THRIVING AS AN UNDERGRADUATE WELCOMING 11 NEW FACULTY MEMBERS TRANSMITTING DATA THROUGH TISSUE REMEMBERING COLLEAGUES TRANSCRIBING SOUNDS WITH SPEECH RECOGNITION

RESONANCE

THE MAGAZINE OF ECE ILLINOIS

FALL/WINTER 2016

THE UNDER-GRADUATE EXPERIENCE

ILLINOIS

TOP OF MIND

THIS FALL, WE WELCOMED MANY NEW FACES TO ECE ILLINOIS.

We welcomed our first cohort of MEng students. This rigorous degree, which is highly flexible, replaces a master's thesis with required credits in professional development or a project.

We also welcomed eleven new faculty members, which makes 31 new faculty in the last three years. Our faculty members are the foundation of our department. Their research, experience, interests, and leadership are the springboard that launches our students. You can learn about our roster of new faculty on page 7.

Thirteen alumni returned to campus in September to be honored, some for the first time since graduation. We honored this elite group of thought-leaders and pioneers with distinguished alumni awards and gave our students opportunities to exchange ideas with them.

And we welcomed the incoming class of 2020 to our campus community. Computer engineering is now the second most popular undergraduate major on campus, and electrical engineering is the third. Adding these numbers up, our 2,346 undergraduates comprise nearly one-third of all undergraduate engineering students.

But this doesn't mean that our students are just numbers, lost in the shuffle. Quite the contrary. The undergraduate experience at ECE ILLINOIS has been carefully designed to help students find their niche in smaller groups, while having access to one of the best research facilities. In fact, Computer Engineering just rose to number four on the U.S. News and World Report undergraduate rankings. Electrical Engineering holds strong at fifth.

On the next pages, you'll get a taste of what it's like to be an ECE ILLINOIS undergraduate. And if you haven't been to our campus recently, I invite you to come visit us. We'd be happy to welcome you.

Sincerely,

William H. Sanders
ECE Department Head
Donald Biggar Willett Professor of Engineering

RESONANCE

FALL/WINTER 2016

ECE ILLINOIS

ECE.ILLINOIS.EDU

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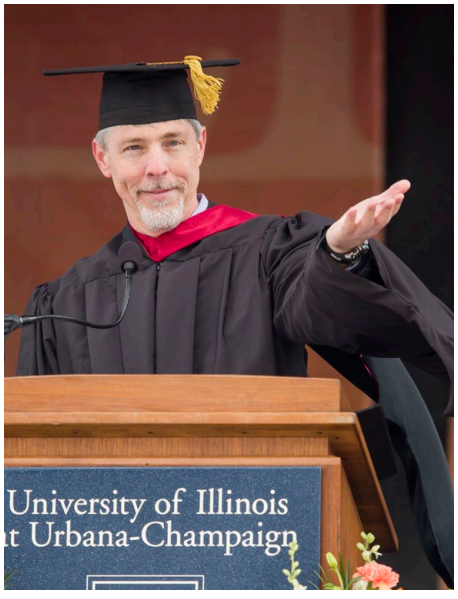
Sakshi Srivastava,
graduate student



GRAIL CEO SPEAKS AT COMMENCEMENT

Illinois alumnus Jeff Huber, whose company is developing a revolutionary blood test to detect early stage cancer, was the University of Illinois' commencement speaker in May 2016.

Huber is the CEO of Grail, a company that builds on "ultradeep genome sequencing" technology, leading-edge computing, bioinformatics, and machine learning to create unprecedented scientific understanding of cancer biology. Grail's new test uses a technique called "liquid biopsy," which scans blood for traces of cancer DNA and then indicates whether a tumor is forming - even before the doctor or patient has detected it. Huber said he founded the company in memory of his wife, Laura, who died of cancer after a late diagnosis.

Huber earned his bachelor's degree in computer engineering from Illinois in 1989 and a master's degree from Harvard University. Read the full text of Huber's address online.

» go.ece.illinois.edu/huber

"THINGS DON'T HAPPEN FOR A REASON. BUT THEY DO OFTEN HAPPEN BECAUSE NOBODY HAS YET FOUND A BETTER WAY. THAT'S MY MESSAGE TO ALL OF YOU: **FIND A BETTER WAY.**"
JEFF HUBER (COMPE '89), GRAIL CEO

NEXT-GENERATION COGNITIVE COMPUTING

The new Center for Cognitive Computing Systems Research (C3SR) integrates and advances scientific frontiers in both machine learning and heterogeneous computing systems optimized for new cognitive computing workloads. IBM Research (pictured at right with Illinois administrators and faculty) visited the Champaign-Urbana campus to launch the multi-year collaboration. Headed by ECE Professor Wen-Mei Hwu, the center opened this summer, beginning collaboration with IBM scientists and conducting research using IBM OpenPOWER technology.

IBM Research with Illinois administrators and faculty

HIGH SCHOOL GIRLS EXPLORE

For the seventh year, young women gathered for the Girls Learning Electrical Engineering (GLEE) camp. Headed by ECE Associate Professor Lynford L. Goddard, the camp is designed to increase the students' exposure to engineering by allowing them to experience the field though the eyes of an innovator-engineer.

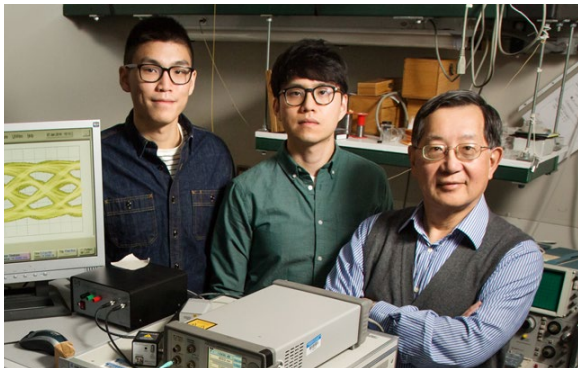
The curriculum for this unique, hands-on opportunity has developed over the years thanks to feedback from students and included five projects: an FM transmitter, LED calculator, optical projection, solar cells, and a new photochemical project based on Dr. Goddard's own research.

NSF FUNDS TWO NEW RESEARCH CENTERS

The National Science Foundation (NSF), along with several industry partners, has funded two new Industry/University Cooperative Research Centers (I/UCRC) at the University of Illinois in two critical fields.

ECE Professor Elyse Rosenbaum will lead the Center for Advanced Electronics through Machine Learning (CAEML). Co-led by researchers from Georgia Tech and North Carolina State University, CAEML will leverage machine-learning techniques to develop new ways to increase performance while reducing chip size and development cost, tapping into a need of the semiconductor industry.

The Center for Computational Biotechnology and Genomic Medicine (CCBGM) will be led by ECE Professor Ravishankar K. Iyer. The center will work with colleagues at the Mayo Clinic to advance pressing societal issues, such as enabling patient-specific treatment and improving the efficiency of plant and animal agriculture.



RECORD-BREAKING DATA SPEEDS

As big data has grown, so has the need for a high-speed data transmission infrastructure that can accommodate the ever-expanding volume of bits transferred. With record-breaking speeds, a team of University of Illinois engineers has made exciting developments in oxide-VCSEL technology, which underpins fiber-optic communications systems. The research team is led by Milton Feng, Professor Emeritus Nick Holonyak, Jr., and graduate researchers Curtis Wang and Michael Liu, pictured above with Feng.

ACROSS THE SPECTRUM

STUDENTS WIN INTERNATIONAL COMPETITION

A team of three Illinois students, Somak Ghosh and Antonio Woods, both ECE undergraduate students, and Chemistry student Sean Ebihara, won the international Shell Ideas360 competition for innovation this past summer. Their idea, "Graphene Coated Condensers for a Greener Future," received the Judges' Choice Global Innovation Award. It looks at the Graphene coating process to reduce greenhouse gas emissions and the footprint of power plants.

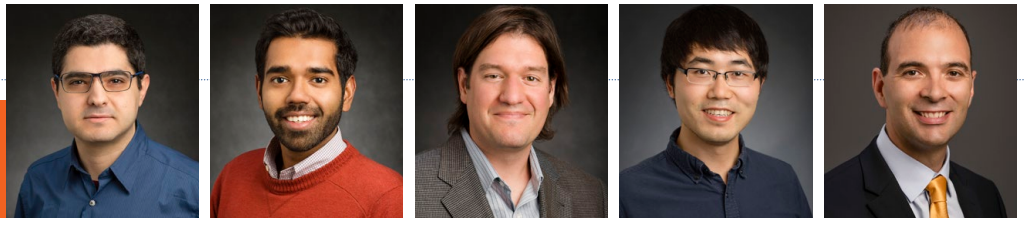
In addition to the Shell Ideas360 trophy, their prize includes a National Geographic adventure of a lifetime. The Illinois team was one of five teams and the only team from the United States to travel to London to compete in the final round of competition.

ECE ILLINOIS alumnus Michael Daly receives the Top Scientists and Engineers of the Year Award at the Pentagon. He is pictured with Sean Stackley, ASN RD&A, and Dr. Dolores Etter.

ALUMNUS HONORED AT PENTAGON

Michael Daly's (BSEE '07, MSEE '08, PhD '12) vector sensor allows warfighters to determine what direction a high-frequency signal came from, helping paint a more accurate situational awareness picture. Daly was honored with the 2015 Top Scientists and Engineers of the Year Award in a ceremony at the Pentagon. "Figuring out where these signals came from—both for friendly and enemy signals—is extremely important," Daly said. "Normally you have a group of antennas that, together, will figure out where a signal came from. You want the size of the receive sensor array to be as large as several wavelengths of the frequency you're trying to find. But with HF, each wavelength could be up to 150 meters long, which is out of the question for most platforms except ships. What I helped to design is called a vector sensor. Instead of making those spread out antennas, you co-locate a bunch of them—in our case six antennas—in the same space."

NEW FACULTY



Among the many new faces on campus this year are eleven new ECE faculty members. Their interests range from Bitcoin and distributed systems to new generation optical sensors, but all are experts in their respective fields. Pictures are shown in alphabetical order.

HAITHAM AL-HASSANIEH

Assistant Professor Haitham Al-Hassanieh came to ECE ILLINOIS from MIT in spring 2016. His work on the Sparse Fourier Transform was recognized by Technology Review as one of the ten breakthrough technologies of 2012.

SUBHONMESH BOSE

Assistant Professor Subhonmesh Bose joined ECE ILLINOIS in spring 2016 from Cornell University. His current research interests lie in understanding the operation and economics of modern power systems.

PETER D. DRAGIC

Assistant Professor Peter D. Dragic, who joined our faculty in fall 2016, has over 100 archival journal and conference papers covering components and glass science up to complete electro-optical systems, including fiber lasers, LIDAR, and distributed sensing systems.

LIANG GAO

Assistant Professor Liang Gao joined ECE ILLINOIS in summer 2016. His primary research interests are microscopy, cost-effective and high-performance optics for diagnostics, computational optical imaging, ultrafast imaging, and multidimensional optical imaging.

