CONNECTIONS

Inclusion in Engineering

Iowa State ECpE students and faculty reflect on their experiences as minorities in STEM and the importance of diversity and inclusion within the department and the university.
Pictured: ECpE graduate students Cimone Wright-Hamor and Nichelle'Le Carrington.

Greetings from ECpE at Iowa State University. We are enjoying the warmer spring temperatures and sunshine here on campus in Ames, and I wish the same for you.

In this issue of Connections, we highlight the work of our faculty. Liang Dong received an award from the U.S. Department of Agriculture for his team's development of wearable plant sensors. Srikanta Tirthapura won an award from the National Science Foundation (NSF) for his research in big data, and Aditya Ramamoorthy earned an NSF award for a coded caching project. Rana Biswas and Jaeyoun Kim recently were published in the prestigious journal Nature Communications, and stay tuned for more coverage in the future on our recently announced NSF CAREER Award winners!

We also focus on the work of our engineering students, who represent a wide range of backgrounds and bring unique experiences to their contributions in the department. One of these students is Shawn Flanigan, who became a joint first author on an innovative paper based on research he did as a freshman at Iowa State — a rare feat for an undergraduate. Another is Jennifer Kincaid, who is taking engineering classes on campus while her father, living in Colorado, is earning his online master's degree in information assurance from Iowa State. The father-daughter pair like to study engineering over Skype on Sundays. Finally, we have students Brendon Geils and Victory Omole, who were awarded the Hacker Prize at HackHarvard, and Tim Lindquist, who built his own version of the Nintendo Switch, called the "Nintimdo."

To celebrate February's Black History Month, we take a look at inclusion in engineering and in our department. Associate Professor Phillip Jones shares his experiences as an African-American faculty member on campus, and students Nichelle'Le Carrington and Cimone Wright-Hamor reflect on their journeys coming to Iowa State as minorities in Ames and in STEM fields in general. As a land-grant institution welcoming students of all backgrounds, we continue to make strides and to build a community and culture of diversity and inclusion here in our department.

Finally, as always, we honor successful ECpE alumni, starting with March's Women's History Month feature on Anita Woodroffe of Alliant Energy. Recently, I had the pleasure of meeting with distinguished father-son alums Wendell and Brian Sander, who worked together at Apple; Wendell is known as the Father of the Apple III computer. We also remember Aziz Fouad and Richard Stanley, who sadly passed away last fall; they both have profoundly impacted ECpE at ISU through their scholarship and philanthropy.

I hope you enjoy this issue of Connections. Please keep in touch, and come see us!

Ashfaq

Ashfaq Khokhar
Professor and Palmer Department Chair in Electrical and Computer Engineering
Iowa State University

IN THIS ISSUE

ECpE ENGINEERS HELP BLACK SEA COUNTRIES FIGHT CYBERSECURITY THREATS

BY MIKE KRAPFL, COURTESY OF ISU NEWS SERVICE

ECpE faculty with Black Sea electricity regulators in front of Coover Hall. The regulators visited campus last September.

Iowa State University faculty members and graduate students recently powered up their cybersecurity test bed and dissected the December 2015 cyberattack that hijacked and took down dozens of power substations across western Ukraine. That cyberattack left 230,000 Ukrainians without power for up to six hours.

Eight electric utility regulators from Ukraine and three other Black Sea countries – Armenia, Georgia and Moldova – paid very close attention to what Iowa State's test bed showed them.

"It had a huge impact," said David Jiles, Anson Marston Distinguished Professor, Palmer Professor and Stanley Chair. "Seeing what we can do was enormously important to them."

The Black Sea electricity regulators were on campus last fall as part of a cybersecurity study tour sponsored by the U.S. Agency for International Development (USAID) and organized by the National Association of Regulatory Utility Commissioners.

The study tour featured three days of meetings, presentations and training sessions in Washington, D.C. Those were followed by two days of cybersecurity demonstrations and presentations at Iowa State, all organized by the ECpE department, its Electric Power Research Center and its Information Assurance Center. The Iowa leg of the tour also featured a field trip to MidAmerican Energy Co.'s control center in Urbandale.

The agency's Cybersecurity Initiative began three years ago, said Steve Burns, the chief of USAID's Energy and Infrastructure Division in the Bureau for Europe and Eurasia. The initiative is all about reducing the region's vulnerabilities to cyberattacks, drafting cybersecurity strategies, boosting economic growth and increasing the region's energy security.

