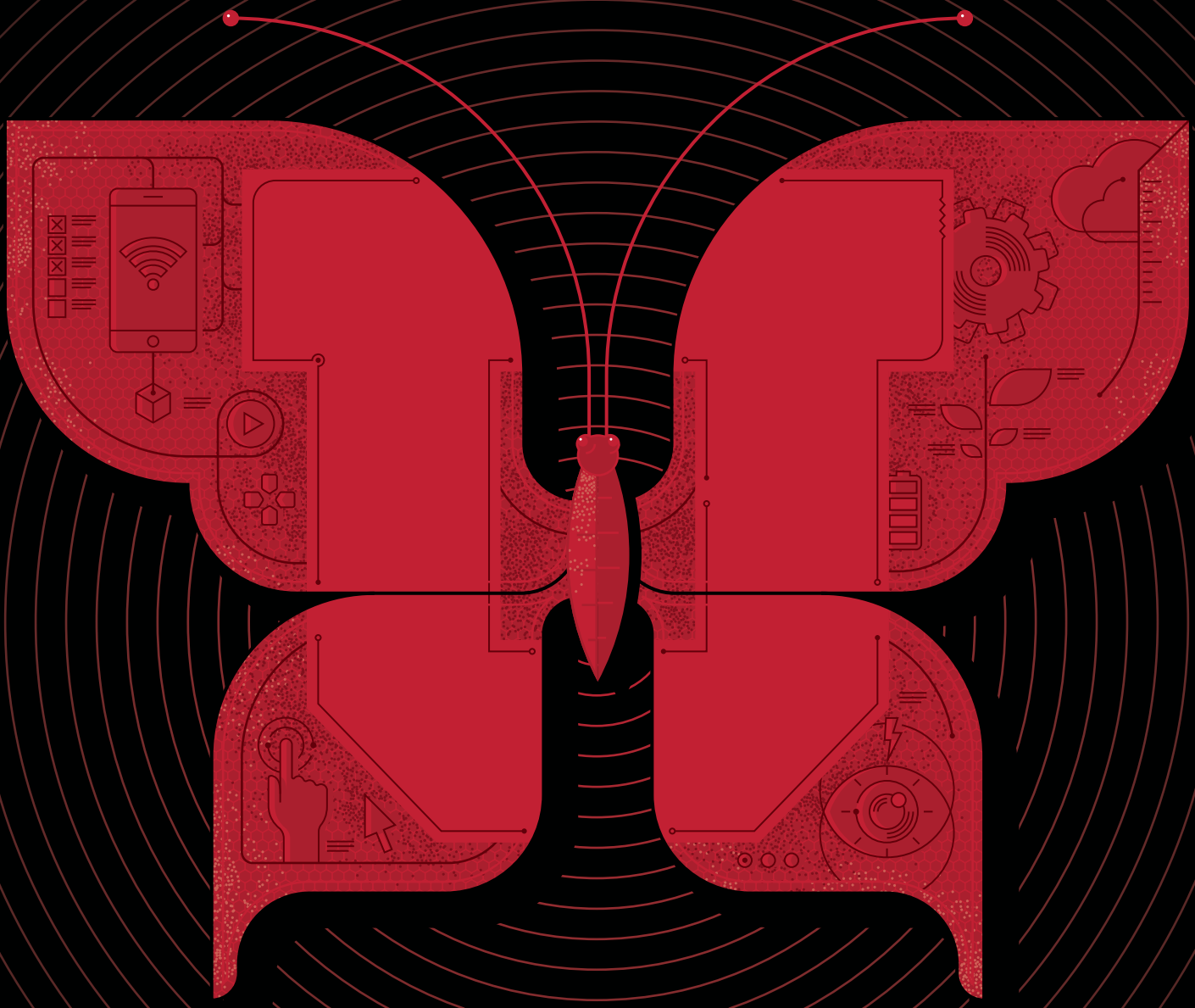
TECHNOLOGY & VENTURE COMMERCIALIZATION

TRANSFORMATIONS

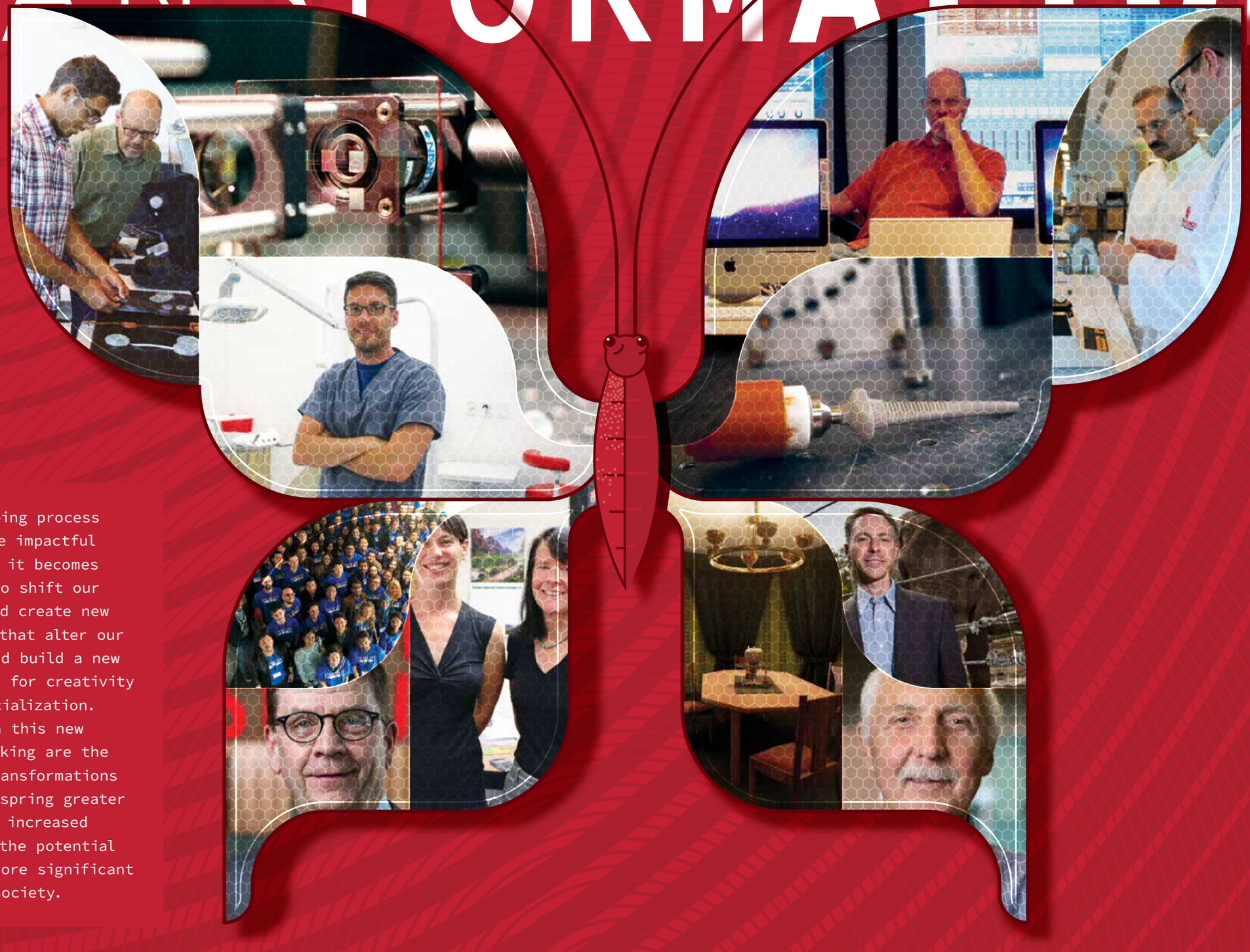


2017

ANNUAL REPORT

UNIVERSITY OF UTAH

TRANSFORMATIONS



In the ongoing process to cultivate impactful innovation, it becomes necessary to shift our thinking and create new strategies that alter our approach and build a new environment for creativity and commercialization. Embedded in this new way of thinking are the seeds of transformations from which spring greater innovation, increased value, and the potential for a far more significant impact on society.

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Message from PRESIDENT PERSHING

AT THE UNIVERSITY OF UTAH, WE CELEBRATE A SPIRIT OF COLLABORATION AND A CULTURE OF INNOVATION AND DISCOVERY. The track record of success is undeniable. Tremendous work by our faculty and students leads to new knowledge and innovations that benefit the broader community through high-skill job creation and companies. Technology & Venture Commercialization is the hub of that process. It's dedicated to transforming great ideas into life-changing applications.

We were recently named by the Milken Institute as Number 1 for Best Universities for Technology Transfer. The reasons cited include the U's ability to attract millions in research spending, its licensing income generated, the number of start-ups created, as well as the support systems for ideas and invention, such as the Center for Medical Innovation, the Entrepreneurial Faculty Scholars program, the Lassonde Entrepreneur Institute, and the Center for Engineering Innovation.

While such prestigious recognition is always encouraging, it only confirms what we already know. The University of Utah is a leader in the transformation of innovation and entrepreneurship into products and businesses. Diligent, inquisitive, passionate, and intelligent people are working together to blaze new paths. Their work and achievements, when combined with the support systems in place at the U, are positively impacting society. Within this publication, you will find examples of success, and information on the ways the university is also transforming to meet the needs of future visionaries.

NEW LEADERSHIP Seeks to BUILD on PAST SUCCESS at TVC

KEITH MARMER

ANDREW WEYRICH

As part of its ongoing commitment to commercialize and add value to new transformative technologies emerging from the University of Utah, Technology & Venture Commercialization (TVC) is undergoing its own transformation, as newly appointed Executive Director and Associate Vice President Keith Marmer and Vice President for Research Andrew Weyrich assume key leadership roles at TVC.

A successful entrepreneur and consultant specializing in early-stage technology startups, Marmer joins TVC after years of experience working in academic technology transfer. Previously, he served as the chief business officer for the Penn Center for Innovation at the University of Pennsylvania, and as the director of the Penn State College of Medicine's technology commercialization office. Prior to his appointment as vice president for research, Weyrich served as the dean for research at the University of Utah's School of Medicine, where he also worked as a professor of internal medicine. An experienced researcher in his own right, Weyrich hopes to build on the university's commitment to cultivating innovation. The new TVC leadership duo recently sat down to answer a few questions, and speak to their vision for the future of TVC.

The theme for this year's annual report is centered on transformation. In your opinion, what is transformational about commercialization at the University of Utah?

WEYRICH: For starters, we're both new, so that's a transformation, in and of itself. It also means there have been, and will continue to be, transformations in our approach based on our individual experiences. I'm excited by the opportunity to see the U continue to shape society's landscape by bringing innovations to market that impact people's lives.

MARMER: Being new to both the university and to Utah, I've been experiencing an exciting transformation, and I'm thankful the welcoming and supportive ecosystem we have both on campus and in our region. Looking ahead, I believe we should continue to transform the way universities commercialize technology. The University of Utah has become a recognized leader by being willing to explore new commercialization strategies. I want this to continue.

With both of you being new in your respective roles, what is your vision for commercialization at the University of Utah?

WEYRICH: I believe TVC should continue to support faculty in the commercialization process as they have in the past, while likewise serving to drive new relationships and opportunities with private and public partners.

MARMER: TVC has three core pillars: service, compliance, and revenue. These three functions are inherently in tension with each other. Frankly, the tension is healthy. I want to see TVC excel in all three areas by achieving a successful balance between these three pillars. I am also focused on seeing us create value for our stakeholders. While this can be defined in a number of ways, I think it means driving quality and impact into everything we do. At TVC, we provide the infrastructure to support the commercialization of other people's innovations. In many instances, these people entrust us with their life's work. We take that very seriously, and there's a real service component involved in our work. We're moving technologies through the patent process, the license process, the technology development process and adding value to their innovations with each step.

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In addition, we are hoping to develop and expand a number of programs and processes that will allow TVC to further technologies at a greatly accelerated rate. That means accelerating the time it takes to get a license agreement in place, training our staff internally, and ultimately accelerating engagement with various stakeholders, such as entrepreneurs and investors. In general, universities aren't known for speed. But, when it comes to commercialization, we're hoping to change that mentality.

TVC has enjoyed a rich history of commercializing technologies. Will anything change?

WEYRICH: Nothing will change as it relates to the continued commitment to strive for success, as TVC has experienced in the past. That said, we have to be realistic. The environment for academic technology commercialization has changed recently and TVC must adapt. For one thing, compliance requirements have become more stringent. Federal and state agencies are looking to offices like TVC to provide a higher level of transparency and compliance with regulatory requirements. This means not only additional resources to manage the workload, but managing the expectations of an array of stakeholders to fit into these new requirements.