VIKTOR GRUEV

Assistant Professor Viktor Gruev joined our faculty in fall 2016 from Washington University in St. Louis. His primary research area is in imaging technologies, algorithms, and their applications to biomedical problems.

DANIEL KATZ

Research Associate Professor Daniel S. Katz is interested in advanced cyberinfrastructure. His technical research interests are in applications, algorithms, fault tolerance, and programming in parallel and distributed computing.

MINJOO LARRY LEE

Assistant Professor Minjoo Larry Lee, who joined our faculty in fall 2016 from Yale, works at the intersection between electrical engineering and materials science. His group's current interests include low-cost, high-efficiency solar cells and novel III-V lasers.

ANDREW MILLER

Assistant Professor Andrew Miller joined ECE ILLINOIS in fall 2016 and is recognized as a Bitcoin expert. He is also interested in distributed systems, programming languages, and cryptography, with an emphasis on peer-to-peer networks and emergent decentralized systems.

ALEXANDER SCHWING

Assistant Professor Alexander Schwing came to ECE ILLINOIS in fall 2016 from University of Toronto, where he was a post-doctoral fellow. His research is centered around machine learning and computer vision, including exploring techniques such as conditional random fields, structured support vector machines, and deep learning to extract information from data.

YURII VLASOV

Yurii Vlasov joined ECE ILLINOIS in spring 2016 as a Founder Professor of Engineering. He established two experimental labs: the first focused on integrated photonics for biomedical applications; the second dedicated to experimental systems neuroscience. These two main directions reflect his current interest in applications of engineering solutions to life sciences.

ZHIZHEN (JANE) ZHAO

Assistant Professor Zhizhen (Jane) Zhao joined ECE ILLINOIS from New York University in fall 2016. Her research interests include applied and computational harmonic analysis, signal processing, dimensionality reduction, information theory, and scientific computing.

›PROFESSORS ›BAILEY ›BAYRAM ›BERNHARD ›BOPPART ›BRESLER ›CARNEY ›CHO CHEW ›CHOQUETTE ›CHOUDHURY ROY ›DALLESSE ›DRAGIC ›EDEN ›HAKEN ›JIN ›KIM ›KIYAVASH ›KREIN ›KUMAR ›LIBERZON ›LIANG ›LU ›MAKELA ›MOULIN ›NICOL ›PILAWA-PODGURSKI ›ROSENBAUM ›SANDERS ›SINGER ›SMARAGDIS ›VARODAYAN ›VARSHNEY ›VASUDEVAN ›VEERAVALLI ›WALDROP ›WONG ›ZHU

MICHAEL BAILEY
Named to Usenix Board of Directors

CAN BAYRAM
Young Investigator Research Program from the Air Force Office of Scientific Research Awards
Named to IEEE Society Senior Membership

JENNIFER BERNHARD
Named to Engineering Research Council Executive Board of Directors
Director, Division IV, IEEE Board of Directors (2017-2018)

STEPHEN BOPPART
Won the Propel Chicago Innovation Showcase Business Competition 2015, received first place for Diagnostic Photonics and second place for PhotoniCare
Received the Andrew T. Yang Award, 2015
Received the 2016 EMBS Technical Achievement Award

YORAM BRESLER
Named a Distinguished Lecturer of the IEEE Signal Processing Society, 2016 and 2017

P. SCOTT CARNEY
Received the Rose Award for Teaching Excellence
Named a University Scholar

DEMING CHEN
Won the IEEE/ACM William J. McCalla ICCAD Best Paper Award

WENG CHO CHEW
Won the 2017 IEEE Electromagnetics Award

KENT CHOQUETTE
Elected as a Sandia Faculty Fellow by the University of Illinois
Received the 2016 SPIE Technology Achievement Award

JOHN MICHAEL DALLESASSE
Received the Dean's Award for Excellence in Research

PETER D. DRAGIC
Elected as a Senior Member of the Optical Society and the International Society for Optics and Photonics

J. GARY EDEN
Received the Distinguished Alumnus Award, University of Maryland, Department of Electrical and Computer Engineering

BRUCE HAJEK
Ronald W. Pratt Faculty Outstanding Teaching Award

LIPPOLD HAKEN
Was the keynote speaker at ContinuuCon2016, the first Haken Continuum Fingerboard conference, sponsored by the Bob Moog Foundation and the Asheville Synthesizer Community

JIANMING JIN
Was an IEEE Antennas and Propagation Society Distinguished Lecturer
Received the 2016 ACES Computational Electromagnetics Award
Won the 2016 IEEE ICWITS and ACES Best Student Paper Award

NAM SUNG KIM
Named IEEE Fellow

NEGAR KIYAVASH
Became a Center for Advanced Study Associate

PHILIP KREIN
Elected to National Academy of Engineering

RAKESH KUMAR
Received the Engineering Council Award for Excellence in Advising Best Paper at SELSE 2016
Received the Ronald W. Pratt Faculty Outstanding Teaching Award
Participated in the Distinguished Lecture Series Speaker, IBM Research - India
Received the Engineering Council Award for Excellence in Advising

DANIEL LIBERZON
Named a Fellow of IFAC (International Federation of Automatic Control) in 2016

ZHI-PEI LIANG
Received the 2016 EMBS Technical Achievement Award
Named the Nanqiang Lecturer, Xiamen University, 2015
Became a Center for Advanced Study Associate
Named a Distinguished Reviewer, Magnetic Resonance in Medicine, 2016
Named a William Mong Distinguished Lecturer, University of Hong Kong, 2016
Named a Paul C. Lauterbur Lecturer, 24th Annual Meeting of International Society of Magnetic Resonance in Medicine, 2016

YI LU
Received the 2016 Sigmetrics Rising Star Award

JONATHAN J. MAKELA
Received the Alan Berman Annual Research Publication Award, Naval Research Laboratory

PIERRE MOULIN
Elected member, Board of Governors of the IEEE Information Theory Society

DAVID M. NICOL
Received Siebel Energy Grants

ROBERT PILAWA-PODGURSKI
Received the Dean's Award for Excellence in Research, Assistant Professor
Received the IEEE COMPEL Best Paper Award
Received the IEEE International Future Energy Challenge - Top Innovation Award (Advisor)

ELYSE ROSENBAUM
Won the Best Paper Award and Best Student Paper Award, 2014 EOS/ESD Symposium

ROMIT ROY CHOUDHURY
Received the Distinguished Alumni Educator Award from the Department of Computer Science
Won the 2015 IBM Faculty Award
Received the ACM Sigmobile Rockstar Award, 2015

WILLIAM H. SANDERS
Received the Best Paper Award, 12th International Conference on Quantitative Evaluation of Systems (QEST), Madrid, Spain
Received the Best Paper Award, SECURWARE 2015: The Ninth International Conference on Emerging Security Information, Systems and Technologies, Venice, Italy
Received the Best Paper Award, 46th Annual IEEE/IFIP International Conference on Dependable Systems and Networks, Toulouse, France

ANDY SINGER
Named as Fellow, Technical University of Munich Institute for Advanced Study, 2016

PARIS SMARAGDIS
Named as a IEEE Signal Processing Society Distinguished Lecturer
Received the Dean's Award for Excellence in Research, Assistant Professor

DAVID VARODAYAN
Received the George Anner Excellence in Undergraduate Teaching Award

LAV R. VARSHNEY
Received the Data for Good Exchange Paper Award, 2015

SHOBHA VASUDEVAN
Received the IBM Faculty Partnership Award
Named as the Assistant Editor for IEEE Transactions on Computer Aided Design of Integrated Circuits and Systems

VENUGOPAL V. VEERAVALLI
Won the Wald Prize in Sequential Analysis

LARA WALDROP
Received the NSF CAREER Award

MARTIN WONG
Won 1st Place, ACM TAU 2016 CAD Software Contest on Timing Analysis, 2016 (Students: Tsung-Wei Huang and Tin-Yin Lai)
Won 3rd Place, ACM CADathlon Programming Contest, IEEE/ACM ICCAD-2015 (Students: Tsung-Wei Huang and Tin-Yin Lai)

HAO ZHU
Received the Siebel Energy Grant
Received the Air Force Summer Faculty Fellowship

THE UNDER-GRADUATE EXPERIENCE

BY DOUG PETERSON

Mosab Elagha still remembers the first career fair he attended at ECE ILLINOIS. As a freshman, he wasn't expecting to attract any serious interest from recruiters, but that didn't stop him from standing in line to talk to a Qualcomm rep.

"She looked at my resume and wrote all over it, telling me to change this, change that," says Elagha, now a senior. "She was extremely helpful, explaining how to navigate the career fair and giving me tips for the future."

It can be overwhelming being a first-year student in one of the largest and highest ranked departments on campus. The undergraduate computer engineering program at Illinois is ranked number four in the country by *U.S. News and World Report*, and electrical engineering ranks fifth.

But ECE offers something that cannot be measured by program rankings. It has a strong sense of community, says Sakshi Srivastava, a graduate student who grew up in India. "The ECE community is so helpful and so kind. I am thousands of miles from home, and although I miss home, I know I belong here."

FIND YOUR NICHE

Student organizations are at the heart of ECE. Because of its size, the department has a myriad of opportunities for undergrads to connect, adjust, find friends, and thrive in and out of the classroom. And these opportunities help students find their niche.

In ECE alone, there are six Registered Student Organizations (RSOs): ECE Student Advancement Committee (ECESAC), Eta Kappa Nu (HKN), Institute of Electrical and Electronics Engineers (IEEE), iRobotics, Women in Electrical and Computer Engineering (WECE), and PULSE.

Andreya Dart, an ECE senior, says she has loved the IEEE experience. As she closes in on graduation, her only regret is that she didn't become active in engineering-related activities until her sophomore year. "You only have four years of college, so the faster you get involved, the better," she says.

IEEE is divided into three branches. The Technical branch puts on multiple hackathons each year, along with workshops on such topics as soldering or the Arduino electronics platform. IEEE members can also become active in technical advancement groups, which are broken into specialties: circuits, digital signal processing, cyber physical systems, and robotics.

Technical advancement groups work on all types of projects, many of which are showcased at the annual Engineering Open House. Dart is part of the circuits technical advancement group, and she says her favorite project was working on a laser guitar. Instead of physical strings, the guitar had laser strings. By obstructing the laser beams with your finger, you could create sounds—like strumming.

The second branch of IEEE is the Professional group, which organizes resume-building workshops, mock job interviews, and internship panels, where students talk about their internship experiences. This branch of IEEE also makes corporate connections, bringing in companies for tech talks.

The social side is Dart's bailiwick. As director of the Membership branch, she oversees the organization's social events, from semi-formal dances and karaoke to cookouts and barn dances.

There is a balance among the three groups, and Dart advises all undergrads to strive for a similar balance in their lives on campus. She follows her own advice by playing "double second" for a steel drum band on campus. "Look for that 'work hard, play hard' balance," she says. "It's important to develop your own community."

"YOU ONLY HAVE FOUR YEARS OF COLLEGE, SO THE FASTER YOU GET INVOLVED, THE BETTER."

