstanding contributions on a global scale.

JENNIFER WEST

M.S. 1994, Ph.D. 1996

Jennifer West has been named the 14th dean of the School of Engineering and Applied Science at the University of Virginia. ■





REMEMBERING
A.J. WELCH

Biophotonics Pioneer and Founding Faculty Member

Ashley James (A.J.) Welch, a leading biophotonics researcher and one of the founding faculty members of the Department of Biomedical Engineering at UT, died at the age of 88 on January 1, 2022. Welch leaves a legacy of fundamental research and influence that carry on in the students he mentored and colleagues with whom he worked. Known for his patience, kindness, and ability to teach, the Texas engineering community mourns his loss.

Welch joined UT Austin as an assistant professor in 1964 in the Department of Electrical Engineering, and began teaching introductory courses for graduate and undergraduate students in biomedical engineering.

In 1968, he began teaching with what was at that time known as the Biomedical Engineering Program. His research focused on what happens to tissue when exposed to lasers, and he wrote Optical-Thermal Response of Laser-Irradiated Tissue, a classical reference for those working in the area of laser-tissue interaction. His research in this area first focused on laser safety, specifically as part of a project sponsored by the U.S. Air Force to investigate laser flash blindness in pilots and safe levels of laser exposure to the eye. Welch's work later evolved into how lasers could be used in medical applications and for diagnosing disease.

Welch was born in 1933 in Fort Worth, Texas and raise by a single mother who was one of the first women to work as a physical therapist in the state. He earned his electrical engineering degree from Texas Tech University, where he also met his wife, Pat Combs.

He later earned his M.S. in electrical engineering from Southern Methodist University, while working as an engineer for General Dynamics in Fort Worth, and then sought a PhD in electrical engineering from Rice University to fulfill his dream of teaching and conducting research.

Welch was a fellow of the American Institute of Medical and Biological Engineers and a recipient of numerous honors, including the Cockrell School's Billy & Claude R. Hocott Distinguished Centennial Engineering Research Award. He supervised nearly 50 PhD and 100 master's degree students during his time at UT and left a remarkable impression on those he mentored.

> "A.J. WELCH TOOK MY LIFELONG FASCINATION WITH LASERS AND INSPIRED ME TO MAKE A DIFFERENCE IN HUMAN HEALTH THROUGH BIOMEDICAL OPTICS," SAYS UT ALUM AND UNIVERSITY OF ARIZONA PROFESSOR OF BIOMEDICAL ENGINEERING JENNIFER BARTON. "HE INSTILLED PERSISTENCE, EXCELLENCE, AND AN ATTITUDE OF COMPASSION IN ALL HIS TRAINEES. I AM HONORED TO HAVE LEARNED FROM HIM."

Welch is survived by his children, who all received STEM degrees from UT Austin, and his seven granddaughters. ■

DEPARTMENT OF BIOMEDICAL ENGINEERING
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Ana Maria Porras (B.S. 2011) is an assistant professor of biomedical engineering at the University of Florida who creates models of disease tissues to study interactions between humans and microorganisms. She also explains how microbes work on YouTube, using her own crocheted creations. Here she poses with a life-size statue representing her at the Smithsonian in Washington, D.C. Along with 125 other women, Porras is an American Association for the Advancement of Sciences IF/THEN Ambassador. The program, made possible by Lyda Hill Philanthropies, promotes women in STEM. The Smithsonian exhibit was on display during March 2022 to emphasize the diverse coalition of contemporary women STEM innovators.

FOLLOW AND LEARN MORE ABOUT HER WORK WITH MICROBES ON INSTAGRAM @ANAMAPORRAS AND EN ESPAÑOL: @ANAEROBIAS

STAY CONNECTED @UTBIOMEDICAL

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