MARMER: I also think we have greater pressure to provide financial returns. There is an expectation for university tech transfer offices to become profitable, which is both understandable and surprising when you consider that more than 90% of the technology commercialization offices in the U.S. do not generate a profit. TVC has enjoyed successful returns in the past and I believe we should continue to develop our efforts to do so in the future. It's challenging to make everyone happy all the time. But, I believe if we are transparent and continually drive towards improving our stakeholder experiences, we will achieve our goals. And, while I'm impressed with the history of TVC and what it has already accomplished, looking to the future, I would love to see it create even more value. Whether it's through relationships, the impact new technologies have on society, or in a monetary sense, I have always focused on creating value in my career, and I'm excited to continue that here. I'm also excited for the opportunity to create new programs to better support commercialization at the U.

Can you give us some examples of these new programs?

MARMER: Sure. First, we are creating a program we call StartUp 360. Faculty members at the U have created more than 180 companies in the past decade. Each time a company is created, it represents an extraordinary amount of effort for both the faculty and TVC, especially if the faculty member has never launched a company before. In order to ensure best practices, and engage with the right people to support the new company, we created StartUp 360, which brings together entrepreneurs, mentors, advisors, and service providers such as attorneys, accountants, and others to provide the necessary guidance and services from day one. Many of these services will be provided pro bono, saving the startup critical resources. While the program is still being formed, I have been particularly impressed by the enthusiasm of so many individuals and companies who participate in the program and support the startup community at the U.

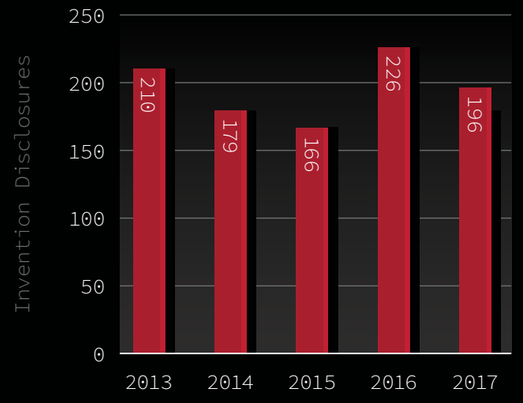
Second, I have asked our team and other stakeholders to come together and review every one of our agreement terms. I would like TVC not only to be "user friendly," but I would like us, where possible, to be fully aligned with our partners. That means we will be able to better support the challenges of our startup companies and partners during the uncertain times associated with commercialization. This will become a continuous process of learning and refining our approach.

What are you most excited for as you assume your new responsibilities at TVC?

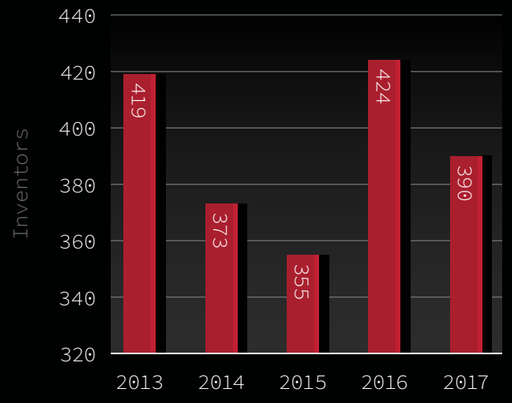
MARMER: The University of Utah and TVC have a reputation for being very innovative in their approach to technology commercialization. Academic tech transfer has been around for decades, but in some places it can be quite disconnected from the entrepreneurial process. TVC is different, in that it's very forward-thinking. The team here has created an incredible culture of innovation. I'm excited to be a part of that, and to build on that history to create something special.

2017 By The Numbers

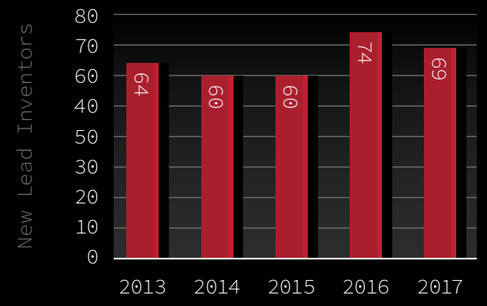
INVENTION DISCLOSURES



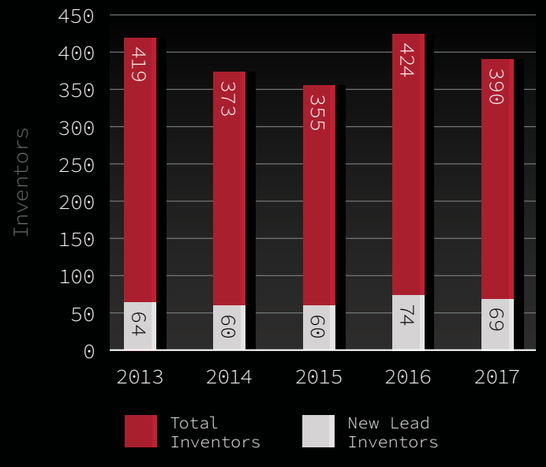
INVENTORS



NEW LEAD INVENTORS

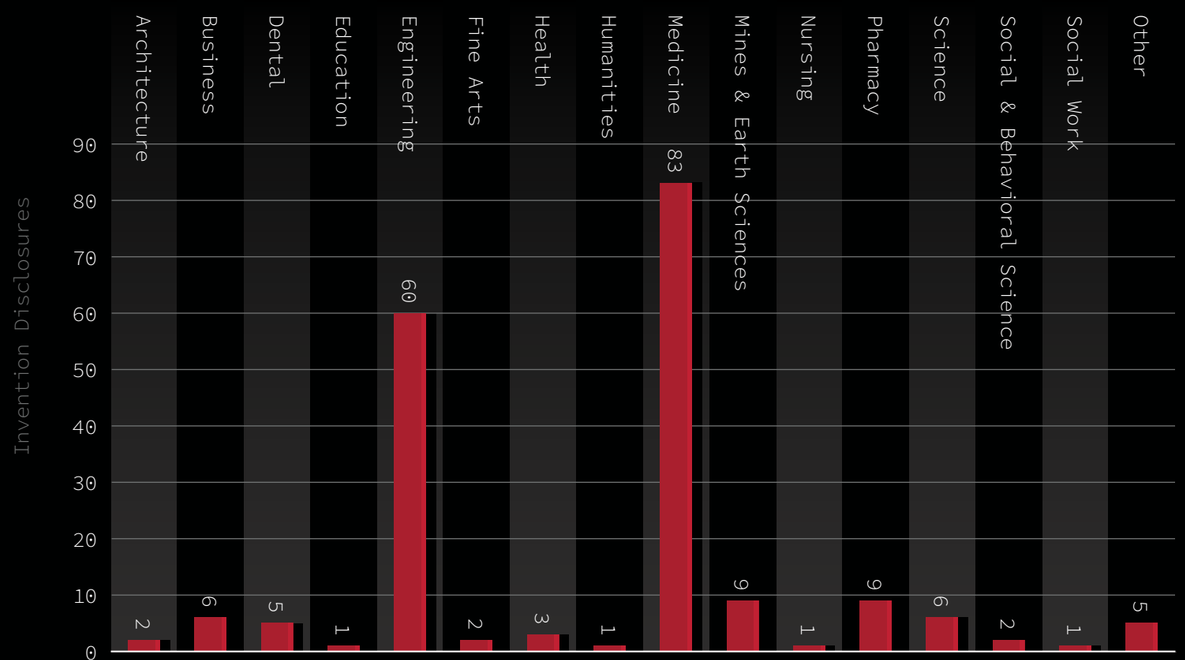


TOTAL INVENTORS AND NEW LEAD INVENTORS

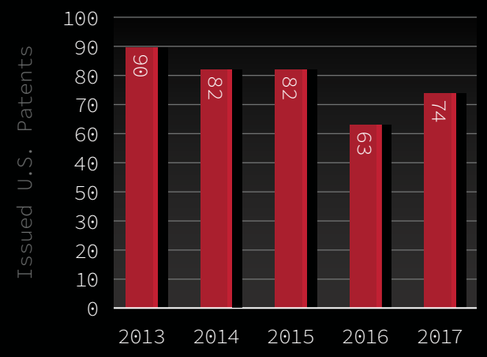


SPINOUTS

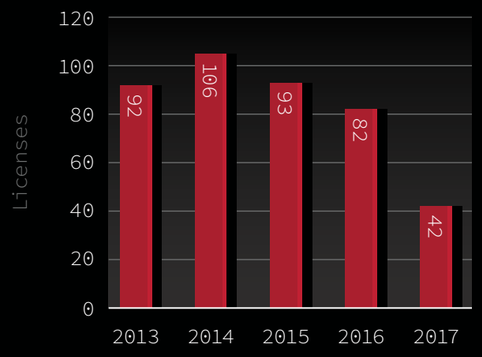
2017 NUMBER OF INVENTION DISCLOSURES BY COLLEGE



ISSUED U.S. PATENTS



LICENSES



Spinouts Launched Since 1970

The U has been successful at creating spinout companies—especially in recent years. Below are spinouts by fiscal year with notation for status.

● Acquired ▲ Active ■ Inactive

1970
- TerraTek ●

1973
- Advanced Composite Materials ■
- Metals Manufacturing ■

1977
- FFFractionation ●
- Iomed ●

1980
- Ceramatec ■
- Bunnel ■

1983
- Datex-Ohmeda ■
- Sarcos ●

1984
- ARUP ▲
- Engineering Geom. Systems ●
- Medtronic Gastro/Uro ■

1985
- DataChem Lab ■
- Rocky Mountain Research ●
- Techniscan Medical Systems ■

1986
- Anesta ●
- NPS Pharmaceuticals ●

1987
- A.D.A.M. ●
- Evans & Sutherland ●

1988
- Darbick Instructional Software ■
- J. Bunger & Associates ■
- Tepnel Lifecodes ●

1989
- MacroMed ●
- Parvus Corporation ■
- TheraTech ●

1990
- MicroMath ■

1991
- BioFire Diagnostics (Idaho Tech.) ●
- Femtoscan ■

1992
- Cardiowest Technologies ■
- InfaBloc ■
- Myriad Genetics ▲

1993
- HerediLab ■
- PartNet ●

1994
- BioCentrex ■
- Cognetix ■
- ENECO ■
- Innovative Caregiving Resources ■

1995
- Diacor ■
- ErgoWeb ■
- Handtronix Corporation ■
- Process Instruments ■

1996
- Cimarron Software ●
- Rosetta Inpharmatics ●
- Viewpoint Manufacturing ■

1997
- Manticore Pharmaceuticals ●
- Signature Immunologics ■

1998
- Echelon Biosciences ●
- Spectrotek ■
- Zars ●

1999
- Fiore Automation ■
- MedQuest Products ●
- Mineral Technologies ■
- TheraDoc ■
- ThermaCom ■

2000
- Aciont ■
- Allvivo Vascular ■
- Attensity Corporation ▲
- ParSciTech ■
- Pharmanex ●
- Salus Therapeutics (Genta) ■
- Sonic Innovations ■

2001
- Sensicore ■
- Tramontane ▲
- Universe Partners ■

2002
- Amirsys ■
- Hydra Biosciences ■
- Versa Power Systems ●
- Visual Influence ●
- Wyoming Research Innovations ■

2003
- Applied Medical Visualizations ■
- Q Therapeutics ▲

2004
- Coherex Medical ▲

2005
- Globalmatics ■
- Goldfinger ■
- Lineagen ▲
- MedAnalytics ■
- Milcin Therapeutics ■
- N-ERGY ■
- Sentryx Surgical ●

2006
- AlloCure ■
- Carbylan Biosurgery ■
- Exeven V ■
- Fuels Development Group ■
- Glycosan Biosystems ●
- Heightened Technologies ■
- Intan Technologies ■
- Intellivis ■
- LifeScan ■
- LiveWire Innovation ▲
- Neuroadjuvants ▲
- Respiris ●
- SentrX Animal Care ▲
- TechnoImaging ■
- Vestan Medical Imaging ▲
- Visual Share ■
- Wasatch Microfluidics ▲
- Xapio ■
- Zicthus ■

2007
- Bioclassifier ▲
- BioFuels Development Corp ■
- Boulder Technology Development Labs ■
- Central Logic ■
- Clear Carbon Solutions ■
- ContraDyn ■
- Image Technologies ▲
- Larada ▲
- LV Partners ●
- Navigen ▲
- nFocua ■
- Osteoseek ■
- Polevault Media ■
- PowerMems ■
- RayScale ●
- Rescue Medical Systems ■
- Thermimage ■

2008
- Advanced Signal Detection ■
- Akadi ■
- Allegro Diagnostics ●
- BabyJock ■
- BioEnergenix ▲
- Catheter Connections ▲
- Celux Scientific ■
- Epitel ▲
- Geo Mind ■
- GlycoMira Therapeutics ▲
- Heavystone Laboratories ▲
- I2S Engineering ■
- Nano-Oxides ▲
- Nanonc ■
- PFO Technologies ●
- Philotek ■
- Rigalya Pharma ■
- RU Ready ▲
- Surfagen ■
- Trapeze Media Solutions ■
- ViroPan ▲
- VisTrails ■
- Wasatch Nanopore Sensors ■