ANDREYA DART, ECE ILLINOIS SENIOR

WOMEN IN ECE

This fall, the College of Engineering welcomed the most diverse first-year undergraduate engineering class yet, including 18 percent more women, nearly 30 percent more Latino/a students, and twice as many African American students compared to last year. But there is still more work to be done.

Sakshi Srivastava comes from Allahabad, India, where she attended an all-girls school from first through twelfth grade. So it was a culture shock in more ways than one when she began as an undergraduate in engineering—a field where men still significantly outnumber women.

Emily Alessio, an ECE senior, had similar feelings as she walked into her first class as a freshman and saw a room of mostly guys. But she soon spotted someone from her dorm floor at the Florida Avenue Residence Halls. During her first year, Alessio was part of her dormitory's living-learning community called Women in Math, Science, and Engineering. She says both the College of Engineering and ECE go to great lengths to smooth the transition for women.

As a freshman, Alessio went to the Women in Engineering camp, held a few days before classes start. She also joined Women in Electrical and Computer Engineering (WECE), and this year she is secretary/treasurer of the student organization that has meant so much to her.

The largest engineering group for women on campus is the Society of Women Engineers (SWE), which draws from all engineering disciplines. But WECE is specifically for ECE students, and Alessio says she prefers the smaller numbers and the group's personal touch. For instance, WECE has a buddy program that pairs first-year students with a WECE board member or upperclassman, as well as special homework hours when students can find help.

"WECE has made me more confident by helping me with my technical skills and by hosting professional events, such as tech talks," Alessio says. She says science, math, and building things have always come naturally to her.

"I was that kid who could play with both my dolls and my Legos," she says. Her father is an electrical engineer with U.S. Cellular, so he served as a role model, whether it was giving her advice on building bridges for the school science fair or working alongside her to assemble one of her many Harry Potter Lego sets. "At an early age, I was interested in what my dad did," she says. "I think a lot of other girls don't have this frame of reference for engineering."

The role model factor is a primary reason that Srivastava proposed a new statue for campus representing a woman engineer. She says some women do not even consider engineering because "they do not see themselves represented as role models. Public art shows what a community feels and what it commits to."

"Grainger Bob" is the legendary bronze statue of a man in beige pants and blue sweater, permanently parked on a bench outside of the Grainger Engineering Library and Information Center. It's an extremely realistic, detailed sculpture with a wristwatch stuck forever at 11:25.

And Illinois has decided it's time for a woman engineer to be represented in public art. The new statue will be unveiled this spring thanks to support from Texas Instruments.

CORPORATE PARTNERSHIPS

Supporting the new statue on the Illinois campus is just one of the ways that Texas Instruments (TI) partners with ECE. TI also offers internships and co-sponsors the Women in Engineering Camp, held for freshmen a few days before classes start. The company is among ECE's many corporate partners, but there's a special historical connection with TI.

"Jack Kilby is one of ours, and he's one of yours," said Texas Instruments' Renee Fancher. Kilby, a 2000 Nobel Prize winner in physics, is one of the most famous undergraduate students to have ever received a bachelor's degree in electrical engineering from the University of Illinois. As a new employee at Texas Instruments in 1958, Kilby spent his summer in the lab. While other employees enjoyed vacations, he spent the warm months building the first integrated circuit, changing the world as we know it.

As manager of communications for the university segment of TI, Fancher works closely with ECE ILLINOIS and other top engineering schools in the world. TI helps with curriculum development, recruits on campus, gives tech talks, and provides products and tools so "students are working with the latest and greatest technology," she says.

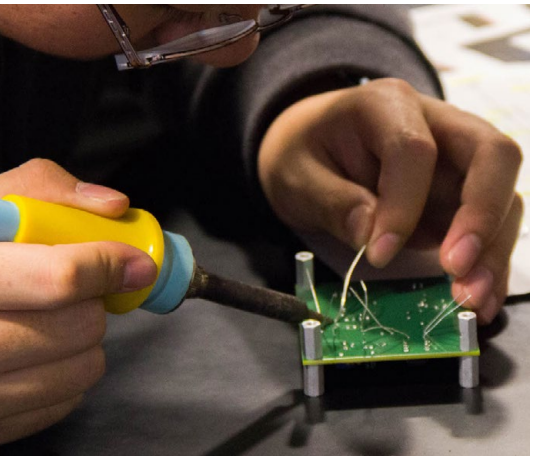
One of the most significant gifts from TI was a $3.2 million pledge that funded some of the key spaces in the new building. Walk into the spacious lobby, and you can't miss the Texas Instruments Electronics Design Lab just to your right. This is where all freshmen take ECE 110, a hands-on introduction to electronics. During the first 10 weeks of the class, students create a robotic car with a bright red chassis that can automatically follow any set pattern, explains Khushboo Jain, a junior in ECE.

Along one wall of the new lab are cabinets packed with supplies, including mini car wheels, ultrasonic sensors, and Texas Instruments' integrated chips that give the car the logic to know that it needs to turn when reaching an obstruction, Jain says.

"We work with engineering programs around the world because we want to make sure students are industry-ready when they graduate," Fancher says. "We want students to not just be book smart, but to get that hands-on experience. And we want to make sure we've got employees to come on board and are ready to hit the ground running."

"IF YOU WORK ON INTERESTING PROJECTS, INVENTION IS KIND OF A NATURAL CONSEQUENCE."

JACK KILBY



UNDERGRADUATE RESEARCH

Can you turn a shirt into a Wi-Fi hot spot by embedding an antenna into the fabric? Could state-of-the-art technology enhance facial expressions on existing photographs? Although these are two very different types of research projects, they both have one thing in common: Srivastava worked on both as an ECE undergraduate. She believes that her early research experiences were crucial to helping her decide her post-undergrad path.

"I knew I wanted to go to graduate school, but I needed to figure out what I wanted to study, and I wanted to get an idea of what graduate school would be like," she says. "I knew those two questions would be answered if I jumped into research as an undergraduate."

"Around 45 percent of engineering undergraduates are doing research," says Natasha Mamaril, coordinator of undergraduate research for the College of Engineering. This early access to research opportunities gives Illinois students an advantage compared to other engineering programs.

PURE, or Promoting Undergraduate Research in Engineering, "is aimed at first and second year students," Mamaril explains. This short-term program allows undergraduates to commit to only one semester of research. "The rationale is to get the students' interests going and give them a feel for what research is like," she says. The hope is that PURE will be their first step towards more long-term research opportunities.

Srivastava has worked on facial recognition research through PURE during the first semester of her sophomore year, and she continued the work with a graduate student for an extra semester as independent study. After a year off to explore more areas of concentration in electrical and computer engineering, she returned to research her senior year. Two courses about fields and waves convinced her that she wanted to focus on developing antennas for communication, which led her to research about embedding antennas in clothing and investigating how the human body affected the antenna properties.

She worked in the laboratory of ECE Professor Jennifer Bernhard, where she continues as a grad student, now studying what happens when two devices are operating at the same frequency.

Undergraduates looking for a commitment longer than a single semester can apply to ISUR—the Illinois Scholars Undergraduate Research Program. This structured one-year program includes an introductory class on research, monthly luncheons where professors share their research work, and a poster expo where students present their research projects.

The most flexible program is MUSE, or Mentoring Undergraduates in Science and Engineering. Students work with a mentor to set goals and tailor the program to meet their needs, whether it's doing research or getting advice on applying for graduate school.

All three of the college's undergraduate research programs involve mentorship. Students are paired with a graduate student, postdoctoral researcher or, in certain cases, a professor.

"There's no substitute for practical experience," Mamaril says. "It gets your creative juices going and helps students understand what scientists and engineers do."

PULSE
THE HEARTBEAT OF INNOVATION

STUDENT-DRIVEN DEVELOPMENT

"My advice is to dive in and do whatever you feel like researching," Srivastava adds. "It's not a life-long commitment you're making. It's a semester-long commitment. Try it, and if you like it, maybe you are in the right place."

Mosab Elagha, a senior in computer engineering, co-developed an app with a five-star rating and more than 2,000 active monthly users. The app, named Transit, helps the local community by tracking buses. And it's just one example of how app development can make an impact on the world around us. That's why PULSE was founded: to help students turn theory into real-life applications. Elagha is the co-director of the annual student-run conference.

"PULSE shows you the applications that are possible from what you learn in your classes," says Elagha. As PULSE approaches its sixth year, it continues to grow. When Elagha was a freshman, he says PULSE attracted between 200 and 300 students, but the 2016 event boasted over 600 registered participants.

PULSE kicks off with a single day of competitions in various technical areas, such as sensors, digital signal processing, software, and reverse engineering. In the 2016 digital signal processing competition, for instance, teams were handed an assortment of materials with which to create something. One of the top teams created a "Who's That Pokémon?" device, where you slowly scratch away a black box displayed on a touch screen and try to identify the Pokémon character hidden behind it.

On the Thursday after competitions, the PULSE conference continues with the keynote speaker, attracting industry leaders such as Irwin Jacobs, co-founder of Qualcomm, and Mark Dankberg, CEO of the satellite company ViaSat. Jensen Huang, CEO of NVIDIA, has agreed to speak at the upcoming 2017 event.

On the following weekend, the conference features tech talks and workshops, which draw big crowds. Last year, everyone who attended the Qualcomm workshop received one of the company's Snapdragon boards and learned how to use it. Meanwhile, at the popular Texas Instruments workshop, students learned how to use the TI Launchpad.

PULSE also includes a start-up panel, which in the past has featured entrepreneurs working on a product that automates homes, as well as a company developing electronic ticket systems that police departments can use to replace paper tickets.

"A huge part of PULSE is networking," Elagha points out. "You get to talk directly to engineers and recruiters from different companies."

He also says that working on apps and other projects opens the doors to recruiters and can often lead to internships. Elagha did a summer internship at Apple in 2016, but he says, "I wouldn't have ever been able to land that internship without doing multiple projects, including the bus app."

"A HUGE PART OF PULSE IS NETWORKING. YOU GET TO TALK DIRECTLY TO ENGINEERS AND RECRUITERS FROM DIFFERENT COMPANIES."

MOSAB ELAGHA, SENIOR IN COMPUTER ENGINEERING

DOING THEIR RESEARCH:
ECE'S SENIOR THESIS STUDENTS

BY JAMIE HUTCHINSON

The ultimate in undergraduate research at ECE-Illinois is the two-semester course combination of ECE 496 and 499—"senior thesis" for short—which entails an individual research project and a thesis presenting the results. Following is a small sample of senior theses completed in Spring 2016 by some of ECE's newest alumni.

Shawn Ahn addressed the incorporation of haptic feedback into a touchscreen for the vision-impaired. He demonstrated how dc vibrating motors can convey the surface roughness of images, a step toward enabling users to "see" two-dimensional onscreen images with their fingertips.

"I had to do a lot of reading in the literature," said Ahn, now pursuing an MD/PhD at Yale. "My project involved some components in biology, software, and hardware, so it was difficult to connect the three together seamlessly."

Not only did Carl Haken's senior thesis project launch his career, but he expects it will be launched itself—as part of the U of I CubeSat nanosatellite project scheduled to go into orbit late this year. Haken's contribution is the switching current regulator for the satellite's magnetic attitude control system. His custom design fits the project specifications better than any commercially available design.