Burns said Iowa State's expertise was brought into the program after meeting and working with Jiles during his recently completed one-year term as a Jefferson Science Fellow and scientific adviser to the U.S. State Department and USAID.

Jiles, while using his fellowship to develop a triage tool to help countries fight off cyberattacks, suggested that U.S. officials working to promote international cybersecurity should take advantage of "PowerCyber," Iowa State's test bed.

PowerCyber is part of grid cybersecurity studies led by Manimaran Govindarasu, Ross Martin Mehl and Marylyne Munas Mehl professor; and Doug Jacobson, ECpE professor.

PowerCyber is a high-fidelity, remote-access tool for research and development to help train industry professionals and educate students to protect power grids. The test bed is designed to do vulnerability analysis, risk assessment, attack-defense evaluations and other tests.

The study tour's visit to Iowa State featured several demonstrations in the PowerCyber lab, including a case study of the power grid attack in Ukraine. The visit also featured discussions of threats, lessons learned, best practices, strategy development and cybersecurity literacy.

"After 30 years of designing and using technology to protect systems, we still have problems and maybe we need to look at how to make the users more secure," Jacobson said. "I talked about using security literacy as a way to educate users about cybersecurity concepts, threats and mitigations."

Govindarasu said defense measures can start with better training for engineers to help them keep up with dynamic and evolving situations. Helping the Black Sea regulators protect the power grids in their countries could also have benefits around the world.

After all, Jacobson said, "They are on the front line of cyberattacks against critical infrastructure."

THE NEW ENGINEERING EDUCATION

BY EMILY BENDA

Iowa State University's Electrical and Computer Engineering (ECpE) department knows there is more to these subjects than just equations and code. Postdoctoral researcher Nick Fila is on a mission to prove the depth of electrical and computer engineering through new learning experiences.

Fila was hired as the post-doc for Iowa State's Reinventing the Instructional and Departmental Enterprise (RIDE) project last summer. RIDE, funded by the National Science Foundation (NSF), is focused on creating a new collaborative instructional model for course design to develop the next generation of engineers within ECpE. Fila collaborates on course design through a cross-functional group called an x-team, including faculty from ECpE, Industrial Design and Aerospace Engineering. His position involves researching how ECpE courses are being redesigned and helping faculty instruct students with a design-thinking approach to help students recognize the applicability and impact of their engineering projects in people's lives.

Fila completed his undergraduate degree in electrical engineering at the University of Illinois Urbana-Champaign. It was during this time, especially his sophomore and junior years, he lost his original zeal for the subject.

"Those years were really demoralizing for me," Fila said. "It seemed all of my classes were mostly focused on theory and formulas without any connection to the societal and user problems I wanted to solve as an engineer."

This realization led Fila to pursue a path in education, not just engineering. He went to receive his master's degree in electrical and computer engineering at the University of Illinois Urbana-Champaign and later his Ph.D. in engineering education at Purdue University.

At Purdue, Fila studied how engineering students characterize and approach the constructs of innovation and empathy within engineering. This work culminated in his dissertation, which identified eight distinct ways that engineering students experienced innovation during over 40 different engineering design projects, both within and outside of their coursework. This study has informed Fila's current work by demonstrating the multitude of ways and contexts within which students engage with technical and societal problems and the important role individual priorities and interests play in motivating innovative work.

Because of his own educational experience, Fila found a connection to the RIDE mission. He said he enjoys working with students and faculty at Iowa State and finds their contributions and ideas inspiring.

"It's really invigorating to see these different perspectives and reflect on my own thinking in this redesign process," Fila said.

One of the major changes Fila and the RIDE team are incorporating into engineering courses here at Iowa State is a human-centered, collaborative and iterative mindset, called design thinking, especially during the second and third years of the ECpE curriculum. Fila says students have given positive and constructive feedback on this approach and other changes they have introduced, including reflections on their course experiences and a jigsaw activity with data sheets. A jigsaw activity is a teaching method where students are broken into small groups and assigned to work on problems or topics to bring to the whole class to determine a final solution.

Along with an encouraging student response, the RIDE team also credits Fila for his work in the project and its success.

"Nick has been a breath of fresh air," said ECpE Professor and RIDE Co-Principal Investigator Joe Zambreno. "His design-minded strategies and experience have been invaluable to our team."

Diane Rover, ECpE Professor and Co-Principal Investigator, has worked with Fila and x-team members on course redesign and said Fila envisions and synthesizes concepts in novel ways that lead the RIDE team.

"Our progress can be directly attributed to Nick's efforts and insights," Rover said.