2009
- Accendo ■
- Blackrock Microsystems ▲
- Branching Tree ■
- Energence ■
- Ergonomic Tool Development ■
- H2OTEQ ■
- Headwaters Clean Carbon Services ■
- Honde Environment ■
- Integratech Proteomics ■
- JSK Therapeutics ▲
- Marrek ▲
- Metallosensors ■
- Miracotech ■
- Nanomedic ▲
- Optema ■
- Oscilla ■
- Purple Energy ■
- Sci-U ■
- Sera Prognostics ▲
- TheraRenal ■
- TheraTarget ▲
- RNA Biosciences ■
- Wastewater Compliance Systems ▲

2010
- 7Revolutions ■
- Brickell Biotech ▲
- Converus ▲
- F2 Solutions ▲
- Fay Financial Engineering ■
- G6 ■
- iVeena ▲
- Kayak Biosciences ■
- KickStart ▲
- Predictive Medical ■
- RedSpan ■
- Salt Lake Biosciences ■
- Seasonal Energy ■
- Sfida Biologic ■
- Short Solutions ■
- Solan ■
- Veritract ▲
- Versalion Pharmaceutics ■
- Vutara ●

2011
- AvanSci Bio ▲
- Axon Optics ▲
- Beijing Great Sun BioTech ■
- CB Bioenergy ■
- Cell Reader ■
- CoNextions ▲
- Doman Surgical ●
- e-Sens ▲
- Elute ▲
- Espira ■
- Granite Mountain Technologies ▲
- HOT Water Global ■
- Innoception Technologies ■
- Knudra ■
- MacCure ■
- Perfect Vision ▲
- Seismic Option Safety (SOS) Systems ■
- SymbioCellTech ■
- Telomere Diagnostics ▲
- TransViragen ■
- US Bioremediation ■
- Xandem ■
- XEnd ▲

2012
- Add-it ■
- Creative Medical Health ▲
- DecipherGenX ■
- Falgatter Technologies ▲
- iBiologics ▲
- Lazarus Medical ▲
- Lone Star Thiotherapies ▲
- MultiFunctional Imaging ▲
- Navillum Nanotechnologies ▲
- Pecten Technologies ■
- PRONTO International ▲
- Salarius Pharmaceuticals ▲
- Utah Medical Solutions ■
- Vaporsens ▲
- Veristride ▲
- Visus ▲
- Voyant Biotherapeutics ▲

2013
- Active Desk ▲
- Applied Biosensors ▲
- Arapeen Medical ▲
- ASHA Vision ▲
- CIRJ ▲
- Curza Global ▲
- Molecular Cloud ▲
- Navigen Endo-Shield ■
- Ore to Metal Technologies ▲
- Proactive Memory Services ▲
- Resolution Applications ▲
- Simplicity MD Sharps ■
- SimplicityMD Solutions ▲
- Synoptic ▲
- University Innovation Services ■
- Verus Mobile Security ▲
- Vettore ▲

2014
- ApopTx ▲
- Behavioral Health Strategies ▲
- Episona ▲
- Javali ▲
- Medvantage Corporation ■
- NeuroCircuit Therapeutics ▲
- NeuroVersity ▲
- Orriant ▲
- Progenitor Life Sciences ▲
- Recusion Pharmaceuticals ▲
- Sentius Technologies ■
- Symptom.ly ▲
- Tactical Haptics ▲
- Techcyte ▲
- Xenocor ▲

2015
- 4DQC ▲
- 6S Medical ▲
- Bastion Biologics ▲
- Clinacuity ▲
- IDbyDNA ▲
- Madra Learning ▲
- Majelco ▲
- NanoSynth Materials & Sensors ▲
- Origyn ■
- ProMD ▲
- Safe Blade ▲
- Solefire ▲
- StreamDX ▲
- T3S Technologies ▲
- uBiota ▲
- Vertias Medical ▲

2016
- Blacksand Technology ▲
- Farhang Wireless ▲
- Fluidx Medical Technology ▲
- Frameshift Labs ▲
- iCORDS ■
- ItRunsInMyFamily.com ▲
- Polarized Antenna Innovations ▲

2017
- Base 2 Genomics ▲
- Danta Group ▲
- Epicadence, Inc. ▲
- Lumos Imaging ▲
- Microsurgical Innovations ▲
- Nanonc ▲
- ParatusRX ▲
- Peel Therapeutics ▲
- Synthetic Biodesign ▲
- Through the Cords ▲

Innovative RECORDING SOFTWARE TRANSFORMING the SCHOOL of MUSIC

Audio Minions

THOUGH THEY MIGHT SEEM A NATURAL PAIR, music and technology can sometimes be at odds. While technology captures the complex and pushes for advancements, music stresses simplicity and tradition. It recognizes the importance of meticulous repetition and good, old-fashioned hard work. Yet, despite this, the evolution of music marches on. It may happen to the beat of a different drum, but much like music itself, every once in a while, technology and the simplicity of sound combine to create something beautiful.

Dr. Mike Cottle, assistant professor of music technology and composition at the University of Utah School of Music, understands that time-honored tradition and advancements in technology can coexist in harmony. In fact, he believes that making his students' lives easier can make them better musicians. A self-described stereo pair engineer, Cottle subscribes to the sound engineering theory that less is more. Therefore, with a few hanging microphones and a computer, he set out to create software that would allow his students to produce professional quality recordings by picking up their instruments and playing music, no matter the time of day, or any other circumstances, for that matter.

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Like most great inventions, Cottle's idea started with necessity creating opportunity. His desire to never miss a concert prompted him to think outside the bounds of traditional studio engineering. At first, Cottle decided to start concert hall recordings at the beginning of every day and turn them off at night, capturing every note of music played. Before long, this unconventional recording practice became a useful tool for faculty and student rehearsals, as well.

"Turning the recordings on and off was a hassle, and it's just hard drive space," Cottle recalled. "Faculty members can now listen to the students' rehearsals, or tell their students to listen themselves."

With the realization that even more musicians could benefit from having access to their recorded music, Cottle then worked to automate recording. The new program provides the benefits of continuous recording without the need for massive amounts of hard drive space. Now, instead of leaving recording devices on all day, Audio Minions recognizes sound coming from two rehearsal studios and three concert halls at the University of Utah and automatically initiates a recording when the sound rises above a predetermined threshold. When a concert or rehearsal has ended (or sound falls below the predetermined threshold), the recording automatically shuts off. Audio Minions then files and catalogs the recordings and conveniently makes them available to the musicians and the university through a simple file server.

Audio Minions has come in handy on more than one occasion. In 2012, when a director neglected to officially request edited CDs for a concert series (six performances), Cottle's program automatically recorded every performance. They sat dormant on the hard drives until the miscommunication was cleared up. Those files were retrieved, and the music was made available. Similarly, there have been times when a musician or ensemble executed a perfect rehearsal, only to have the actual concert compromised by outside noise. Audio Minions had automatically recorded the perfect rehearsal performance and made it available to the musician and the university. In addition to the convenience and accessibility, the recording software has helped students improve on their performance which enables them to become better musicians.

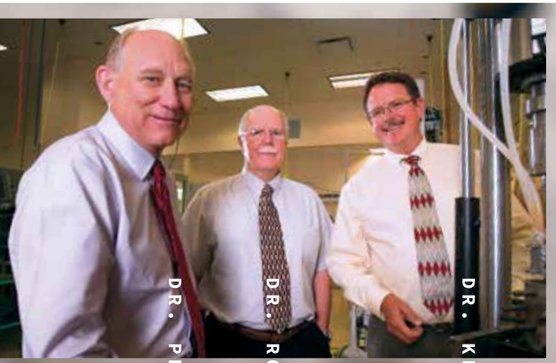
"For me, it's mostly the impact," Cottle explained. "The impact it has on students' lives. A graduating senior used to spend a lot of time and money to rent studio space and hire an engineer to record audition materials. Now, they walk into a hall, play, and request the files. It's there, it's running, and it's as good of a recording as you could get by hiring an engineer." In addition to saving students money, the automated recording software defuses the tension of a session, allowing the musician to relax and therefore, perform better.

Tom Call, a recent graduate of the University of Utah in Jazz Composition, called the software program undeniably influential. "Having opportunities to record made me want to write more," Call said. "Having this opportunity as an option, was beneficial to me as a musician, and a lot of students will say the same thing."

"As a musician, one of the most powerful ways to improve is to record yourself and listen," Cottle said. "Musicians are typically their own worst critics. All they need to do is switch to the listening perspective and avenues for improvement are crystal clear. This software has transformed the School of Music at the University of Utah," he added. "It has transformed the way we work, the way we rehearse, the way we perform, and the way we teach at this school. We are better performers because we have this system."

TVC has worked extensively with Cottle to investigate possible commercial avenues for his technology. In particular, by participating in TVC's Lean Canvas Cohort, Cottle gained valuable insights into exactly who might benefit from a product or service based on Audio Minions. Cottle believes Audio Minions will continue to help student and faculty musicians, and he is confident that its utility will eventually extend beyond the recording walls of the university, with practical application in high schools, private studios, and the entire music industry.

Building a BETTER FUTURE with BONE-INTEGRATED PROSTHETICS



DR. PETER BECK DR. ROV D. BLOEBAUM DR. KENT N. BACHUS

Bone-Integrated Prosthetic Implants

IT USED TO BE THE STUFF OF SCIENCE FICTION—the kind of thing only possible in a galaxy far, far away. But, for a few amputee veterans working with researchers at the University of Utah, the future is now.

Dr. Kent N. Bachus, a research professor of orthopaedics and adjunct professor of bioengineering at the University of Utah, spent years studying prosthetic attachments, mostly in the realm of total hip and total knee replacements. The bone-integrated implants he helped to refine yielded improved results in studies and provided a better quality of life for patients. In 2006, however, Bachus' work took a turn when officials from the Department of Defense challenged researchers at the University of Utah and the Salt Lake City Veterans Affairs Medical Center with the task of returning veteran amputees back to their pre-amputation levels of activity.

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"This was pretty exciting to us," Bachus said. "Up until that point, we had been doing more mundane biomechanical testing, but we had never actually created anything from the start, and this was a great opportunity."

To Bachus and the Utah team, achieving pre-amputation levels of activity meant foregoing the traditional socket prosthetic. Instead, they wanted to develop a device that could integrate into a person's residual bone, pass through the skin, and attach directly to a prosthetic limb. In other words, it meant creating something closer to a real limb than any previous prosthetic had ever achieved.

Based on his prior work, and with the help of a team of expert engineers and surgeons at the university, Bachus knew he could achieve bone ingrowth into the implant with skeletal attachment. But, he was unsure whether the osseointegrated implant, passing through the soft skin tissue and into the environment, could create the requisite biological seal to facilitate proper function.

"We were naïve enough to believe we could do it," Bachus recalled. "We didn't want these patients to be on antibiotics or to smear an antibiotic ointment on their skin implant interface for the rest of their lives. We wanted to get to the point where this was a normal, biological wound-healing response, and a clean heal was what we were targeting."

In 2012, that goal became more realistic when the University of Utah entered into a license agreement with DJO Surgical to use its proprietary titanium P2 porous coating on the implants, which allow skin and bone growth into the material. This ongoing collaboration, as well as a partnership with the George E. Wahlen, Department of Veterans Affairs Medical Center in Salt Lake City, eventually resulted in FDA acceptance for the team to conduct an Early Feasibility Study with 10 patients. The study won't be complete until the end of 2017, but patients are already beginning to see transformative results.

Those results include an improved quality of life for many amputees. One patient is participating in a triathlon, another is riding a bike, and yet another is enjoying the simple pleasure of walking down the beach with his wife once again. The study's participants recognize improvements in their ability to perform tasks that most people take for granted—the ability to get up at night for a drink of water, a quick check-in on the kids, or a trip to the bathroom. Amazingly, these people now have the ability to feel textures on the ground beneath their implants—a result of nerve endings interacting with the device—a feat that was never possible with traditional prostheses.

When the Utah team brought the idea of bone integrated prosthetic implants to their colleagues in 2006, many people said it could never be done. Today, many of the patients have had these implants for over a year and the results seem very promising. It's exciting to imagine that the team may have developed a futuristic biomechanical technology, but for now, they are happy just knowing that they're providing better futures for individual amputees.

U of U STUDENT TEAM Creates FORWARD-THINKING VIDEO GAME

Delirient

LIKE PEAS AND CARROTS, peanut butter and jelly, mashed potatoes and gravy—college students and video games seem to go together. Take a look around almost any campus dormitory or shared college apartment, and video games are part of the picture. They come with the territory and are as synonymous with the college experience as text books and toga parties. So, it might seem natural, even typical, to hear about a group of college students getting together to make a video game as part of their education. But, Delirient, a video game developed by a student group at the University of Utah, is anything but ordinary.

Delirient, created by Ben Steele, Tara Mleynek, and a group of 12 other students at the University of Utah's Entertainment Arts & Engineering program (EAE), is less of a traditional video game and more an interactive experience in thought and empathy. Where many video games can fall into the trap of providing mindless entertainment, Delirient takes a different approach. It invites the player to explore

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DELIRIENT TEAM

> “As students, this was our chance to do something a little risky. We wanted to take the opportunity to create something that was a little bit different.”