"THIS IS PRETTY MUCH MY DREAM JOB, AND I DEFINITELY HAVE MY SENIOR THESIS PROJECT TO THANK."

CARL HAKEN, POWER ELECTRONICS ENGINEER AT SPACEX

"This is pretty much my dream job," said Haken, now a power electronics engineer with SpaceX, "and I definitely have my senior thesis project to thank."

Andrew Netherton investigated the high-speed modulation of vertical cavity surface-emitting lasers (VCSELs), using theory to derive the device characteristics that influence VCSEL bandwidth, then testing VCSELs produced in the Micro and Nano Technology Lab to verify his conclusions.

Netherton said the experience "familiarized me with tools I expect I'll use throughout my career ... and gave me a deeper appreciation for how difficult it can be sometimes to collect good data." He is finishing an internship at Infinera this fall and preparing to start PhD work at UC–Santa Barbara.

"While I was interviewing for a position with IBM Research, it definitely helped that I had some involvement with academic research," recalled Mahika Dubey, now employed at the company's TJ Watson Research Center. Dubey's thesis drew on numerical methods as well as listening tests to assess several commonly used signal processing methods of speech enhancement. She concluded by advocating the use of machine learning techniques—especially neural networks—instead.

"Now that I have started working," said Dubey, "I think the experience gave me a few insights on how to work in a lab environment."

Hao Jin contributed toward meeting the ever-growing need for computing resources in the sciences by mining and analyzing the performance and job scheduling logs of U of I's Blue Waters petascale computing system. Jin created tools for parsing, handling, and extracting information from the Blue Waters logs and performed analyses to determine which applications performed best and why.

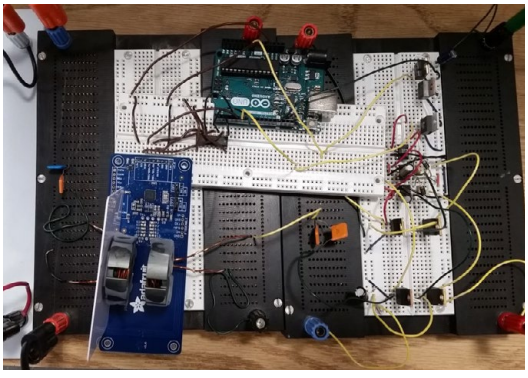
"Doing research at U of I ... you get access to data and facilities that are not available elsewhere," said Jin, now pursuing a master's in computer science at Carnegie Mellon.

With outdoor positioning systems proliferating in phones, cars, and more, Jane Wang's interest was aroused by the lack of indoor positioning systems available despite their potential utility—especially for emergency responders—in places like malls, schools, and hospitals. Her wireless solution rests on using the phase difference between a client's transmitted and received signals in order to find the distance from client to server.

"My senior thesis experience helps me a lot in the design and testing phases of product development," said Wang, now an RF engineer with startup Tagore Technology.

Thomas Navidi investigated two possible modes of rural highway electrification to extend the range of electric cars. Using the characteristics of catenary and road-embedded wireless power transfer systems, combined with data about Interstate 5 through California, Navidi ran simulations demonstrating their potential benefits. He also built a small prototype of the wireless system.

"The most satisfying aspect ... was learning about independent research and paper writing," said Navidi, now pursuing a PhD in electrical engineering at Stanford.



LEFT: The final torque coil design for Carl Haken's current regulator for magnetic attitude control of nanosatellites that will be launched into space.

RIGHT: Thomas Navidi's WPT transmitter hardware prototype for the "analysis of wireless and catenary power transfer systems for electrical vehicle range extension on rural highways."

SENIOR THESES ARCHIVED ONLINE AT go.illinois.edu/eceSenThesis

FOCAL POINT

» MORE THAN 400 INCOMING FRESHMEN AND TRANSFER STUDENTS ATTENDED ECE IGNITION, AN ANNUAL EVENT DESIGNED TO HELP NEWCOMERS BUILD A COLLABORATIVE COMMUNITY

ECE ILLINOIS
Department of Electrical and Computer Engineering

PHOTO BY DELLA PERRONE

FRANK KUO

ALUMNUS GIVES ADVICE ON LIFE AFTER PHD

BY MEG DICKINSON

FRANK KUO (BS '55, PHD '58) HAS THREE BASIC STEPS FOR SUCCESS. **ONE, FIND A MENTOR, TWO, COLLABORATE WITH OTHERS, AND THREE, NETWORK WITH AS MANY PEOPLE AS POSSIBLE.**

Kuo spoke to students at a luncheon about the options available to them after graduate school or after their PhD: teaching, research, neither, or both. In his own career, he did them all. But it was important to him to get out into the workforce after earning his PhD. Kuo has been on the cutting edge of communication technology since he graduated. He created the first form of communication between computers, inventing the earliest form of Wi-Fi.

» FIND A MENTOR »

"You are here, and you have professors here. It's very important to have a mentor who can help you," he said. "And professors are excellent options." Kuo's mentor was Mac Van Valkenburg, a professor of electrical engineering who later became the dean of Engineering at Illinois. Kuo said Van Valkenburg helped guide him throughout his entire life.

"It was important to have someone I could ask questions and to help me find the right career path and make the right decisions," Kuo said. Van Valkenburg also helped Kuo with his research. Kuo attributes his first job and later success to his mentor helping him do such interesting work for his PhD.

"He helped me throughout my life. Whenever I wanted to change I asked him, should I do this or not? He would always help me decide," Kuo said. Van Valkenburg also worked with Kuo on research, which used one of the first computers, the Illiac I. "Computer science did not exist at the time, but I spent a lot of time on that computer," he said.

Kuo credits this work with getting him his first job at Bell Laboratories, one of the top research institutes at the time.

» COLLABORATE »

"That is the second thing that is important in your life: to collaborate. You don't know everything," he said. "You know your specific PhD topic – but that's it."

Kuo said he took the job at Bell Laboratories in 1958 because he wanted to keep learning, but this time in industry. He figured Bell Labs would be a good place to begin broadening his knowledge. There, he worked with world-renowned scientists who were making important discoveries all the time. He also worked with the earliest computers at Bell Laboratories – but wasn't too impressed. "I knew computers would be great, but they were pretty terrible at first," he said.

Kuo said he encourages students after their PhDs or graduate programs to first work in industry to learn as much as they can about various areas. Some of the best projects he ever worked on, Kuo said, were collaborations with people from different backgrounds. The most important thing he learned at Bell Laboratories was to collaborate.

More then than now, he believes, people collaborate on papers. Kuo said he would even publish papers with mathematicians, as well as with other engineers. Funding was less difficult to come by, as well. The goal was to publish whenever possible, and even better with many people from different disciplines. "Don't be stuck-up about your accomplishments," he said. "Collaborations are very important."

» NETWORK »

Kuo said he got to know Nobel laureate Philip Warren Anderson not because he was a renowned physicist at Bell Laboratories but because together, they played Go, one of the world's oldest known board games. In 1976, after Anderson beat Kuo at every game of Go, Anderson won a Nobel prize.

Kuo has lived everywhere from New Jersey to Hawaii. After his work at Bell Laboratories, Kuo took a position as a full professor at the University of Hawaii at the age of 32. There, he received funding from ARPA, now DARPA, to study and build a network based on packet switching.

The result was ALOHAnet, which launched in 1971. Created by Kuo, along with Norman Abramson, Thomas Gaarder, Shu Lin, Wesley Peterson and Edward Wheldon, it was one of the earliest forms of radio communication incorporated with packet switching – meaning it was the earliest communication system similar to what is now called Wi-Fi.

ALOHA originally stood for Additive Links On-line Hawaii Area and was used to communicate among different locations at the University of Hawaii, which were spread across the main Hawaiian Islands.

Kuo said the project, which paved the way for other communication networks, wouldn't have been possible without the diverse backgrounds and collaboration of the team. "Wherever you go, don't be proud. Don't say 'Well, they didn't go to as good a school as I did, so I won't work with them.'" Kuo said "They will teach you more than you know."

"IT WAS A VERY COMPLEX MACHINE. YOU MIGHT CALL IT A RUBE GOLDBERG. AND IBM BUILT THREE OF THEM."

RICHARD TOEPFER

BY JOHN TURNER

IN THE 1950s, MOST ECE ILLINOIS GRADS FOLLOWED A WELL-ESTABLISHED PATH—FROM A GREAT SCHOOL, TO A GOOD JOB, WHERE THEY WORKED UNTIL THEY WERE HANDED THEIR GOLD RETIREMENT WATCH AND POLITELY SHUFFLED TOWARDS THE DOOR. RICHARD TOEPFER (BSEE '56, MSEE '57, PHD '62), HOWEVER, TOOK A DIFFERENT ROUTE.

Over the course of his career he worked for several established companies, including IBM, Hewlett-Packard and Apple. But he wasn't afraid to take a risk on smaller start-up companies that sprang up in the Silicon Valley, such as Convergent Technologies and Measurex. "What I followed was technology," he explains. "I did not leave a project uncompleted, but I also sought the opportunity to learn new things. I think the essential skill I developed was the ability to quickly adapt and contribute in a new environment and technology."

Even his path to Illinois was somewhat circuitous. It began with a full scholarship at the Fournier Institute of Technology in Lemont, Illinois, just south of Chicago. Established by the Arthur J. Schmitt Foundation in 1942, the school was designed to give young men a college education in business, chemistry and electrical engineering. But with only about 100 students, it simply couldn't compete with the bigger schools. When it closed in 1955, students had the choice of completing their education at Marquette, Notre Dame, or University of Illinois. Toepfer, along with several other students, chose Illinois, beginning almost seven years of combined undergraduate and graduate studies.

"It was an excellent choice," he says now, recalling the caliber of the instruction he found. "We had a lot of stellar names on campus at that time — John Bardeen, Mac Van Valkenburg, Franz Hohn and another name that probably a lot of people don't know today, W.R. Ashby, a pioneer of the new field of

Richard Toepfer with Glamorous Gal in Oshkosh.

cybernetics. Many of us took those classes as electives. My graduate advisor was Professor Gil Fett, one of the pioneers in control system engineering, whose role as a mentor was something I tried to emulate as a manager during my career."

Over the summer, he took various jobs to advance his career. "My earliest summer job in college was with a group of German scientists that had been brought over from Germany after WWII to prevent their knowledge from falling into Soviet hands. Their story can be found in the recent book 'Operation Paperclip.'" That exciting summer was soon followed by others with Motorola, IBM and Boeing where, in 1955, he witnessed an early demonstration flight of the 707 prototype, and the first production models of the B-52.

After graduating, he felt the call to move to California. And so in 1961, with a job offer from Aerospace Corporation in hand, he put all of his worldly belongings in the back of his VW bug and headed west.

Over the course of the next several years, he worked for a long list of companies exploring many facets of technology, including anti-ballistic missile defense, underwater laser communication, and the trillion-bit photo storage system, which was used to store digitized images from bubble chamber photographs taken by the Atomic Energy Commission. He was involved with the control system for the electron beam writer that it used. "It was a very complex machine. You might call it a Rube Goldberg. And IBM built three of them."