Fila joined the project in July 2017, one year after the NSF grant was awarded. Fila and team members of RIDE have created project strategies and implemented design-thinking practices into the first ECpE course, CPR E 288: Embedded Systems I: Introduction. They plan to adopt these new strategies into another course, EE 230: Electronic Circuits and Systems, next semester.

"We are continually improving and evaluating these strategies," Fila said. "These improvements will be reflected in the additional course we revise."

LIANG DONG WINS USDA AWARD
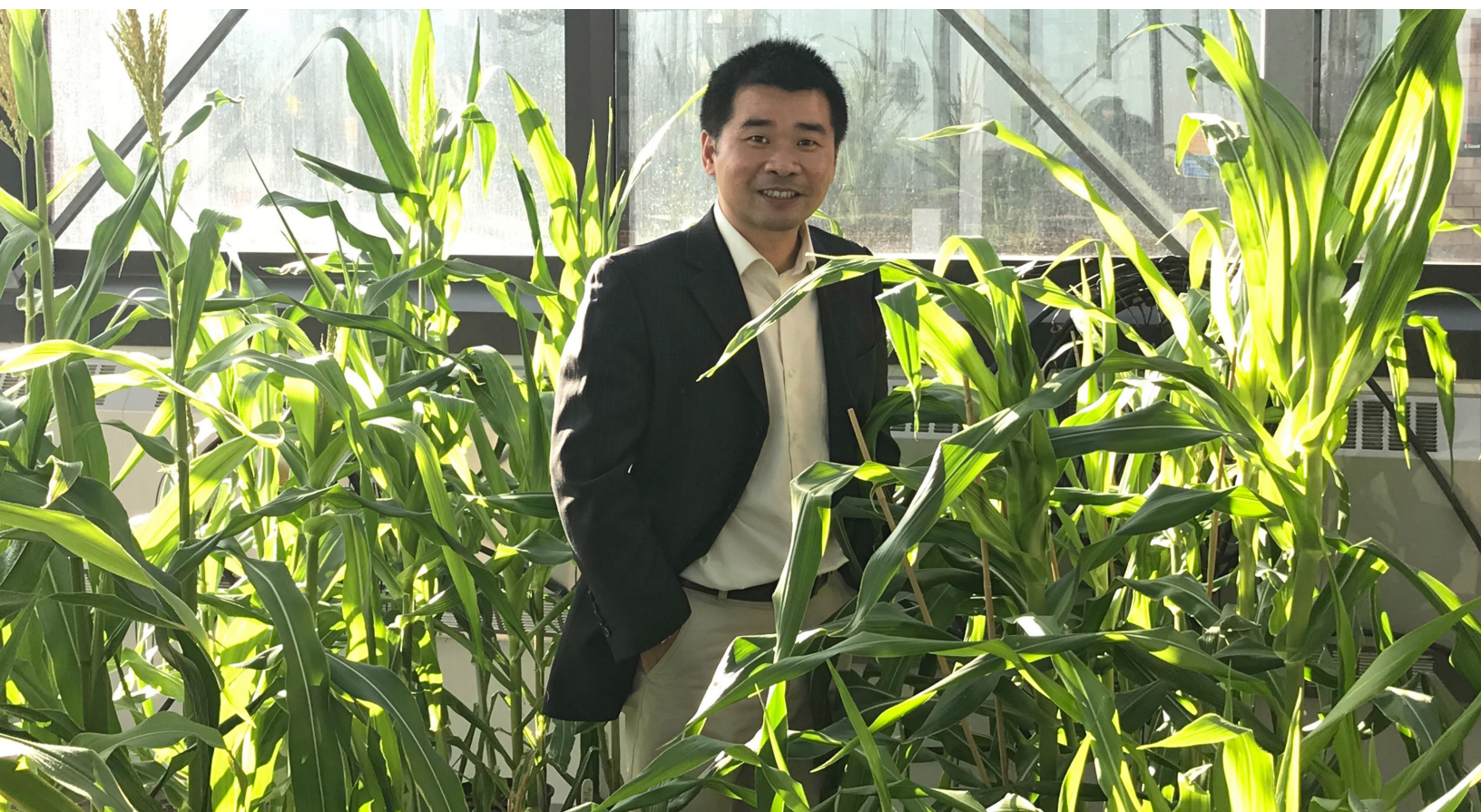
BY EMILY BENDA

Liang Dong, associate professor of Iowa State University's Electrical and Computer Engineering department, was part of the team that recently won a $472,363 U.S. Department of Agriculture (USDA) award for the project titled, "Miniature, Low-Cost, Field Deployable Sensor To Advance High-Phenotyping For Water Use Dynamics." Dong works with Project Director Michael Castellano, Iowa State associate professor of agronomy and William T. Frankenberger Professor in Soil Science, and Co-Project Director Patrick Schnable, distinguished professor in Agronomy and director of Iowa State's Plant Sciences Institute (PSI).