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a 1970s home, complete with shag carpets and patterned wallpaper, to piece together a story through the use of subtle environmental cues left by the home’s inhabitants. And, with a little effort, exploration, and abstract thinking, stories of abuse, coping, and strained family relationships begin to unfold.

“As students, this was our chance to do something a little risky,” said Mleynek. “We wanted to take the opportunity to create something that was a little bit different. That, combined with the understanding that not all games have to be games, served as our inspiration for this experience.”

As part of its curriculum, EAE introduces students to a variety of video game genres, including more serious games that address issues such as health, poverty, even abuse. These games stress storytelling first and de-emphasize gameplay to communicate an important message to the player. Some are meant for personal enjoyment, while others are developed for educational purposes, or as therapeutic tools to help people cope with specific challenges.

With the themes involved, the Delirient team didn’t want to tell their story in a heavy-handed way; instead, they decided to give the player freedom to explore, learn for themselves, and slowly unravel the mystery, piece by interactive piece. Through a first-person perspective, the player can pick up a recipe book, for example, and read a message suggesting self-doubt and past psychological abuse by a loved one. Or, the player might discover several discarded alcohol bottles lying next to a child’s broken toy and a bible. And, if the player spends enough time immersed in the game world, the message becomes clearer—a family’s story can be told (and empathy created in the process) simply by observing a place called home.

“We wanted to tell a story without any overt narrative,” Mleynek explained. “We wanted to have players visit this home entirely on their own, without any guidance, and piece together their own experiences through what they find in the environment. That way, the game allows for more personal interpretation, with each person having a unique experience. You get out what you put into it.”

Delirient is only the second student-developed game published on Sony’s PlayStation 4 platform, which has a history of rejecting games that fail to meet certain standards of quality. It is also the first game to be self-published by a student group on PS4—through a startup, Manic Interactive—a testament to the students’ commitment and passion for their creation. With more than 55 million PS4 units sold worldwide, Delirient has reached a broad audience. In fact, since publication, the team has received numerous emails from people who said the game touched them on a deep level. “That’s probably the most validating part of this for me,” said Steele. “There’s a classic phrase in game development, which is, ‘Find the fun.’ But, that never actually applied to us, because we weren’t trying to make ‘fun.’ We did what we set out to do, and we got an even better response than we were expecting.”

Brian Salisbury, an associate professor and lecturer at EAE, worked with the Delirient team during production and was impressed that the students deviated from the traditional video game experience. “I want to see games become narrative, storytelling, training, learning focused—something to help society,” he said. “There are so many kids entrenched in this medium; you’d like it to be able to enhance their lives, beyond just shooting as many enemies as they can.”

Steele and Mleynek seem to agree. They recognize that video games have the power to improve education, healthcare, and other important fields. As graduates about to begin their careers, they plan to continue exploring atypical, experiential game development. While they’re proud that their work has helped to transform the video game industry, they hope that non-traditional gaming experiences can go on to transform the world.

A TRANSFORMING POLYMER and the Potential for CHANGE

Embolitech

IN THE CONTEXT OF SCIENTIFIC RESEARCH, figurative transformations are a common topic of discussion. New ideas are commonly lauded for their potential to change lives, industries, and even the world. But, in the case of at least one new technology being developed at the University of Utah, the transformation is quite literal. Silk-elastin like protein polymer, commonly referred to as SELP, can be injected into the body as a liquid, where increasing temperatures transform it into a solid gel. Because of its ability to change states, SELP works well as an embolic, penetrating deep into targeted blood vessels and restricting blood flow to tumors. And, with the potential to treat some of the deadliest forms of cancer, this technology might just transform the world.

SELP was originally developed by Dr. Joseph Cappello, now an adjunct chemistry professor at the university, and colleagues at Protein Polymer Technologies, Inc. Cappello had been developing protein polymers for various applications when he began collaborating with

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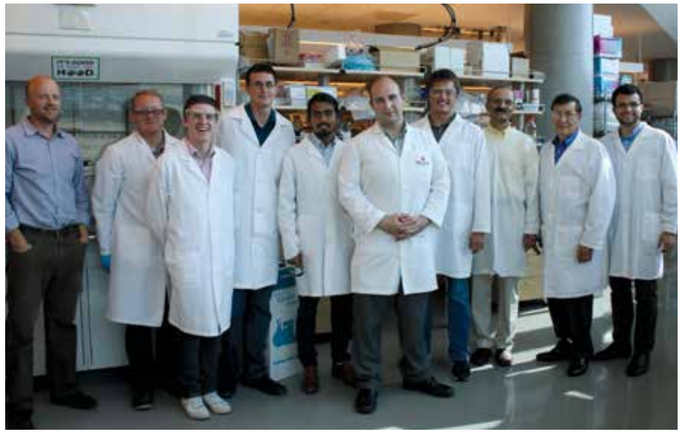
Drs. Hamid Ghandehari and Jindrich Kopecek, both professors of pharmaceutics at the school. The purpose of their partnership was to explore the use of protein polymers for drug delivery.

After a great deal of experimentation and laboratory success, the group decided to form a corporation called TheraTarget, in order to advance the technology and its commercial future. The company is an offshoot of the USTAR program, which recruited world-class research teams to the state of Utah. In addition to providing multiple financial grants, Technology & Venture Commercialization (TVC) has helped the company chart a path toward commercialization, emphasizing the need to scale from laboratory-sized experimentation to real-world levels of production and distribution.

Together, the organizations believe that they can commercialize SELP, first as a medical device and later as a localized drug delivery system. In its early stages, SELP will be used as a bland embolic, functioning only to block blood flow to tumors. Eventually, SELP could simultaneously starve a tumor and deliver potent, anti-cancer drugs to a highly targeted area of the body. SELP has the potential to treat many forms of cancer, but the team is currently focusing on its ability to treat hepatocellular carcinoma, or liver cancer. Liver cancer is one of the deadliest forms of cancer in the world and, unlike many other cancers, it's actually increasing in prevalence.

As a targeted therapy for liver tumors, SELP offers advantages over traditional chemotherapy, which takes a systemic approach to cancer treatment and causes a variety of negative side effects. Robert Price, one of the graduate researchers that has worked on the project hopes that "the technology will offer patients with hepatocellular carcinoma additional options in curative and palliative treatment,



allowing for a greater number of patients to be moved to the liver transplant list for total cure."

The use of embolization as a cancer treatment is nothing new. Frequently, tiny beads are used to block the flow of nutrients to tumors. And, while this type of embolization can be effective, it simply cannot penetrate all targeted blood vessels or reach deeper capillaries. Other liquid embolic materials can provide better blockage, but until now, they have included potentially harmful chemicals.

Because SELP is made of the same materials found in the human body, it includes no toxins or chemical byproducts and is extremely safe. But, what makes SELP truly different is its ability to transform its physical state. That transformation is made possible by the power of recombinant polymers, which allow for control over their structures and their physical properties.

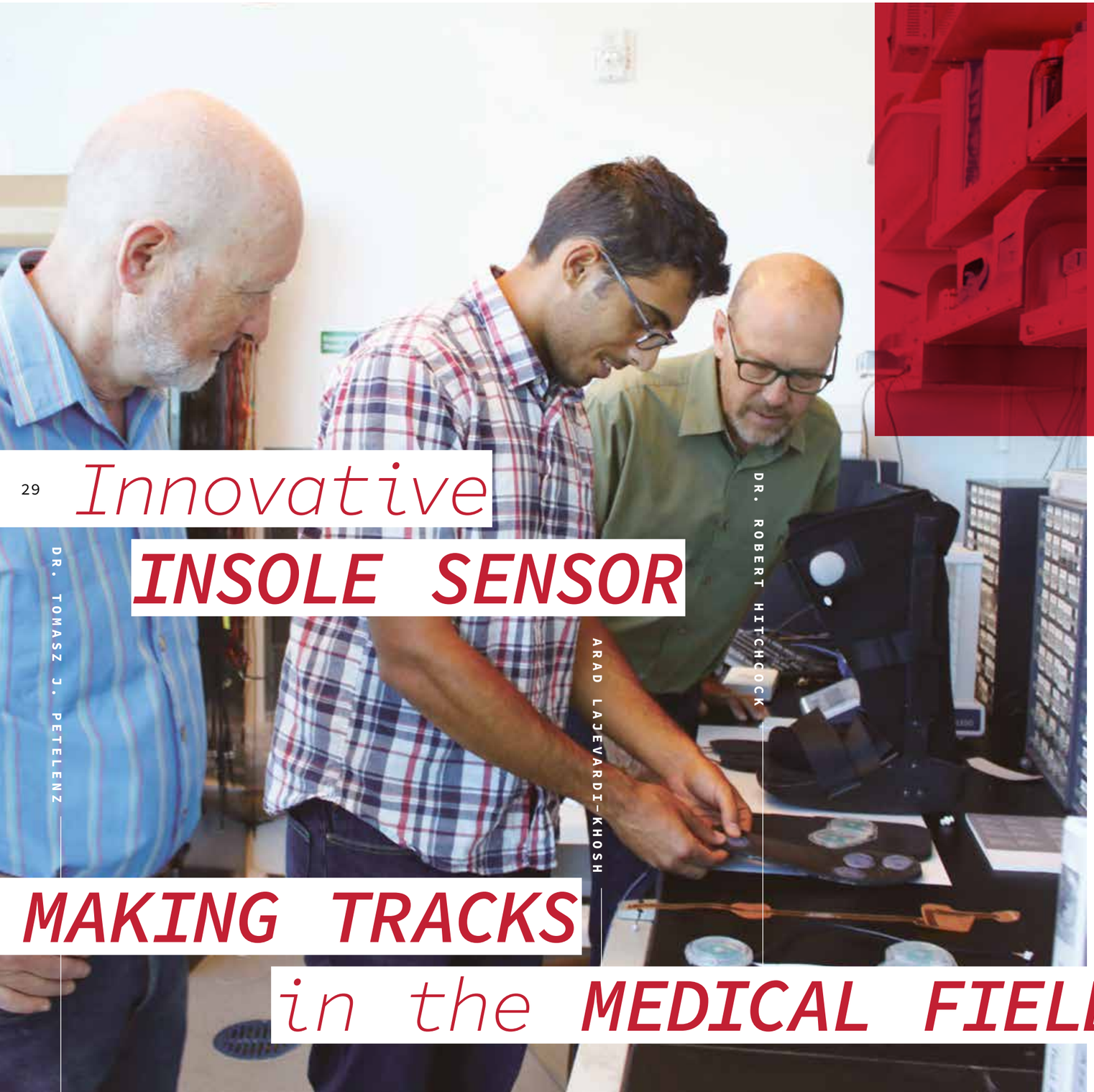
"By manipulating their structural features, we can precisely tune these polymers to accomplish a particular task," explains Martin Jensen, a graduate research assistant working on the project. "The task that we've tuned this particular set of polymers for is a transition from a liquid, soluble state at room temperature into a rigid hydrogel at body temperature."

This transformation from liquid to solid is critical to the function and efficacy of SELP. Once placed, traditional liquid embolics quickly wash away, limiting their effectiveness. SELP, on the other hand, with its ability to transform from a liquid to a solid, can both penetrate precise areas and remain in its intended location. "When SELP gels, it fills up the cavity or vessel. It doesn't shrink and nothing gets by it," explains Dr. Darwin Cheney, President and CEO of TheraTarget.

The SELP team refers to their innovation as a platform technology and believes it has application beyond targeted liver cancer treatment. Because the liquid phase of the material is saline, oncologists could potentially mix in any soluble drug. "There is immense value in smart design of customizable drug delivery systems," explains Azadeh Poursaid, an MD-PhD candidate and member of the research team. "Patients rarely fit textbook scenarios, so developing systems that can be modified to fit specific needs will provide the next phase in medical therapy."

As one of the inventors of the technology, Dr. Ghandehari understands the desire to look for applications beyond current areas of experimentation. But, he also recognizes the value in staying focused on the device's immediate application for treating hepatic carcinoma. "People are interested in treatments, not polymers," he quipped.

Recognizing a tendency within the scientific community to exaggerate a technology's potential for changing the world, members of the team are understandably hesitant to speculate about the future of SELP. However, as they continue to evolve their work and progress their company, they can't help but wonder how much change a little transformation may bring.



Innovative INSOLE SENSOR MAKING TRACKS in the MEDICAL FIELD

DR. TOMASZ J. PETELENZ

ARAD LAJEVARDI-KHOSH

DR. ROBERT HITCHCOCK

FLEx Sensor

OFTEN, THE WORLD MUST TRANSFORM AN IDEA before the idea can transform the world. Recognizing this fundamental truth, Dr. Robert Hitchcock and Dr. Tomasz J. Petelenz—both associate professors in the Department of Bioengineering at the University of Utah—structured their laboratory to maximize the influence of the outside world. As a translational facility, the Hitchcock Research Group collaborates with clinicians to actively target real-world challenges and opportunities. The lab's mantra, "good solutions require good problems," clearly reflects an understanding that great ideas are often shaped and reshaped by the real world.