Ten years were spent at Hewlett-Packard, where he managed the development and release of several significant products, including the HP 3000—a 16-bit minicomputer that's Operating System is still used by many banks today. "HP provided the real education of my career," he says of his time there. "I learned the craft of management, as well as that of engineering, marketing and manufacturing." He also learned a valuable lesson that has stuck with him to this day.

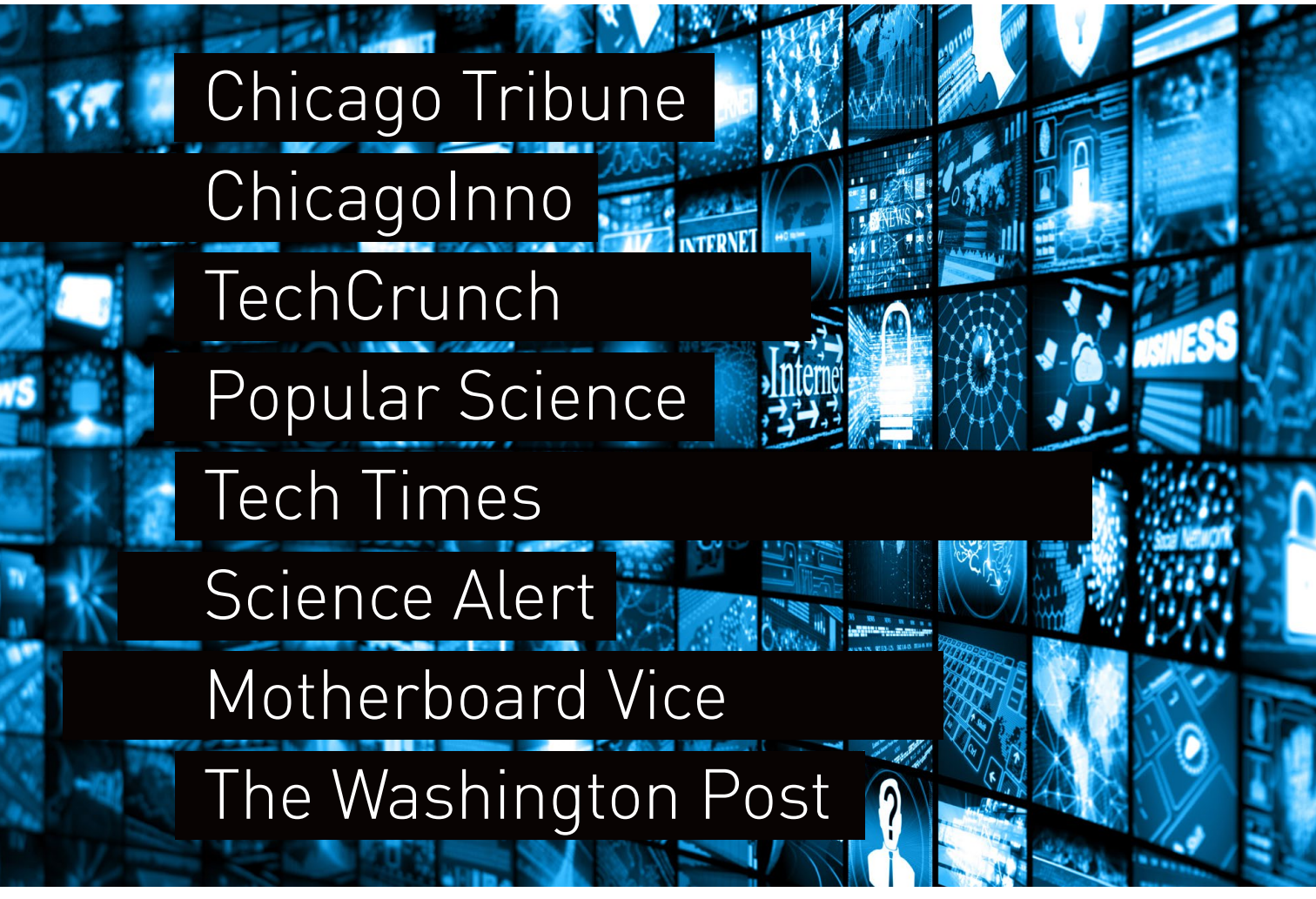
"When an employee was brought up for a promotion or award, Hewlett and Packard asked one question — what were his or her contributions. 'Contribution' was the key word. It's fundamental, as an employee and as a citizen."

Toepfer took that philosophy to heart. Even in his retirement years, he has continued to contribute, coaching high school students in physics and calculus and acting as a "manufacturing mentor" in Stanford's school of Mechanical Engineering and Design.

He has also kept in touch with many of his fellow students from Fournier, whose careers took them all over the country. For over 40 years, they held a reunion every two years, sharing stories of family and career.

Today, he's happily enjoying his retirement in the Bay area with his wife of 50 years, indulging his passion for water coloring and aviation, and sharing his experiences with the next generation of engineers. "I've had the uncertain career their facing," he says. But he has no regrets for taking the road less traveled.

"I have a friend who was with one company and had the same manager for his entire career. I think I would have gone crazy," he laughs. "I sought challenge, variety and the opportunity to contribute to new technology as my formula for a career; it proved a rewarding equation."



IN THE MEDIA

Associate Professor Romit Roy Choudhury and PhD candidate Nirupam Roy attracted media attention from T*he Chicago Tribune, ChicagoInno, TechCrunch, Popular Science, Tech Times*, and other outlets with their research about using a cell phone's vibration motor as a listening device. This work expands the possibilities for communicating with wearables, but it also raises concerns about using smartphones for eavesdropping.

Associate Professor Michael Bailey conducted a study on the Illinois campus to test just how easy it might be for hackers to gain access of someone's computer. His team dropped 300 USB drives around campus, and up to 45 percent of the drives were connected into computers. "Why go through cryptology or some other complicated way of compromising a system when you can clearly just get a user to click on something?" Bailey asked. *The Chicago Tribune, Science Alert, and Motherboard Vice* shared his research findings.

Assistant Professor Lav R. Varshney helped accurately predict the financial losses for Chipotle after an E.coli outbreak using the data from the application Foursquare. "These data sets give a very detailed view of human behavior. It's a really powerful instrument in all kinds of settings," Varshney said in *The Washington Post*.

***The New York Times* highlighted ECE affiliate Rashid Bashir's** advances in the development of "biohybrid" robots. Bashir, a professor of bioengineering, led the construction of a light-controlled robot powered by light and living rat cells, similar to a stingray robot created at Harvard. Bashir's research focuses on how rat cells work together to propel the robot.

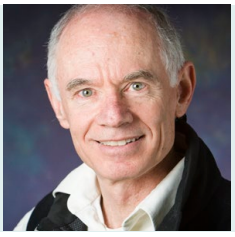
***Scientific American* featured Professor Olgica Milenkovic's** DNA-based data storage research. "DNA lasts for centuries if it is kept cold and dry, and in theory you could store billions of gigabytes into the volume of a sugar crystal," she said.

NAMED PROFESSOR APPOINTMENTS ANNOUNCED

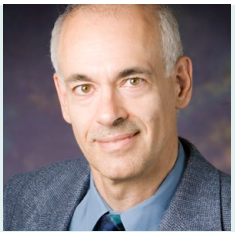
ECE ILLINOIS AND THE COLLEGE OF ENGINEERING HAVE ANNOUNCED SIX NEW NAMED PROFESSORSHIPS AT ECE ILLINOIS. THESE PROFESSORSHIPS ALLOW THE DEPARTMENT TO RECRUIT AND RETAIN PROMISING RESEARCHERS AND TEACHERS, ENCOURAGING THEM TO EXPAND THEIR WORK AND CAREERS AT ILLINOIS.

Jennifer Truman Bernhard, Donald Biggar Willett Professor in Electrical and Computer Engineering, focuses her research in two areas: electromagnetics for wireless communication and reconfigurable active and passive antennas.

Yoram Bresler, Founder Professor in Electrical and Computer Engineering, is a member of the Coordinated Science Laboratory with research interests including compressed sensing, multi-dimensional and statistical signal processing and their applications to inverse problems in imaging, and computed tomography and magnetic resonance imaging.



Joseph W. Lyding, Robert C. MacClinchie Distinguished Professor in Electrical and Computer Engineering, was recruited to Illinois in 1984 by John Bardeen to work on the 1D charge density wave problem. He has pioneered many notable technologies, including ultra-clean nanotube deposition and STM spectroscopic methodologies, which allow subtle effects to be seen for the first time and to be modeled with first principles theory and simulations.

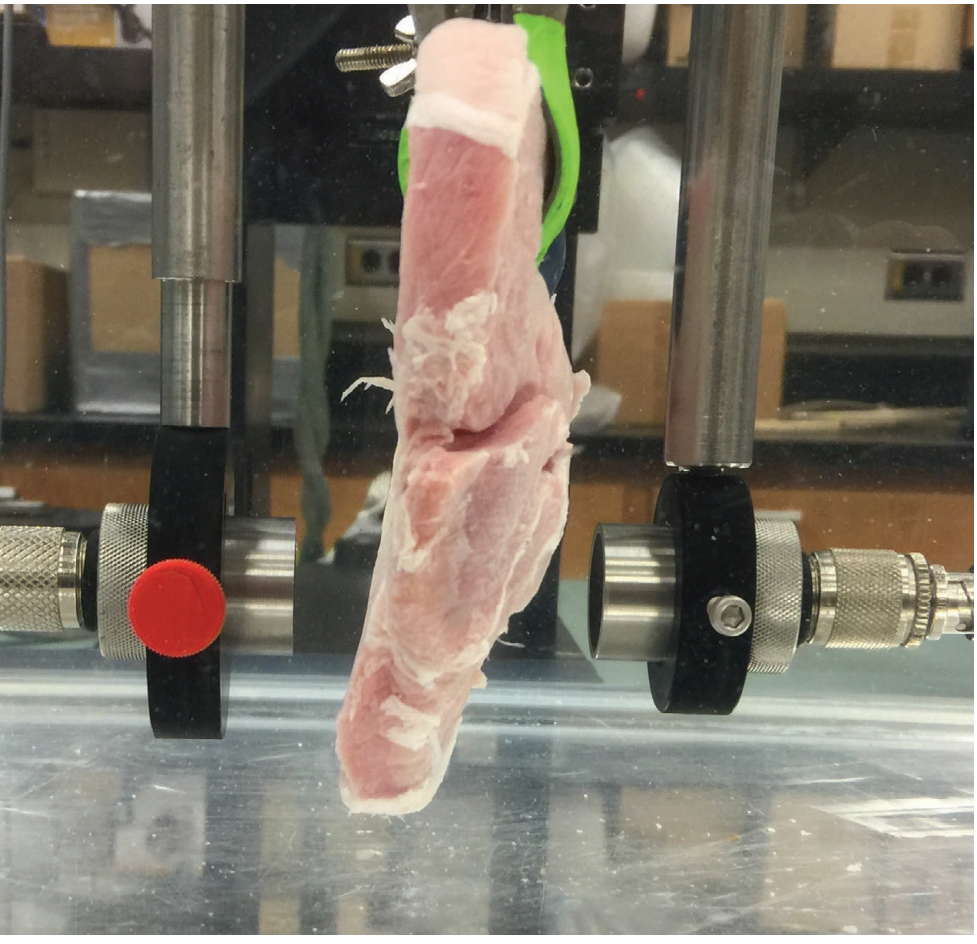


Elyse Rosenbaum, Melvin & Anne Hassebrock Professor in Electrical and Computer Engineering, researches component and system-level ESD reliability, mitigation strategies for ESD-induced soft failures, transient latch-up, ESD-robust high-speed I/O circuit design, compact modeling of on-chip ESD protection devices, and machine-learning aided behavioral modeling of microelectronic components and systems.