Dong's group develops two wearable plant sensors to measure water transport dynamics and water content in plants. The first sensor is to track transpiration (water leaving the plant) from a leaf. This tool uses graphene oxide manufactured on a tape permeable to both gas and water, which can be easily attached to plants. Graphene is a water-vapor-sensitive material that converts water vapor to electrical signals. The second wearable sensor measures leaf water content using a new Micro-Electro-Mechanical Systems technology developed in Dong's lab.

Castellano and Schnable will use the wearable sensors to characterize maize water use efficiency across different weather and soil environments. The team plans to deploy hundreds of sensors to demonstrate the sensors' ability to discriminate among maize genotypes for plant water transport dynamics. They will leverage the Genomes to Fields maize-phenotyping program that spans multiple locations, from Arizona to New York.

"Two wearable sensors developed in this project will advance plant sciences and agricultural research in a manner similar to how wearable human body sensors have advanced human health and biomedical sciences," Dong said. "These new sensors will lead to a new understanding of crop physiology, improving irrigation efficiency and testing crops for diseases and pesticides."

PSI at Iowa State University provides Dong's group the initial funding to start this water sensor research through the PSI Faculty Scholars Program. The Iowa State University Research Foundation has also granted an option to commercialize the tape-based sensor technology to EnGeniousAg – an Ames startup company co-founded by Dong, Patrick Schnable, Castellano and James Schnable (son of Patrick Schnable), an assistant professor of agronomy and horticulture at the University of Nebraska-Lincoln. The company designs, manufactures and deploys low-cost, instant readout, field-based agricultural sensors for crops, soils and water, thereby improving agronomic management practices, increasing grower profitability and sustaining the environment. **c**

Scan this QR code to see WHO-HD's broadcast of Dong's research.

BIG DATA

ECpE professors Srikanta Tirthapura, Aditya Ramamoorthy and Chinmay Hegde have been making waves in the world of big data and processing speeds.
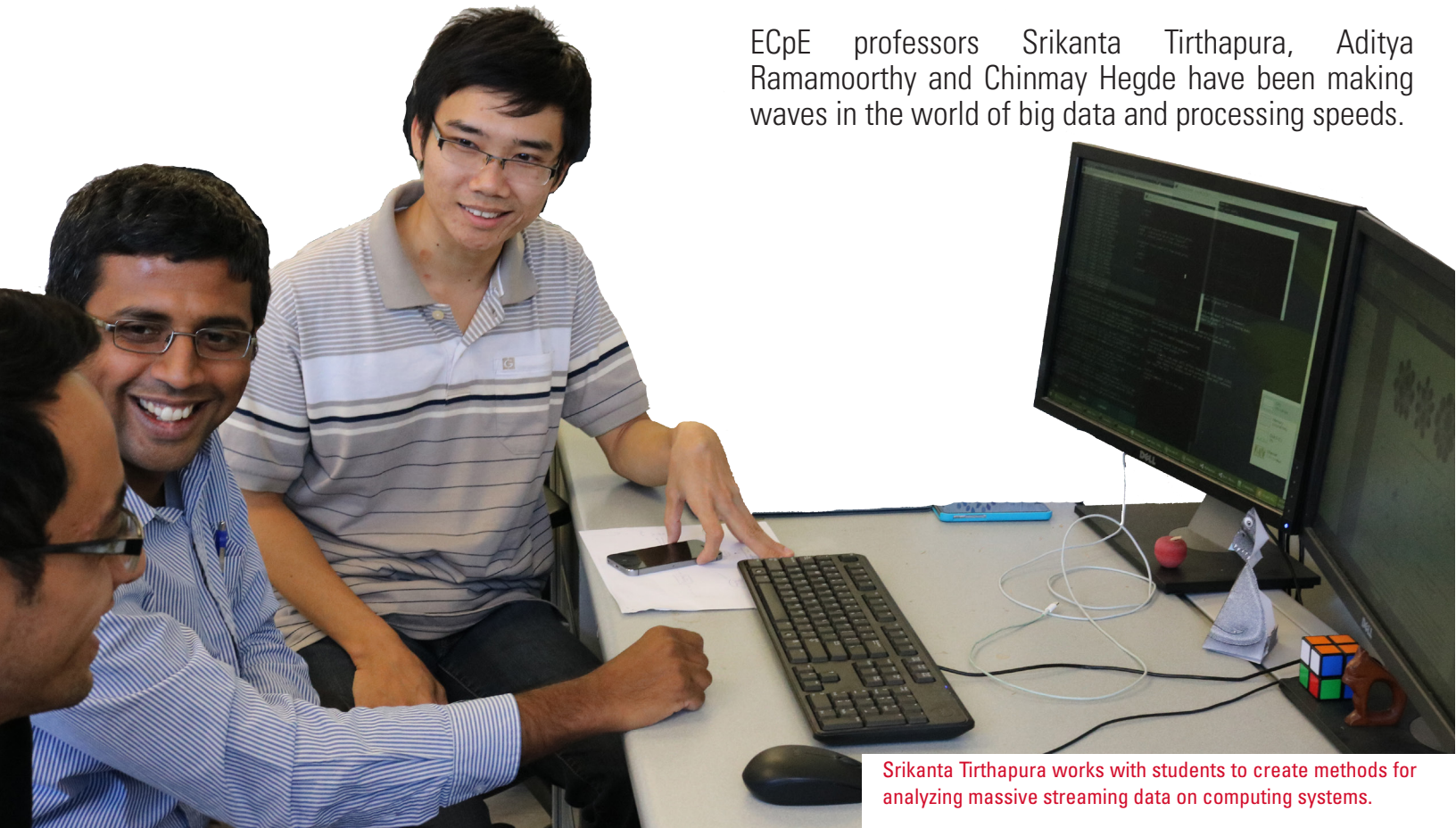
Srikanta Tirthapura works with students to create methods for analyzing massive streaming data on computing systems.