The FLEx (or Flexible Load Evaluation Transducer) Sensor, one of the technologies currently being developed at the Hitchcock Laboratory, clearly demonstrates the value of allowing ideas to transform in response to new information. Originally, the team was working on a project known as the ATLAS (or Ambulatory Tibial Load Analysis System) Boot Cast, developed as a solution to a problem presented by Erik Kubiak, an orthopaedic surgeon at the University of Utah. Dr. Kubiak frequently saw patients with

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broken tibias and suspected that some of them were placing too much weight on their broken bones during recovery. The solution began to develop in the form of an underfoot sensor—ATLAS—that could be placed in a standard controlled ankle motion boot to measure and record the load environment.

In the project's early stages, the group realized that the ATLAS could not be easily adapted for normal footwear. As a result, the team began developing a new, more flexible sensor. The result of this adaptation was the FLEx Sensor, a small, gel-filled pad containing a tiny electronic pressure sensor and custom, flexible circuits. When the gel is pressurized, the device detects, measures, and records pressure, which can be monitored in real time or stored for later analysis.

As the device evolved, so did the lab's thinking on its potential application. "Originally we made something to look at how much weight people were putting on their injured limbs," explained Arad Lajevardi-Khosh, the project's graduate research assistant. "But, when we looked at the data more closely, we were getting a broad picture of a patient's total behavior." Using data provided by the FLEx Sensor, researchers could derive a patient's activity level, exercise patterns, and motion tendencies. Inadvertently, they had developed a portable, flexible sensor with numerous applications in the growing field of total patient monitoring.

Suddenly, the FLEx Sensor was attracting interest from physical therapists, exercise physiologists, sports scientists, cyclists, and even weight lifters. Experts began discussing how it could benefit amputees, injured athletes, and those recovering from surgery. What began as a simple technology with the aim of solving a narrow problem for orthopaedic physicians, the FLEx Sensor has transformed into an exciting technology with broad application. "While working to develop ATLAS, we identified a new need—measuring load in normal shoes for a variety of applications," recalled Dr. Petelenz. At this stage, the project shifted to accommodate the demand for sensors in ordinary footwear.

As the scope and potential of the FLEx Sensor project blossomed, the laboratory sought additional help from Technology & Venture Commercialization (TVC) at the University of Utah. TVC had become a partner very early on, providing the group with early funding to develop and de-risk the technology, perform market research, and protect the intellectual properties. With many applications on the horizon, TVC and the Hitchcock Research Group continue working with various partners to get this technology in the hands of those who will benefit from it the most.

While the project has uncovered a myriad of fascinating medical insights, it is the evolution of the idea itself that seems to interest Hitchcock. "What's really interesting to me is the way that these projects start somewhere, you open a door, and all of the sudden you get another hallway of doors that you can start knocking on." ATLAS has received multiple inquiries from companies interested in licensing the technology for a variety of applications. For now, the lab is focusing on insole applications, but one can envision a future in which these sensors are being used in entirely different ways.

After all of the pivots and adjustments, members of the Hitchcock Research Group recognize that they may not control the future of their innovation, but they embrace the fact that the world will continue to transform their sensor technology. "As long as we make a robust sensor system," commented Lajevardi-Khosh, "it has a future in so many different applications."

"What's really interesting to me is the way that these projects start somewhere, you open a door, and all of the sudden you get another hallway of doors that you can start knocking on."

The IMPLANT TOOTH That Could Change MODERN HEALTHCARE

DR. MARK DURHAM

Implant Tooth

COMMONLY CONSIDERED A RALLYING CALL for increasing community efforts to rear the rising generation, the saying, "It takes a village to raise a child," has application in innovation, as well. The concept is simple and poignant: when it comes to innovations in technology, it takes more than just one person with a great idea to create something lasting and impactful. Rather, it takes numerous people, contributing in their own unique, specialized ways, to take an idea from abstract theory to large-scale utility and implementation.

Dr. Mark Durham, a prosthodontist specializing in the replacement of teeth, came to the University of Utah after spending several years at the Veterans Affairs (VA) Hospital in Salt Lake City. At the VA, he worked with a team to pioneer several advances in prosthodontics technology, including an award-winning technology that gives patients with dentures the ability to chew food with more force than a person with normal dental

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function—a far cry from the limited functionality dentures provided in the past. Now, as section head of prosthodontics, chair of Continuing Dental Education, and assistant professor at the University of Utah School of Dentistry, Durham has surrounded himself with a new team of experts to explore further advances in the dental industry, and beyond. In fact, with the contributions of his university colleagues, including Drs. Tomas Petelenz and Florence Salzbacher, Durham's latest idea has the potential to be truly transformative.

Because many prosthodontics patients have other complicating health concerns, Durham had the idea to place a device within a patient's mouth that could monitor biomarkers inside the body. Innovating upon existing prosthodontics technology, Durham and his team developed a way to monitor glucose and opioid levels within the saliva via a sensor affixed to a denture. The information is stored on a microchip within the denture which acts as a hub for data collection. Even more novel, Durham and his team are currently working to implement this technology within an actual implant tooth, which would allow for data to be collected from two separate sources—the saliva and the blood—thus providing more accurate input results.

"This technology is fast and accurate enough to detect even small concentrations of Fentanyl," said Petelenz. "The implant could be tuned to a series of markers, depending on specific application need, potentially even on a patient-to-patient basis, enabling a personalized healthcare approach."

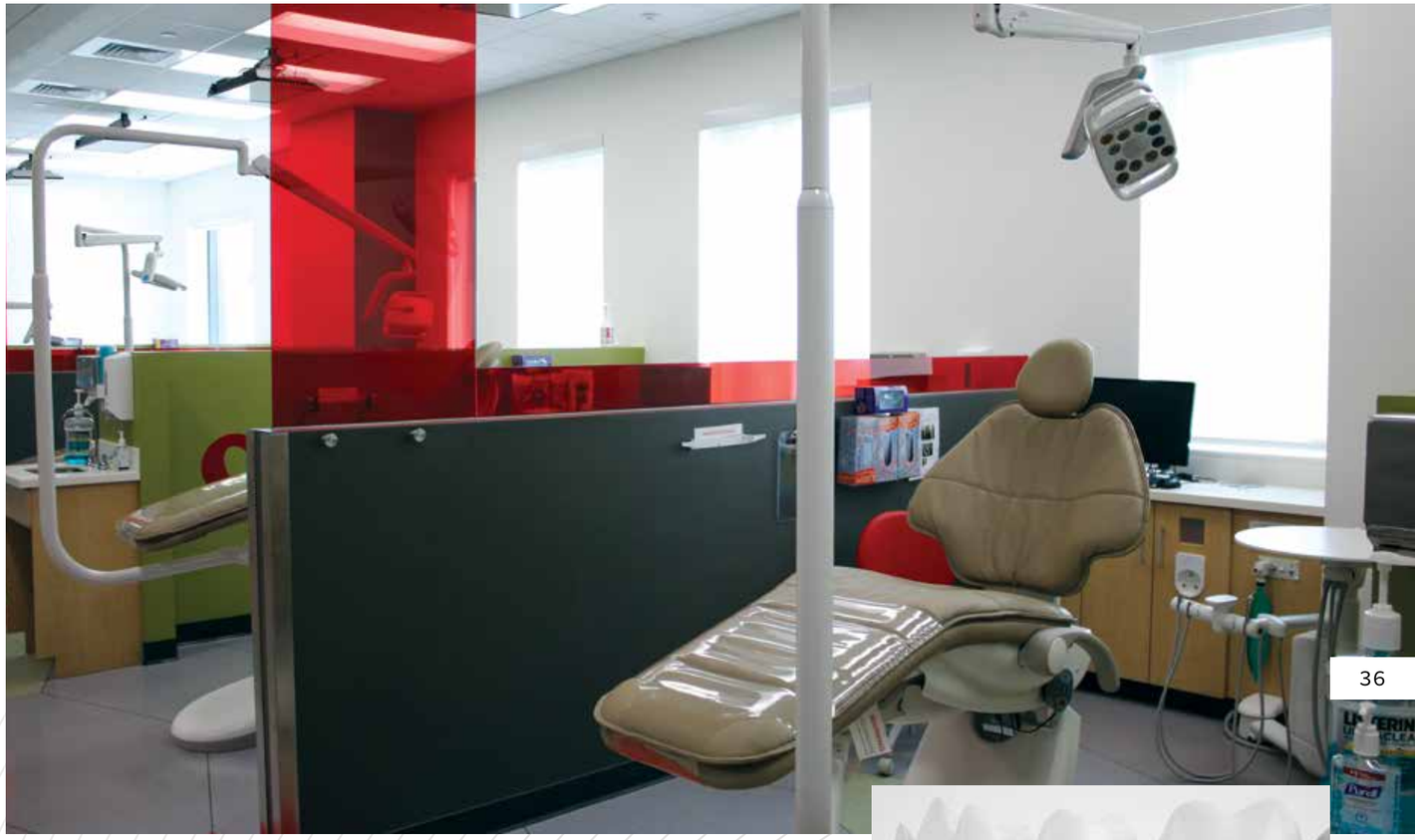
Eventually, Durham and his team hope this technology will scale in size and include various sensing technologies that could be implemented within an existing tooth, a filling, even a whitening tray, to monitor data over time and detect disease at its earliest stages. And, with the data already collected, it is not difficult to see a day when that information is accessible to caregivers and loved ones through the convenience of a simple smartphone app.

"This technology couples the simplicity and versatility of consumer blood pressure and temperature monitors with the ability to measure advanced sets of critical biomarkers," said Salzbacher. "The smartphone/smartwatch industry had started building software and database infrastructure for such uses, but underestimated the challenges associated with suitable sensors. This technology has the potential to enable their applications."

"You look at very specific cancers where you need data over time," Durham added. "That's what's unique about what we're doing. It provides data over time. When you go to get lab results, it's a prick, there's your blood—it's a snapshot. We're giving a video feed, basically—it's continuous. The saliva and blood are always in constant interaction with the sensors."

"Perhaps you'll be able to read from your mobile platform that you have a cold or a bacterial sickness coming on," Durham continued. "You would know ahead of time, and because it's very specific, you can treat it. Or, perhaps your spouse is on a hike or climbing a mountain, and her C-reactive protein is suggesting heart attack or stroke. That message would be sent to your phone, your spouse's primary care provider, and all the people on her network. There are a lot of things going on in our bodies, that are just molecules, that we currently have no way to tap into."

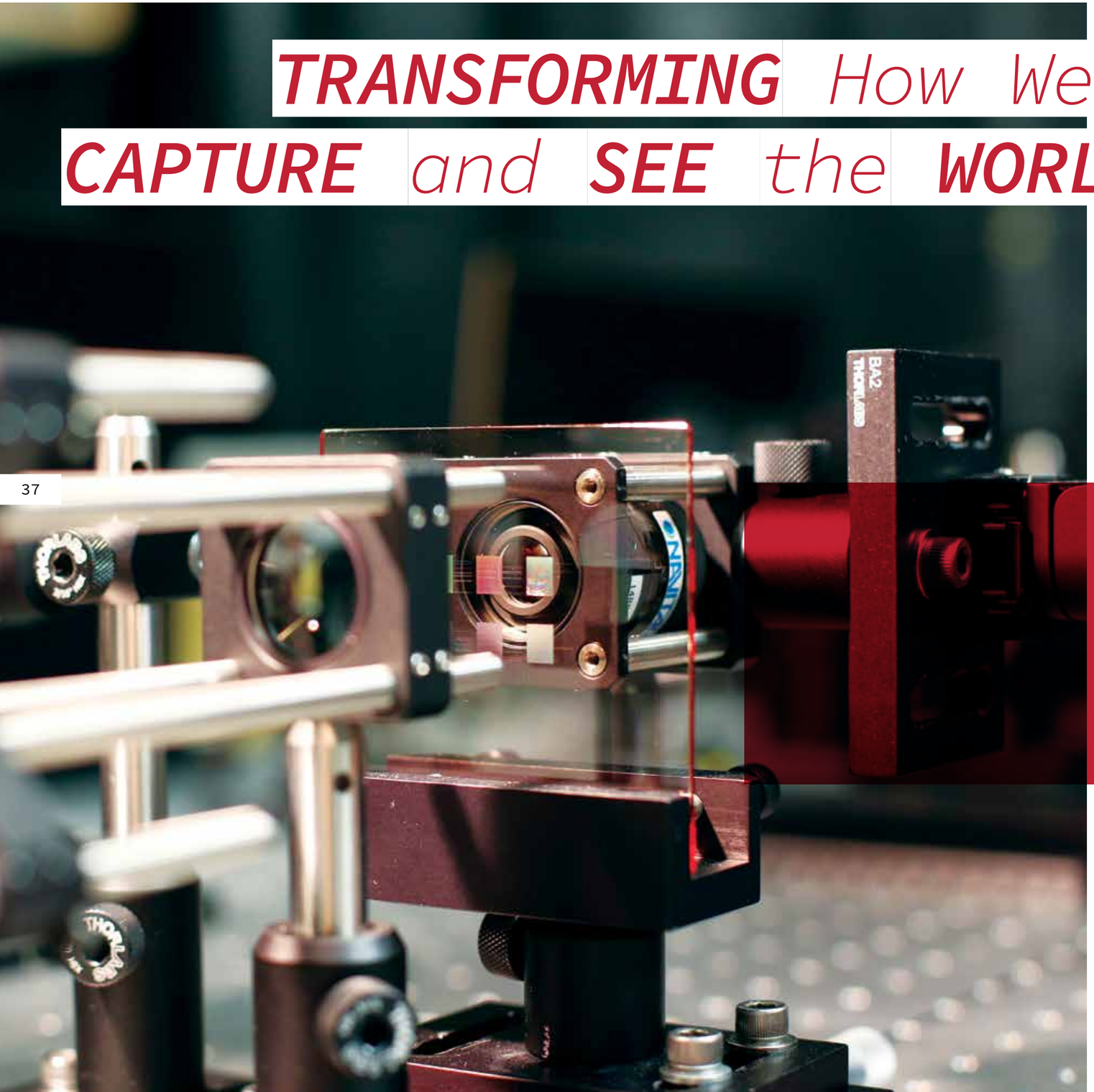
Beyond collecting and interpreting data to detect disease, Durham hopes this technology will eventually progress to the point of providing instant feedback for correcting specific molecule imbalances inside the body. But with the project still in its infancy, he recognizes that there is a lot of work still ahead, and that it is going to take the proverbial village to keep moving the technology forward.