Venugopal Veeravalli, Henry Magnuski Professor of Electrical and Computer Engineering, is a member of the Coordinated Science Laboratory whose research interests span the theoretical areas of detection and estimation, information theory, statistical learning, and stochastic control, with applications to cyber-physical systems, sensor neworks, wireless networks, big data, and genomics.

Yurii Vlasov, Founder Professor in Electrical and Computer Engineering, is interested in applications of engineering solutions to life sciences. A new faculty member at ECE ILLINOIS, he previously hed various research and managerial positions at the IBM T.J. Watson Research Center in New York where he led broad company-wide efforts in integrated silicon nanophotonics.

LEARN MORE ABOUT THESE FACULTY MEMBERS AT ECE.ILLINOIS.EDU



"WHAT CAN YOU DO WITH THIS FORM OF DATA TRANSMISSION? YOU CAN DO ALMOST ANYTHING WITH IT."

MEAT-COMMS DEMONSTRATE DATA TRANSMISSION THROUGH TISSUE

BY DOUG PETERSON

Andrew Singer may be a vegan, but that hasn't stopped him from finding valuable uses for beef liver and pork chops in his research. Using those two cuts of meat, Singer and Michael Oelze, both ECE ILLINOIS professors, have shown for the first time that ultrasound signals can be used to successfully transmit digital data through tissue at data rates capable of streaming Netflix in HD.

Their research, conducted this past spring, opens the door for all sorts of biomedical possibilities. Singer and Oelze showed that these high rates of data can be sent to and from medical devices implanted in the human body.

Currently, some patients will swallow miniature cameras, which move through the digestive tract, using radio frequency (RF) signals to transmit extremely low-quality images. RF signals cannot send high rates of data without exceeding FDA safety regulations, Singer points out.

ECE ILLINOIS faculty members Michael Oelze (left) and Andrew Singer

If such systems were to switch to safer ultrasound signals, the cameras could transmit data at rates 1,000 times greater. In fact, the experiments showed that ultrasound can transmit up to 30 megabits per second through tissue—enough to send high-definition videos from within the human body.

Singer, who has been at Illinois for 18 years, specializes in communication systems and has actively researched underwater acoustic communications for the Navy for over 20 years, focusing on the transmission of signals between ships and submarines. He notes that whales and dolphins have evolved an effective way of communicating for long distances through water—hundreds of miles—using sound. Because the human body can be idealized as a "big bag of salt water," Singer says that transmitting data short range with ultrasound has great advantages over RF, which heats up water and doesn't propagate well at all, especially in salt water.

Their new idea came about in 2015 when Singer was talking with Oelze, whose research focuses on biomedical uses for ultrasound. Oelze suggested that it's not just important to be able to transmit through water; it's also critical to find ways to transmit more effectively through tissue.

"With its layers of tissue, fat, bone, and organs, the human body provides an even more challenging environment than the ocean," Singer says.

So Oelze and Singer, along with graduate student Anthony Podkowa, suspended beef liver and a pork chop in a tank of degassed water (to protect the transducers). Their system has been fittingly named MEAT-COMMS, or Mbps Experimental Acoustic Through-Tissue Communication.

After showing it was possible to quickly transmit hundreds of megabits of data through tissue at short distances, they presented their results at this past summer's International Workshop on Signal Processing Advances in Wireless Communications in Edinburgh, Scotland. The scientific community took immediate notice, and some labs are already advertising for postdocs to come on board to research biomedical applications for this technology. "We have clearly set off a spark in people's imagination," Singer says.

Oelze also presented on these results at the Ultrasonics Symposium in Tours, France, this past September. Meanwhile, Singer and Oelze have applied for funding from the National Institutes of Health to grapple with some of the possible obstacles—most notably, miniaturization. For transducers to be implanted in the human body, they will need to be miniaturized and wrapped in a protective casing.

Battery life will also be critical for devices transmitting large amounts of data, but Singer says remote charging of implanted units should not be an insurmountable challenge. Being able to transmit data to an implanted medical device means that software updates to an artificial heart, for example, could be done wirelessly without having to perform surgery to remove the device. This will greatly expand the life of the device.

Another challenge will be dealing with obstacles in the body, such as bone. For instance, if you are trying to send data to a medical device implanted on the heart, you may not have a direct line-of-sight path without hitting bone.

Singer says they will need to determine the effects of scattering, which occurs when the signal hits bone. But again, Singer sees this as an obstacle that can be overcome through clever signal processing. They have successfully dealt with similar signal processing issues when compensating for reverberation effects while transmitting through the ocean.

According to Singer, ultrasound has proven its safety after decades of medical use for other purposes.

"You'd be hard pressed to find an infant in America who didn't have an ultrasound. It's been greatly researched," he points out.

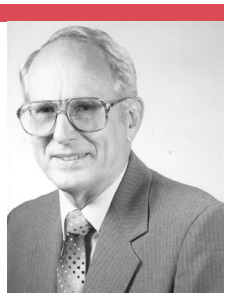
"I imagine that over the next 20 years, we'll see a tremendous increase in the capabilities of implanted medical devices," he adds. "What can you do with this form of data transmission? You can do almost anything with it."

IN MEMORIUM

PAUL D. COLEMAN

Paul Coleman, who dedicated more than 48 years to the University of Illinois, died May 5, 2016. Coleman influenced those around him including countless students, peers, and friends through his research, service, and teaching.

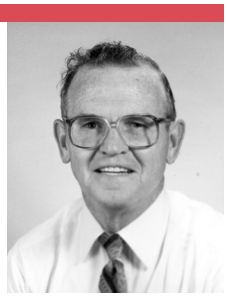
His work focused on coherent electromagnetic radiation across the spectrum. With the help of his students, he researched the first coherent generation of Cerenkov radiation. He demonstrated the world's fastest detector, the world's second chemical laser, and the metal-oxide-metal detector. He also gave the first demonstration of non-linear optics in the infrared and the first real space transfer.



P. EDWARD MAST

Edward Mast, a well-respected former professor, died February 19, 2016. Mast started his career at Illinois in 1952 and began the relationship between the school and his family that has lasted for 64 years. He worked as a professor and later, in 1985, as the associate head of the Electrical Engineering Department. Four of his seven children went on to become ECE alumni.

His research focused on antennas, wave propagation, and electromagnetic field theory. He also worked to design antennas for spacecraft and missiles and on electromagnetic propagation of radiofrequency signals during spacecraft reentry.



JOSEPH VERDEYEN

Professor Joseph Verdeyen died February 16, 2016. Verdeyen began his career just as laser technology emerged from industrial labs and ultimately directed the Micro and Nanotechnology Lab. Verdeyen was well known for his coupled-cavity laser interferometer, a major advance in plasma and laser diagnostics. The device makes ultra-sensitive measurements by comparing light beams. He is named on several patents.

The story is told that Verdeyen was working on research with the CO2 laser and discovered it could be driven by temperature. He published a paper on the topic and received a visit from government officials. Unbeknownst to him, the topic was a classified research area, and the government was shocked someone had made the discovery.

94TH ANNIVERSARY OF SOUND ON FILM

On June 9, 1922, movies were changed forever when University of Illinois Electrical Engineering Professor Joseph T. Tykociner showed how movies could talk in a public demonstration and lecture. Illinois Public Media News marked the anniversary with a radio story that includes audio of Tykociner's voice.

LISTEN AT BIT.LY/SOUND-ON-FILM-94

KOBAYASHI RETURNS FOR 60TH ANNIVERSARY

BY DANIEL DEXTER

In six decades, ECE alumnus Herb Kobayashi (BSEE '56) has worked across the country in a variety of roles, including missile tracking research, federal telecommunications oversight, and even a stint as a biology professor.

Kobayashi came to Illinois in 1952 after serving as a Korean War infantryman from 1950-1951. After graduation, his career focused on telecommunications work, devising satellite communications for Lockheed Martin's missile and space division. It was the only private company he ever worked for; he spent the rest of his engineering career working for the federal government.

He moved on to work for Boulder Labs, a U.S. Department of Commerce scientific research laboratory. Kobayashi's research there primarily focused on highly accurate missile tracking technology.

"What they wanted was to have information on a missile's trajectory after it is launched from Cape Canaveral," Kobayashi said. "The system we were working on would be able to locate the projectile at all times."

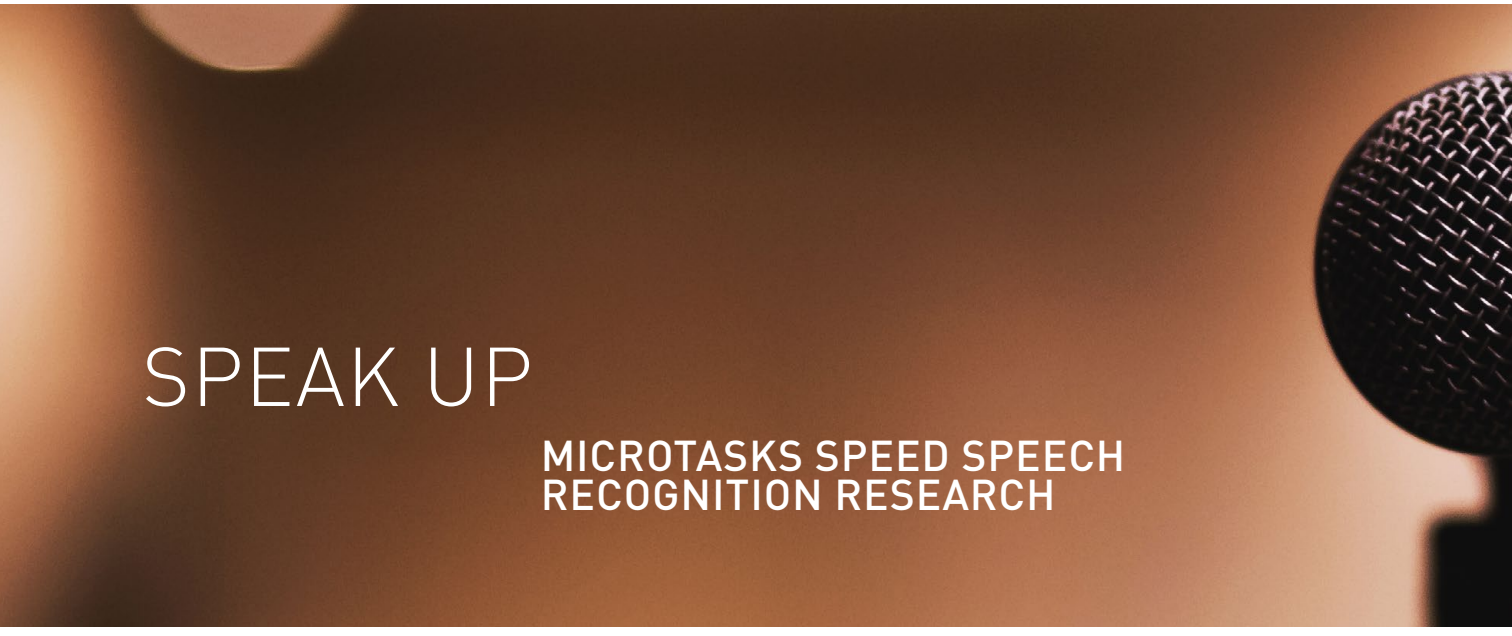
Kobayashi's ten year stint at Boulder Labs ended when he decided to shift to a different STEM field: biology. He enrolled at University of Colorado at Boulder and received his master's degree in biology in 1967 and a PhD in plant ecology from the University of Hawaii in 1973. He travelled back to Colorado after receiving his doctorate and began a 12-year stretch as a professor at the University of Colorado.

But when a position at the NSA in Annapolis, Maryland, piqued his interest, Kobayashi returned to the communications field. He spent the next 25 years helping to improve the telecommunications spectrum through his work with the NSA and the National Communications and Telecommunications Administration.

"We were working on improving and overseeing how the telecommunications spectrum operated," Kobayashi said. "I dealt with radio antennas, and the experience I had with amateur radios at Illinois gave me a leg up on my peers."

He retired 17 years ago and has lived in Hawaii since, but that doesn't mean he has stopped traveling. Kobayashi returned to Illinois in May to see the new ECE Building and celebrate the 60th anniversary of his graduation.

"Geography is one of my favorite subjects," Kobayashi said. "I was really interested in seeing these places and learning what's there because that's how you enlarge your life. As far as I know, I have never been discouraged by traveling."



SPEAK UP

MICROTASKS SPEED SPEECH RECOGNITION RESEARCH

ECE ILLINOIS RESEARCHERS ARE FINDING WAYS TO MAKE SENSE OUT OF NONSENSE, AND THEY HAVE GIVEN A DRAMATIC BOOST TO THE CREATION OF SPEECH RECOGNITION SYSTEMS FOR LANGUAGES AROUND THE WORLD.

BY DOUG PETERSON

"Everyone knows that when a person listens to a foreign language, the sounds make no sense," says Professor Mark Allan Hasegawa-Johnson.

However, Hasegawa-Johnson's team has found a way to correlate the nonsense syllables that people hear when listening to a foreign language with the actual sounds, or phonemes, of that language. Using the data that result, they are able to develop speech recognition systems—the kind of system behind Siri, the famed voice on Apple phones.

Before their project, most experts dismissed the idea of using non-native speakers to transcribe sounds as "absurd," he says. But his team showed it could work.

According to Hasegawa-Johnson, there are close to 7,000 spoken languages in the world today, but automatic speech recognition systems exist for only about 40 of them. Speech recognition systems for cell phones are offered for even fewer—less than 20 languages.

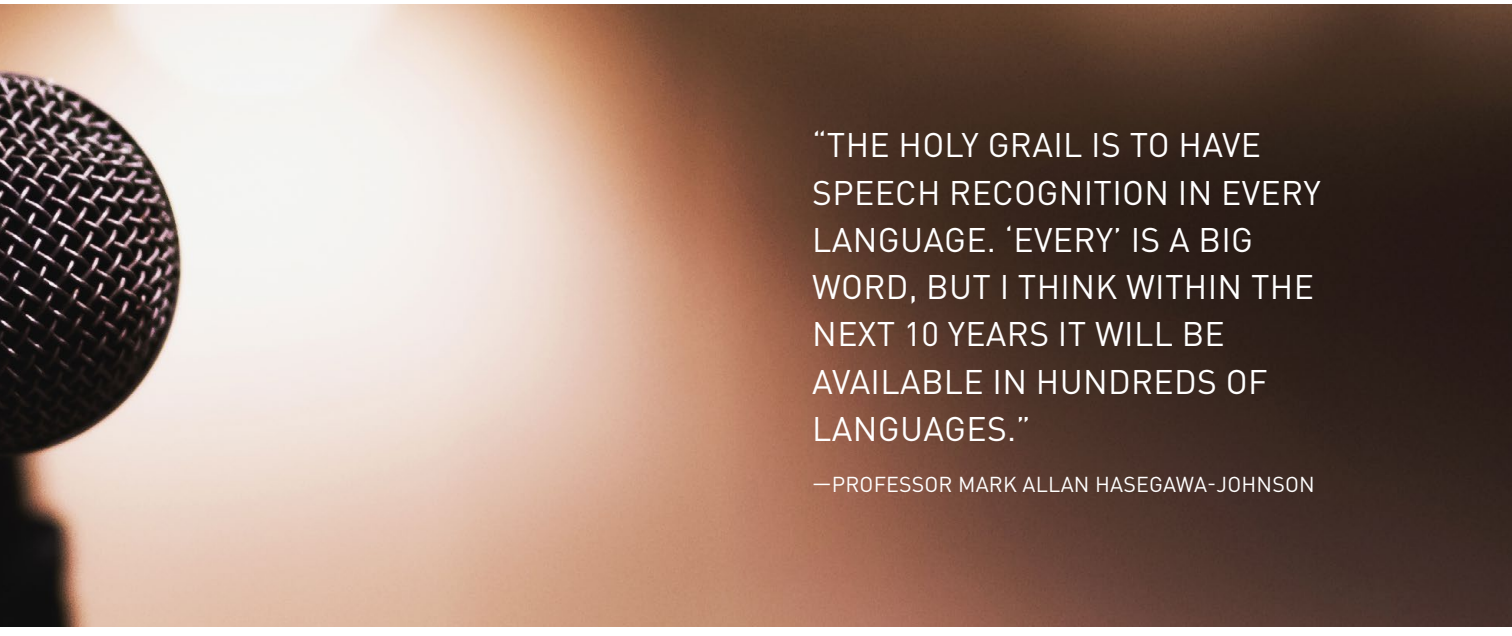
With this new approach, Illinois researchers are able to create automatic speech recognizers faster and cheaper. "What I would like to see happen is that we reduce the cost enough that Google, Apple, or Microsoft will offer a speech recognizer for more languages," he explains.

Hasegawa-Johnson says their team aims to create low-cost speech recognition systems in 200 languages over the next two years. So far, they have developed software for roughly 20 "low-resource languages"—languages for which there is there is no good speech recognizer.

The research project arose near the end of 2013 when Hasegawa-Johnson's graduate student at the time, Preethi Jyothi, tried to find available data to create an automatic speech recognition system for her native language of Hindi. This data, based on transcribed audio, is used to train a system to recognize a particular language.

After considerable searching, Jyothi eventually found some non-transcribed audio that could be used to create a speech recognizer for Hindi, a language spoken by hundreds of millions of people worldwide. To transcribe the audio, one option was to find a single well-trained expert to meticulously do the transcriptions, but this would be time-consuming and expensive.

So Hasegawa-Johnson says, "We did the opposite." They turned for help from hundreds of English speakers who couldn't speak a word of Hindi.



"THE HOLY GRAIL IS TO HAVE SPEECH RECOGNITION IN EVERY LANGUAGE. 'EVERY' IS A BIG WORD, BUT I THINK WITHIN THE NEXT 10 YEARS IT WILL BE AVAILABLE IN HUNDREDS OF LANGUAGES."

—PROFESSOR MARK ALLAN HASEGAWA-JOHNSON

Hasegawa-Johnson's team hired English speakers on the crowdsourcing site, Mechanical Turk, to transcribe the Hindi sounds into the nonsense sounds that they hear. Suddenly, Jyothi and Hasegawa-Johnson had access to hundreds of people who could perform these microtasks—transcribing one-second audio clips of a foreign language.

After the non-expert listeners wrote down what they heard, the researchers mapped out connections between the various nonsense syllables and the actual phonemes, or sounds, in the target foreign language. Then they created probabilistic mass functions, which determined the probability that one particular nonsense syllable corresponded to a sound in the foreign language.

Hasegawa-Johnson says they can create a speech recognizer using roughly 10 hours of transcribed audio. But if they can get that number up to about 100 hours of speech data for a particular language, the recognizer may have an error rate small enough to be commercially useful.

As work progressed and they focused on more and more languages, the research team didn't just rely on English-speaking transcribers. They also went to another crowdsourcing site, Upwork, which is more expensive than Mechanical Turk but has transcribers who speak a more diverse set of languages, including Hindi or Mandarin. Finding transcribers who spoke Mandarin was useful for transcribing Vietnamese because the two languages have similarities in their systems of sounds.

In addition to Hindi and Vietnamese, other low-resource languages they have worked on include Arabic, Hungarian, Swahili, Zulu, Dinka, and Urdu. The reason speech recognition systems for low-resource languages would be so helpful, Hasegawa-Johnson explains, is that cell phones abound in Third World countries.

"People don't always have landline phones, but many have cell phones," he says.

Speech recognition systems for phones in less-developed countries would open up economic possibilities, he adds. For instance, people who make fantastic woven products in the mountains of Zaire could use a speech recognition system to create websites on their phones and sell their products worldwide. In cases of natural disasters or riots, troops or aid workers could use a speech recognition system to monitor radio broadcasts and determine where help is needed.

Hasegawa-Johnson says that once they develop systems for the first 200 languages, it may be difficult to find audio for the remaining languages that could be used for transcriptions. But they will push on.

As he puts it, "The Holy Grail is to have speech recognition in every language. 'Every' is a big word, but I think within the next 10 years it will be available in hundreds of languages."