"You just can't do this stuff in your own little basement. It's just so big," Durham said. "The power for this project came at the University of Utah when we started having team cohesiveness where there was support in financing, support in networking, personnel, and resources."

"But, we are just beginning," Durham cautioned. "These are hard hoops to jump through. You need a really intelligent team to make this happen. Even with all these bright people being on the cutting edge, a lot of this is still unknown. It's going to be all about the team—100 percent."

TRANSFORMING How We CAPTURE and SEE the WORLD



Lumos Imaging

IF THE HUMAN EYE COULD BE REFINED OR RE-IMAGINED, what would it see? Would it capture more light, see sharper images and more vibrant colors, perhaps even detect infrared activity or identify a person through iris recognition? And, what if the integral components of this new eye were almost microscopic, lending super-human optics to artificial intelligence such as drones, robots, and automatic cars? Not only would this technology revolutionize the imaging industry, it would also fundamentally transform the way people see the world.

Beginning with the understanding that the future of cameras will involve much more detailed imaging than any human could process, Rajesh Menon, an electrical and computer engineering professor at the University of Utah, set out to create a camera filter with super-human capabilities.

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Spurred by a challenge and some funding from the National Aeronautics and Space Administration (NASA) to help in the early research and development of small, multispectral cameras that could be put into space to look for near-earth objects, Menon started to think small. Because the difficulty with sending anything into space always involves weight, the goal was to create extremely small, light-weight hyperspectral imagers that could identify objects in space, determine how fast they move, and how much they weigh. Realizing that this technology could also be used in color imaging, Menon's research eventually led him to develop a transparent camera filter. It is approximately 1 micron (one-millionth of a meter) thick, lets in three times the light of a standard camera filter, and can interpret 25 different colors—a giant leap over the traditional red, blue, green Bayer filter used in most cameras.

Menon's filter, essentially a small piece of glass that bends light as it passes through variously-shaped ridges etched into the glass, is only part of the solution, however. With the help of Fernando Guevara-Vasquez, Mathematics Professor at the University of Utah, who came up with the algorithms to interpret the light patterns created, this filter has opened up a new world of imaging possibilities.

Looking ahead, Menon can think of numerous applications for technologies with vision that exceeds the human capacity for sight. "If you have, for example, an autonomous car and it needs to know what it's looking at, whether it's a red light, green light, stop sign, or yield sign, there's no human in the loop. This means there's no reason to go into a human-centric imaging system at all," said Menon. "Our vision is to have superhuman cameras," he added. "There is no reason to limit the eyes of artificial intelligence to human perception."

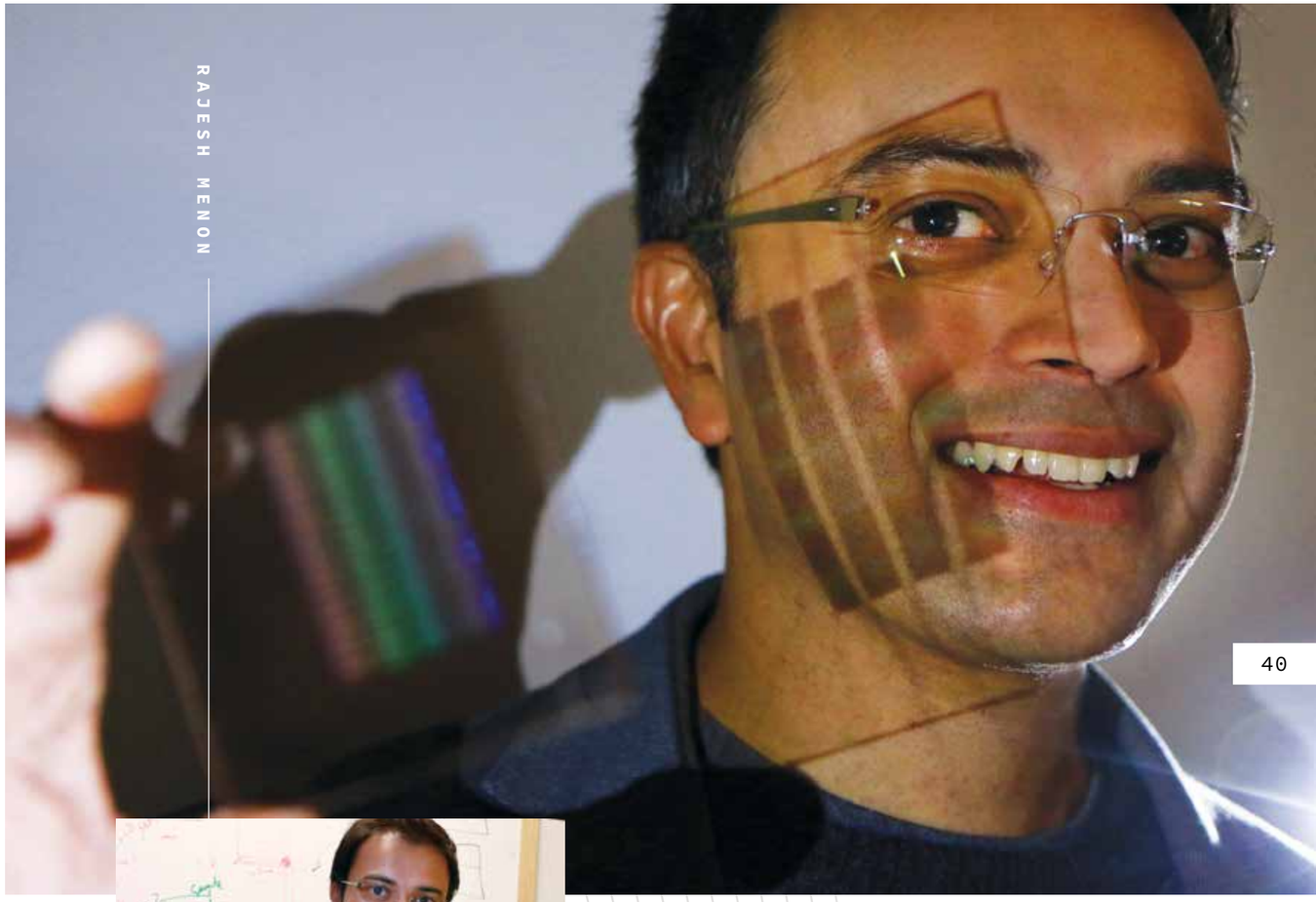
Interestingly, Menon believes the most immediate application for this technology might appear in the agricultural industry. A camera with these advanced imaging capabilities could capture the reflected sunlight from plants to help identify diseased crops and monitor their water and nutrient intake. Because Menon's equipment would be lighter and more affordable than alternative technologies, aerial imaging would be more efficient and more accessible.

In the long run, Menon also believes there will be compelling applications for this technology in the realm of cell phones, biometrics (e.g. to help identify certain types of skin cancers), and beyond. This technology could be applied to almost any situation where imaging-based decision-making is required.

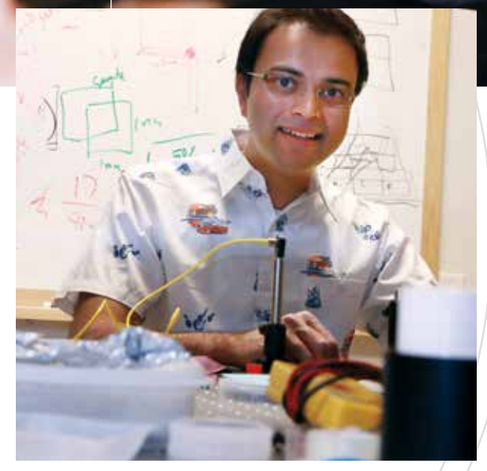
To explore ways to develop this technology further and bring it to market, Menon and Guevara-Vasquez have started their own company, Lumos Imaging. With the help of Technology & Venture Commercialization (TVC) at the University of Utah, their dream of creating the superhuman camera is coming closer to reality.

Menon recently decided to incorporate elements of the business planning process into his optical engineering curriculum at the university, including a business competition at the end of each semester. "As engineers, we're never trained to think about how to commercialize technologies," Menon said. "This is a real need in all engineering schools. I was trying to create this plan from scratch and TVC helped me. They were happy to come in and give guest lectures and act as judges for the business plan competition."

These days, Menon finds himself thinking a lot about sight. As researchers and business professionals, he and Guevara-Vasquez are changing the way technologies see the world.



RAJESH MENON



As a university professor, Menon is trying to change the way his students view their work in the context of commercialization.

ELEPHANTS and EXPERIENCES Open NEW DOORS in CANCER PREVENTION

PEEL Therapeutics

DR. JOSHUA D. SCHIFFMAN, A PEDIATRIC ONCOLOGIST AND PROFESSOR in the Department of Pediatrics and Department of Oncological Sciences at the University of Utah's School of Medicine, understands the devastating effects of cancer, perhaps better than almost any individual. Like many of his colleagues, Schiffman has dedicated his academic studies and professional career to cancer research, trying to better understand the genetics of cancer in order to identify particular susceptibilities within families. It has been his experiences within his own family, coupled with his studies of animals outside the human family, that set Schiffman apart from his peers.

Growing up as the son of a hematologist and oncologist, Schiffman watched as his father made house calls to visit cancer patients on a regular basis. He admired his father's compassion and dedication to helping others, and remembers meeting and being around his father's patients. At age 15, however, his understanding of cancer turned particularly personal when he developed the disease himself. "I had been surrounded by cancer my

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entire life," Schiffman recalled. "I knew all about cancer and how devastating it was from an early age, but my own diagnosis thrust me into the world of cancer more than I ever wanted to be."

Overcoming his childhood cancer diagnosis sparked a desire within Schiffman to pay it forward and help others with the disease. He attended medical school close to home at Brown University, went through clinical training at Stanford University and the Lucile Packard Children's Hospital, and dedicated his life's work to pediatric cancer research and improving patient outcomes.

"I wanted to become a doctor to take care of kids with cancer, just like the doctors took care of me," Schiffman said. "I felt pretty strongly that I would be a palliative care doctor and I would take care of dying kids and their families; that was where there was a large, unmet need. However, when I started working in the laboratory, it opened my eyes. Instead of taking care of dying kids at the end of life, could there be a way to use science and technology so that kids would never have to get cancer in the first place?"

With a newfound goal in mind, Schiffman became enamored with the concept of translational medicine—going from bedside to research bench, and back to the bedside. The ability to identify issues and then make discoveries in the laboratory based on the clinical needs of his patients, allowed Schiffman to generate and test hypotheses, and bring them back to the patients in ways that impacted and improved care. Now, Schiffman continues his research at Huntsman Cancer Institute at the University of Utah, employing combinations of clinical and research methods to discover possible treatments and preventions of cancer.

A large part of Schiffman's research at Huntsman Cancer Institute involves the p53 gene, the so-called guardian of the genome. As it turns out, the p53 gene is among the most important genes for cancer prevention. Its job is to detect mutating cells, stop them from dividing, and fix or destroy them before they become cancerous. With only a single p53 gene intact instead of the normal two genes, the likelihood of Schiffman's patients developing cancer approaches 100 percent, and many of his patients will develop multiple cancers. This condition with only one working copy of p53 is called Li-Fraumeni Syndrome, or LFS, and cancer often strikes during childhood. In fact, some of his patients with LFS have had to endure six, seven, sometimes eight different cancers throughout their lifetimes.