Professor
Mark Allan Hasegawa-Johnson

PHD GRADUATES

AUGUST 2015

STUDENT	THESIS	ADVISER
KARTHIK BALASUNDARAM	Metal-assisted chemical etching as a disruptive platform for multi-dimensional semiconductor sculpting	Xiuling Li
TE-WEI CHANG	Development of novel series and parallel sensing system...substrate for biomedical applications	Gang Liu
YING-YU CHEN	Graphene nano-ribbon and transition metal dichalcogenide field-effect transistor modeling and circuit simulation	Deming Chen
JUNGWOOK CHOI	High performance and error resilient probabilistic inference system for machine learning	Robin Rutenbar
AMIN EMAD	New group testing paradigms: from practice to theory	Olgica Milenkovic
YUN HEO	Improving quality of high-throughput sequencing reads	Deming Chen
TAE WOO KIM	Quantitative phase imaging: advances to 3D imaging and applications to neuroscience	Gabriel Popescu
ANTHONY MANGOGNIA	Helium resonance fluorescence LiDAR	Gary Swenson
DENNIS MATTHEWS	Experiments in quasi-static manipulation of an elastic rod	Timothy Bretl
HUAN-TING MENG	Investigation of general-purpose computing on graphics processing units and its application	Jianming Jin
KUO-HSUAN MENG	Modeling and simulation of full-component integrated circuits in transient ESD events	Elyse Rosenbaum
SAURAV MOHAPATRA	Techniques for determining hidden properties of large-scale power systems	Thomas Overbye
MATTHEW YOUNG	A characteristic mode perturbation approach for antenna loading design	Jennifer Bernhard
CHEN ZHANG	Selective lateral nano-epitaxy for manufacturable nanowire electronics	Xiuling Li

DECEMBER 2015

STUDENT	THESIS	ADVISER
TEJASVI ANAND	Toward realizing power scalable and energy proportional high-speed wireline links	Pavan Kumar Hanumolu
SEYED RASOUL ETESAMI	Potential-based analysis of social, communication, and distributed networks	Tamer Basar
THOMAS GALVIN	Markov-Airy method for electromagnetic fields in layered structures and microsphere-stabilized planar resonators	J. Gary Eden
JOSHUA JUEN	Maintaining privacy during continuous motion sensing	Nikita Borisov
MIN-SUN KEEL	Design of reliable and energy-efficient high-speed interface circuits	Elyse Rosenbaum
HEE-SEOK KIM	Compiler and runtime techniques for bulk-synchronous programming models on CPU architectures	Wen-Mei Hwu
YUN LI	Universal outlier hypothesis testing with applications to anomaly detection	Venugopal Veeravalli, Sean Meyn
ROBERT MERTENS	Understanding, modeling, and mitigating system-level ESD in integrated circuits	Elyse Rosenbaum
JUN MOON	Control and estimation with limited information: a game-theoretic approach	Tamer Basar
ONYEAMA OSUAGWU	Brain-machine interface coupled cognitive sensory fusion with a Kohonen and reservoir computing scheme	Stephen Levinson, Lynford Goddard
SAURABH SAXENA	Architectural and circuit level techniques to improve energy efficiency of high speed serial links	Pavan Kumar Hanumolu
SRIKANTHAN SRIDHARAN	Comprehensive loss optimization of induction motor drives	Philip Krein
KAI VAN HORN	Real-time power system operational reliability tools	Alejandro Dominguez-Garcia, Peter Sauer
ZIGANG XIAO	Design automation algorithms for advanced lithography	Martin Wong
KI JUN YU	Printed microscale mono-crystalline silicon on flexible substrates	John Rogers
DANIEL ZUO	Defect characterization of antimonide-based type-II superlattices for infrared detection	Shun-Lien Chuang, Daniel Wasserman

MAY 2016

STUDENT	THESIS	ADVISER
HOMA ALEMZADEH	Data-driven resiliency assessment of medical cyber-physical systems	Ravishankar Iyer
STANTON CADY	Architectures and algorithms for distributed generation control of microgrids	Alejandro Dominguez-Garcia
BRENT DEVETTER	Design and characterization of surface-enhanced Raman scattering nanoparticles as spectroscopic probes	Rohit Bhargava
CARLOS DUARTE-GUEVARA	Multiplexed label-free electrical detection of DNA amplification using field effect transistors	Rashid Bashir
JUSTIN HUGHES	A framework for enabling the utilization of flexible loads to provide frequency regulation	Alejandro Dominguez-Garcia
TREVOR HUTCHINS	Modeling, simulation, and mitigation of the impacts of the late time (E3) high-altitude electromagnetic pulse	Thomas Overbye
STEVEN MCKEOWN	Development of predictable palladium based optomechanical hydrogen sensors	Lynford Goddard
KYEONG HYUN PARK	Study of electrical and thermal transport aiming for improving thermoelectric efficiency	Umberto Ravaioli
KURT SCHAB	Modal analysis of radiation and energy storage mechanisms on conducting scatterers	Jennifer Bernhard
GLORIA SEE	Photonic crystal enhancement and tuning of quantum dot emission	Brian Cunningham
MRUNMAY V. TALEGAONKAR	Design of energy efficient high speed I/O interfaces	Pavan Kumar Hanumolu
CRAIG WILSON	Adaptive sequential optimization with applications to machine learning	Venugopal Veeravalli

TEN ANSWERS

Ellen Wu graduated from ECE ILLINOIS in 2014, and has since worked for Goldman Sachs and IXL Learning, an innovative educational technology company. In 2016, she came back to pursue her master's in Computer Science.

ELLEN WU

WHAT'S ONE OF YOUR FAVORITE QUOTES?

"Water is fluid, soft, and yielding. But water will wear away rock, which is rigid and cannot yield. As a rule, whatever is fluid, soft, and yielding will overcome whatever is rigid and hard." - Lao Tzu

WHERE IS SOME PLACE IN THE WORLD YOU WOULD LIKE TO VISIT?

I would like to visit Iceland someday. I want to see the glaciers, geysers, aurora as well as its unique architectures.

WHAT'S THE BEST ADVICE YOU'VE EVER RECEIVED?

Stay open minded and be curious. My mom told me that I should never exclude things that I haven't tried. Since then, I've kept her words in mind, and it gives me much more perspective when tackling problems and exploring the world.

WHAT MAKES YOU FEEL ENERGIZED?

I feel mentally energized after I read a wise book or talk to a wise person.

WHAT'S YOUR PERSONAL PHILOSOPHY?

Do not be distracted or depressed when bad things happen as everything happens for a good reason.

WHAT WAS THE TOUGHEST DECISION YOU'VE EVER MADE?

When I was 15, I told my parents I wanted to go abroad for college. That was my first time leaving home and living in a different city by myself. It was really hard for me, and I felt helpless hundreds of times during that time. However, I'm very glad that I did it.

WHERE WAS YOUR FAVORITE PLACE TO STUDY ON CAMPUS?

My favorite place was Grainger in the first two years of college. In my junior and senior years, I used to like studying in Illini Union.

DO YOU HAVE A SECRET TALENT, AND IF SO, WHAT IS IT?

I can find most acupuncture points and meridians on a person.

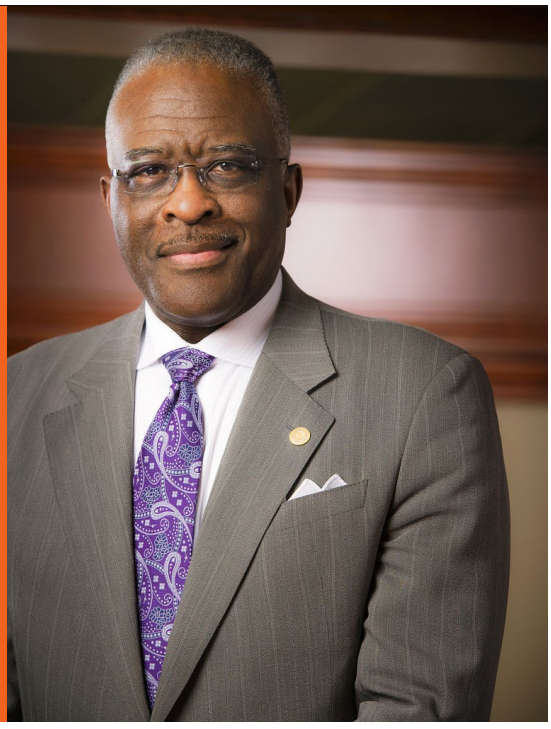
WHAT TIME OF DAY ARE YOU MOST PRODUCTIVE?

I am most productive in the morning, but under the condition that I have enough sleep. For days before deadlines, I can be productive all day.

WHEN YOU HAVE 30 MINUTES OF FREE TIME, HOW DO YOU SPEND IT?

I use it to read or grab coffee with my friends to share updates and thoughts. I love the feeling when my brain gets invaded by new knowledge and ideas.

TEN ANSWERS PROFILES AN ALUM, ASKING THE IMPORTANT QUESTIONS. DO YOU HAVE ANSWERS? EMAIL US AT ECE@ILLINOIS.EDU AND WE MAY FEATURE YOU IN A FUTURE ISSUE.



ROBERT J. JONES NAMED NEW CHANCELLOR

Dr. Robert J. Jones, president of the University at Albany, State University of New York (SUNY), an experienced and accomplished scientist and research university leader, was named chancellor of the University of Illinois at Urbana-Champaign. A native of Georgia, Dr. Jones is the first African-American appointed Urbana chancellor since the office was created in 1967. Visit **go.uillinois.edu/2016Chancellor** to read more about him.

EVERITT LAB RENOVATION BEGINS

The former home of ECE ILLINOIS is undergoing a $55 million makeover to become the headquarters for the Department of Bioengineering. The 125,000 square feet of renovated space will include research and instructional labs, classrooms, and spaces for collaboration for more than 220 faculty, graduate students, post-docs, and staff members. In collaboration with the new Carle Illinois College of Medicine, the researchers in this building will develop new diagnostic technologies, prostheses, therapeutic devices, individualized medicine, and other biotechnology breakthroughs.

SESQUICENTENNIAL TO HIGHLIGHT ACCOMPLISHMENTS AND FUTURE AMBITIONS

The University of Illinois will celebrate 150 years of faculty, staff, and students transforming the landscape of our world with a fifteen month long sesquicentennial celebration. Events, large-format books, a virtual distributed museum, and a physical exhibit in the Campbell Gallery of the Spurlock Museum are among the projects planned, concluding with commencement in May 2018. For event details and to share your own Illinois story, visit **150.illinois.edu**.

NEW DUAL BACHELOR'S DEGREE BRIDGES ENGINEERING AND ENTREPRENEURSHIP

Building on a tradition of successful companies founded by Engineering at Illinois students, a new dual-degree program in Innovation, Leadership, and Engineering Entrepreneurship (ILEE) is now available for students. The ILEE degree grows out of courses that have been offered by the Technology Entrepreneur Center since 2000. Project-based, experiential learning is at the heart of program, which formalizes the course structure and enhances focus on entrepreneurship.

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Urbana, IL 61801

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SIDDHANTH MUNUKUTLA:

JOHN BARDEEN UNDERGRADUATE AWARD + GRADUATE FELLOWSHIP

When Siddhanth Munukutla came to ECE ILLINOIS from Singapore as an undergraduate, he knew the importance of finding his niche. Today, he is an ambassador for the department, serving as the Graduate Vice-Chair of the ECE Student Advancement Committee where he is working to build a strong ECE Illinois Student Community.

He is equally passionate about his research. Under the mentorship of Professor Joseph Lyding, Siddhanth explores the use of carbon nanotubes and graphene nanoribbons in semiconducting devices. His research focuses on these new materials that may be the future backbone of electronic devices.

Unsurprisingly, Siddhanth is keenly aware of the legacy of two-time Nobel Prize winner Professor John Bardeen. Winning both the John Bardeen Undergraduate Award and Graduate Fellowship allowed Siddhanth to pursue his research interests. He is thankful for the awards and the opportunity to work with the most "intelligent, passionate, and hardworking researchers in the field."

BE PART OF THE **GENIUS** AT ECE ILLINOIS.

TO LEARN MORE, VISIT OUR WEBSITE.
AND MAKE THE INVESTMENT THAT MAKES A DIFFERENCE TODAY.

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