While caring for patients with LFS at Intermountain Primary Children's Hospital and also Huntsman Cancer Institute, Schiffman attended a conference presentation by Dr. Carlo Maley, an evolutionary biologist at Arizona State University. There, he learned that elephants almost never get cancer. This is a surprise given how many cells elephants have in their large bodies. Nearly 100% of elephants should be developing cancer by the time they reach the age of 70 years old with so many cells

dividing decade after decade. In fact, only around 5 percent of elephants ever develop cancer (compared with about 50 percent of human males, and roughly 33 percent of human females). Dr. Maley then presented a finding at this conference that piqued Schiffman's interest—the African Elephant has 40 copies of the p53 gene (20 times the number in humans).

"I almost fell out of my seat," said Schiffman. "That's the same gene that my patients are missing and always get cancer." He wondered if there was some way to obtain a sampling of elephant blood in order to study it next to the blood of his cancer patients with the goal of understanding if the extra copies of the p53 gene really are contributing to cancer resistance in elephants. Most research scientists focus on studying people (or mice) who get more cancer. In that moment, Schiffman suddenly wondered if he should be focusing on those people—or elephants—that get less cancer.

Following the presentation, Schiffman approached Maley, and they worked together for several years, along with Dr. Lisa Abegglen in Schiffman's lab, and elephants from Utah's Hogle Zoo and Ringling Bros. and Barnum & Bailey Circus, to demonstrate the potential contribution of elephant p53 in cancer resistance. Their publication in JAMA in October 2015 rapidly became the second most popular JAMA publication of the entire year. Soon thereafter, Schiffman teamed up with Dr. Avi Schroeder, a chemical engineer, from the Technion-Israel Institute of Technology, and they have since focused on how to translate this discovery to impact the lives of children and families with cancer. The duo has now partnered to form a startup company to research possible methods of cancer therapy and prevention through an elephant p53 medicine. Fittingly, the company is named PEEL Therapeutics, "peel" being the Hebrew word for elephant. After only a few years, the collaboration is already making waves in the medical research field.

With the help of Technology & Venture Commercialization at the University of Utah (TVC), PEEL Therapeutics has been able to secure necessary intellectual property rights and is currently moving forward with continued fundraising and research efforts. "Without the support of TVC, we would never have been able to get as far as we are now," Schiffman noted.

As researchers continue to search for ways to prevent cancer, Dr. Schiffman tries to remember that nature has already figured it out in elephants. While he is quick to point out that he and Dr. Schroeder have not found a cure for cancer, he is excited to see where their discoveries may lead. He hopes that those discoveries, coupled with his own personal experiences, can have a positive impact on children and families with cancer around the world, starting with treatment and, even one day, prevention.

Using SCIENCE to Address a Growing SUICIDE EPIDEMIC

Genetics of Suicide

IMAGINE IF SCIENTISTS COULD IDENTIFY THE GENETIC UNDERPINNINGS OF SUICIDE, notify high-risk patients, and undertake clinical and pharmaceutical prevention methods to improve outcomes and save lives. Suicide is a growing epidemic in the United States. It affects young and old, male and female, and rates are steadily increasing across nearly every demographic. According to the Centers for Disease Control and Prevention (CDC), suicide is one of the leading causes of death in the United States, with more than 40,000 people dying by suicide each year. In Utah, the numbers are even more unsettling. The CDC reports that Utah has the fifth highest suicide rate in the country. In 2012, the overall age-adjusted suicide rate in the United States was 12.6 per 100,000 people. In Utah, that number climbed to 21. Dr. Hilary Coon, a faculty member at the University of

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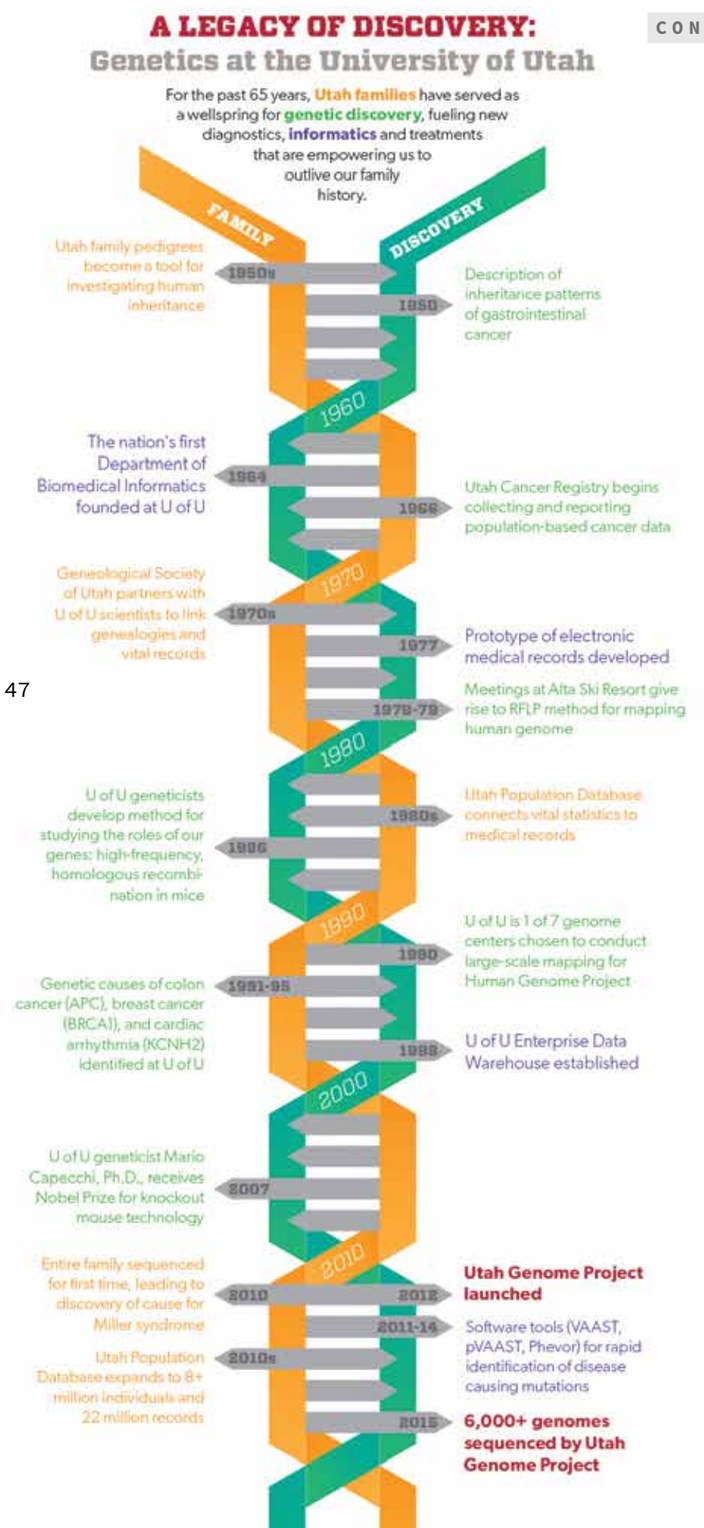

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Utah School of Medicine, has dedicated the last 20 years of her life to researching behavioral genetics and mental disorders, and may be on the verge of such a discovery. In fact, her work is so important, it has attracted the attention of a major global pharmaceutical company, Janssen Pharmaceuticals, that is now funding a collaboration.

In 2006, while participating in research involving childhood-onset disorders, including autism and Tourette syndrome, Coon became aware of a growing database of DNA records, collected by the Utah Office of the Medical Examiner, from those who have died by suicide. Coon had the idea to couple these files with the Utah Population Database (UPDB), an extensive set of family histories collected, in part, by The Church of Jesus Christ of Latter-day Saints and donated to the University of Utah for public health research. Because the UPDB includes extensive diagnostic information about particular causes of death and other medical details, it has been used by researchers at the university for more than 30 years to help identify specific genetic causes of cancer passed down from generation to generation within a family. If this could be used to determine important gene discoveries in cancer research, Coon thought, why not replicate the same study with suicide?

"Suicide genetics felt like it might be harder to study, that it would be even more heterogeneous," Coon said. "If you look at the epidemiology of suicide, it looks distinct. The epidemiology of people who die by suicide is different from the epidemiology of those who think about it, or who make attempts. So, there may be different underlying causes or mechanisms."

"There are plenty of people who have a lot of stress—spouse problems, job loss, and illness," Coon explained. "Most individuals who die by suicide have a mental illness, and it's chronic, and they struggle with it for an extended period. There are plenty of people with depression who do not die by suicide. So, there's something over and above having a psychiatric diagnosis that predisposes someone to suicide."

With her goal in mind, Coon set out to gain permission to link the DNA records of those who died by suicide with the UPDB, and then attempt to discover whether there were any families with historical patterns, who may be high-risk. Going through genealogical records dating back to the 1700s, Coon and her team found several families that were anywhere from 2 to 10 times the average risk of death by suicide. When analyzing the combined data, Coon had to be careful to factor for potential environmental factors. Nuclear families with multiple cases of suicide could share environmental factors. However, when individuals are separated by multiple generations, they are less likely to have lived in the same household and to have shared environmental risk factors. Those types of families are much more likely to share one or more genetic risk factors for death by suicide.

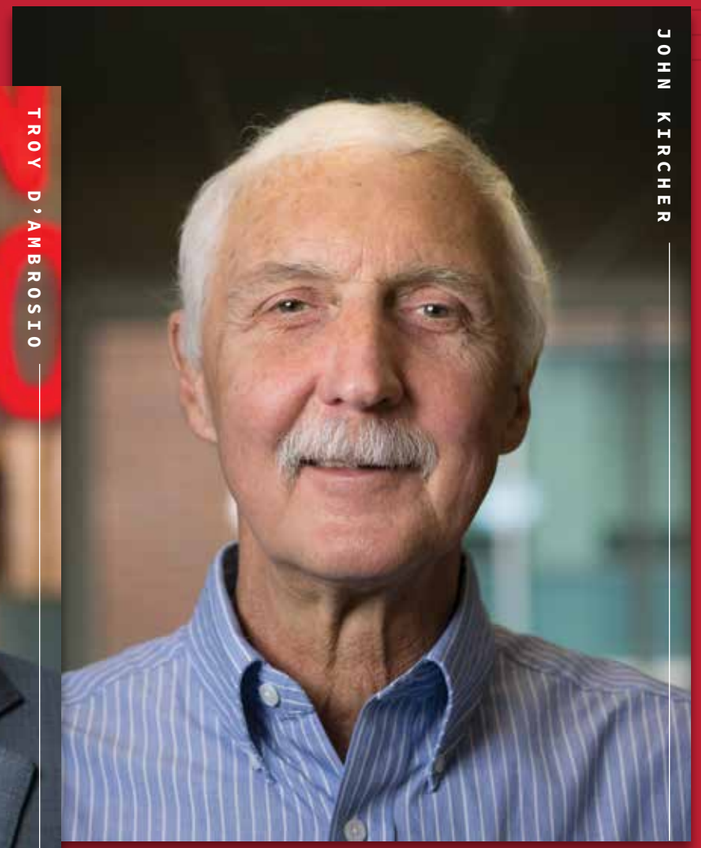
Comparing information with the Utah population, as a whole, and matching by birth cohort, age, and gender, Coon can identify high-risk families. If there are sufficient DNA samples collected by the coroner's office for that family, she conducts statistical analyses. The goal of these studies is to determine whether individual members of a high-risk family share a particular chromosomal region that is above and beyond what would be expected by chance.

"We're not trying to find a single risk factor," Coon cautioned. "Even within these families, there may be multiple risk factors. Even within one particular person, there are probably multiple genetic risk factors, plus environment triggers. We are trying to find whether there are genetic risk factors that make people struggle more with particular environmental stressors – diagnoses, exposures, trauma," she continued. "And then those individuals could get more targeted treatment."

The potential for a targeted treatment is what attracted Janssen to partner with Coon. Technology & Venture Commercialization and the Program in Personalized Health at the University of Utah, with support of other University administration, had the initial brainstorming meeting with Janssen and then, over the course of nearly a year, worked on the agreements to build a successful collaboration with Janssen. The collaboration will sequence more DNA from suicide completers and incorporate even more of their associated families from the UPDB.

U Honors **FACULTY** *for* **INNOVATION** *and* **IMPACT**


TROY D'AMBROSIO


JOHN KIRCHER

Winners of the seventh annual 2017 Distinguished Innovation and Impact Award recognized at commencement ceremony

Article input by Thad Kelling, marketing & public relations director, Lassonde Entrepreneur Institute, University of Utah

THE UNIVERSITY OF UTAH RECOGNIZED THE WINNERS of the seventh annual Distinguished Innovation and Impact Award today. The award recognizes faculty who create products and initiatives with potential to change the world and improve lives.

The awards committee Troy D'Ambrosio, executive director of the Lassonde Entrepreneur Institute, assistant dean at the David Eccles School of Business and a presidential chair in entrepreneurship; and John Kircher, a professor of educational psychology, an inventor and cofounder of Conversus, a company specializing in lie detection using a unique technology developed by Kircher and his colleagues.

The Distinguished Innovation and Impact Award is one of the newest faculty awards at the U. The university created it to recognize faculty entrepreneurial activities that have resulted in innovations with measurable and significant societal impact. The award is managed by the University of Utah's Academic Affairs office with support from the Entrepreneurial Faculty Scholars program, a network of faculty dedicated to maintaining a thriving culture of impact at the university.

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"The Distinguished Innovation and Impact Award honors faculty members at the University of Utah whose creativity and dedication have resulted in their innovations having measurable positive effects on people's lives," said Glenn Prestwich, a presidential professor of medicinal chemistry and founding director of the Entrepreneurial Faculty Scholars. "We created this award in 2011 to celebrate faculty from all colleges on campus who are actively implementing their inventions to propel change."

"This year we celebrate Troy D'Ambrosio and John Kircher, two inspirational innovators," Prestwich said. "We recognize Troy as the vital force behind the creation and success of the student-focused Lassonde Entrepreneur Institute and now the unique and iconic Lassonde Studios. We honor John for translating his research on the psychophysiological basis of deception to an efficient and more accurate ocular-motor test that is now used in security, justice and business contexts."

TROY D'AMBROSIO

Troy D'Ambrosio is the executive director of the Lassonde Entrepreneur Institute, assistant dean at the David Eccles School of Business and holds a presidential chair in entrepreneurship at the University of Utah. In his time at the U, D'Ambrosio developed and now manages the Lassonde Institute, an interdisciplinary division of the David Eccles School of Business that assists students and faculty from idea to company launch through many programs, competitions and curriculum. The Lassonde Institute has been consistently ranked as one of the best 25 programs for entrepreneurship in the nation by the Princeton Review, and it has helped the University of Utah become a leader in technology commercialization.

"We have achieved a lot in just 15 years since we formed what is now the Lassonde Entrepreneur Institute through the vision and support of our founder Pierre Lassonde," D'Ambrosio said. "I am honored to receive this award and recognition for everything we have been able to achieve. It has also been an honor to work with so many students to develop their ideas and help them learn by doing. We look forward to inspiring many more students at Lassonde Studios. We just opened this world-class facility in August 2016, and we expect many great years ahead."

D'Ambrosio is cofounder, officer and director of multiple startup companies that have attracted over $500 million in capital. Those companies include Transworld Telecommunications, which was sold to Sprint in 1998; Convergence Communications, which was sold to Lockheed Martin in 2005; and EPM Mining Ventures, which is listed on the Toronto Venture Exchange. He has served as the vice president of investor relations and corporate communication for American Stores Company, an NYSE listed company, the director of mutual fund operations for Wasatch Advisors and deputy chief of staff to the mayor of Salt Lake City. He graduated from the University of Utah in 1982 and was named the Ernst & Young Entrepreneur of the Year in 2000, a v100 Technology Leader in 2008, Best in State Educational Administrator in 2009 and received the 2014 Governor's Medal for Excellence in Science and Technology.

D'Ambrosio has brought all of this experience to the University of Utah to the benefit of all students and the university's entrepreneurial ecosystem. Every year, the Lassonde Institute engages thousands of students, teaching them how to be entrepreneurs and leaders through many programs. The latest development in the Lassonde Institute is the completion of the Lassonde Studios, a $45 million facility for aspiring entrepreneurs to "live, create, launch." This building has already received worldwide attention and is expected to further the university's reputation for entrepreneurship education.

JOHN KIRCHER

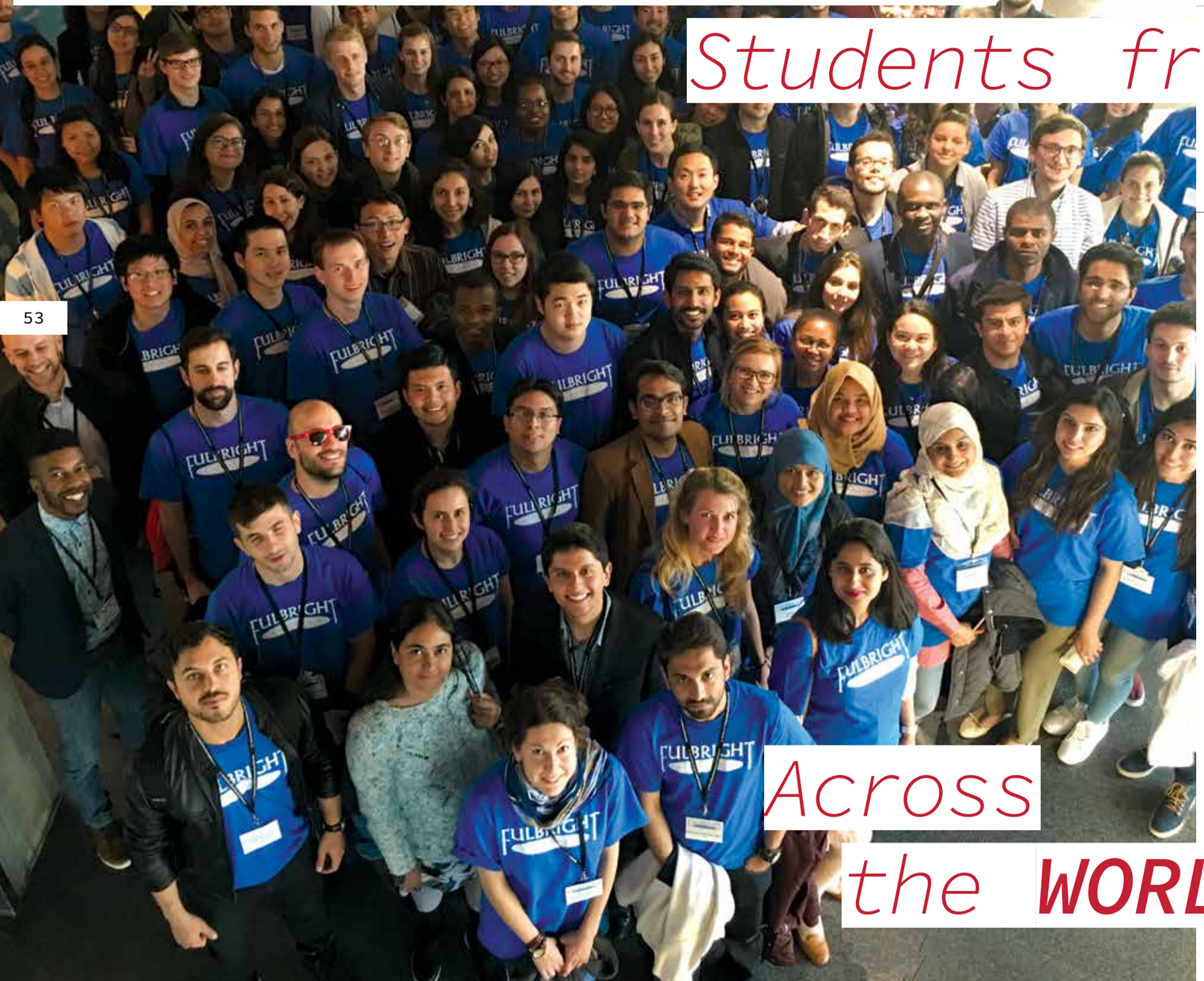
John Kircher is a professor of educational psychology at the University of Utah. He received his Ph.D. in psychology from the University of Utah in 1983. Kircher is an internationally recognized expert on the subject of deception detection in government and industry. He has authored more than 90 scientific publications and technical reports in the field of psychophysiological detection of deception and has served as a consultant on deception detection to the U.S. Department of Defense, U.S. Secret Service, U.S. Department of Homeland Security, National Science Foundation, National Research Council, Royal Canadian Mounted Police, and numerous state and local police departments.

He and his colleague David Raskin laid the scientific foundation for, and in 1991 developed, the software and hardware for the first computerized field polygraph system, which is still in use worldwide today. Since 2002, Kircher has been leading a group of researchers at the University of Utah in the development of a new technology to detect deception that takes into account the psychophysiological, cognitive and strategic components of deception. His research has resulted in the creation of a completely new and innovative technique in the detection of deception. In laboratory and field studies, it consistently classifies 80 to 85 percent of guilty and innocent subjects correctly. This accuracy is as high or higher than that achieved by polygraph techniques. In addition, the technique, called the ocular-motor deception test, is less invasive, takes less time to administer than a polygraph, it's computerized administration eliminates the need for highly trained experts to administer the test and analyze the results, and it is less costly than the polygraph.

Kircher has helped commercialize the technology through Conversus, a company that has provided the technology to nearly 150 businesses and government organizations throughout North, Central and South America as a tool for pre-employment and periodic testing of individuals who are in positions of public trust.

"I have had the privilege to work with many incredible people to develop a groundbreaking technology that is helping redefine lie detection," Kircher said. "We have grown this technology rapidly through Central and South America, and we look forward to continued growth and adoption in North America and across the world. I am deeply honored to have received this award for our work. I could not have done it without the help of outstanding colleagues and students and funding from the Office of the Vice President for Research. The University of Utah is a great place to conduct research because it supports faculty working in all areas and disciplines."

Transforming COMMERCIALIZATION SUCCESS for FULBRIGHT Students from Across the WORLD



By Shannel Kruse, communications student, University of Utah
and Brooke Adams, communications specialist, University of Utah

THE "GO-GETTER" AND "CAN-DO" ATTITUDE that underlies American innovation and entrepreneurialism left a lasting impression on Felipe Zapata during a four-day visit to the U in May 2017.

Zapata joined 120 international first-year Fulbright students for the "From Lab to Market" seminar hosted by Technology & Venture Commercialization. The U.S Department of State and the Institute of International Education selected TVC to host the seminar through a competitive process that involved universities across the country.

The seminar featured speakers, activities, site visits and networking opportunities related to technology commercialization and entrepreneurialism. The goal was to teach students how to apply this knowledge to their own research to advance the public good in their home countries.

Zapata, originally from Colombia, has a master's degree in engineering physics from the National University of Colombia. He hopes to apply the entrepreneurial traits he learned about at the U to increase the rate of creation and innovation once back home.

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American entrepreneurs have a "willingness to take risks and the ability to learn quickly from unsuccessful ideas," said Zapata, who is currently working on a doctorate in technology management at the University of Bridgeport in Connecticut. "These qualities are much needed in Latin America, especially Colombia, to avoid self-limiting efforts and to compensate for the lack of effectiveness of institutions."

Sarchina Kumari, who is from Pakistan, is working on a master's degree in information system management to add to a bachelor's degree in computer science from Loyola University in Chicago. Her takeaway from the seminar: fast decision-making matters.

"It is not enough to simply talk about your goals, you must be committed and execute them promptly," Kumari said. "You need to be a fast decision maker so you can make the most out of what may come your way. Also, be ready for awesomeness ahead of you."

Kumari said she learned how to say "yes" to opportunities that come her way, realizing that experience, no matter the outcome, leads to valuable lessons. She also felt transformed by the seminar and inspired by the energy and aura of her fellow Fulbright students to go the extra mile.

"All I need to do is remind myself that I am a Fulbrighter," Kumari said. "If I change my mindset in a blink of an eye, I have already gotten to the other side of the task. That makes me a little less afraid and a bit more grown up."

Zapata said that being with the talented and "kind-hearted" Fulbright students and seminar hosts really drove home the spirit behind the Fulbright Program.

"In essence, it's being a part of a diverse family and transforming the world for good," he said.

Former U.S. Sen. J. William Fulbright founded the program in 1946 with a goal of increasing mutual understanding between people of the United States and people of other countries. It operates as a merit-based scholarship program that fosters international educational exchanges. Fulbright students are recognized as some of the brightest individuals in the world, representing a wide range of fields; many have gone on to receive Nobel prizes, Pulitzer prizes, MacArthur Foundation fellowships and to fill position as heads of state and government.

The "From Lab to Market" seminar included discussions with experts and politicians, visits to industry-leading companies and research institutions, interactive workshops and peer-engagement networking activities. Sessions focused on the transformation of basic and applied research into new products and explored models that leverage technological innovation to advance economic and social goals in international markets.

While at the U, the Fulbright students stayed in the university's new $45 million Lassonde Studios, a campus facility completed in 2016 where over 400 students currently live, create new products and launch companies.

Speakers at the event included Tom Chi, co-founder of Google X; Paul Ahlstrom, author of "Nail It Then Scale It"; Utah Lt. Gov. Spencer J. Cox; and Chris Wasden, author of "Tension: The Energy of Innovation."

"The speakers, the environment at Lassonde Studios, the site visits and the interactions with fellow Fulbright students transformed my experience," Zapata said. "Being a part of the Fulbright seminar with others reinforced the idea that we are meant to change the world positively and, moreover, it is much more fulfilling when we do it together."

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