BY EMILY BENDA

With today's technology-driven world, the need to have information instantaneously is growing. Big data can be of large "volume," meaning the number of bytes required to store the data, as well as high "velocity," or a high rate of change. The field of analyzing such massive, fast-changing data is called "streaming analytics."

Iowa State University Department of Electrical and Computer Engineering (ECpE) Kingland Professor Srikanta Tirthapura, is working on ways to ways to handle higher data rates and decrease turnaround time for streaming analytics.

Tirthapura recently won an award from the Division of Computing and Communication Foundations (CCF) of the National Science Foundation (NSF) for his project, "Multicore to Wide Area Analytics on Streaming Data." The award is for $308,000 over the next three years.

This project creates methods for analyzing massive streaming data on computing systems, ranging from machines with multiple cores sharing memory to geo-distributed data centers communicating over wide-area networks. When a large data set of the order of hundreds of gigabytes changes due to the arrival of new data, instead of having to recompute patterns in data from scratch, these new algorithms will elicit the new

patterns in a more incremental manner. The results of this project will impact fields that use large-scale machine learning and graph analytics, including cybersecurity and transportation.

Tirthapura said his incremental approach can drastically speed up large-scale data analytics.

"In the absence of an incremental method, even with a cluster of computers, it can take hours to (re)-process large data of hundreds of gigabytes," Tirthapura said. "We want to meet the need of processing within minutes."

One of the challenges Tirthapura's team faces is the variety of parallel computing hardware available today, ranging from shared-memory central processing units (CPUs), to graphic processing units (GPUs) to networked clusters. They are trying to determine how one design solution can be specialized to work with current systems, yet be generic enough to be relevant for future models. He said he believes his research team of graduate students and collaborators at Carnegie Mellon University have promising approaches to a solution.

"I owe it all to the people I work with," Tirthapura said. "My research collaborators, as well as the people I meet on a daily basis — they make the work exciting."

RAMAMOORTHY AWARDED NSF GRANT

BY KRISTIN CLAGUE

Most people have watched videos, TV shows and movies by streaming them on YouTube or Netflix. If you've streamed video content, then you know how frustrating it can be to wait for the video to load. One researcher at Iowa State University is hoping to improve those network delays.

Iowa State Professor of Electrical and Computer Engineering Aditya Ramamoorthy has received an award from the National Science Foundation (NSF) for his project, "Towards Practical Coded Caching." The grant totals $449,996 over the next three years.

According to the project's abstract, this research will "investigate practical issues in the deployment of coded caching, which is a technique that promises huge reductions in caching network traffic… This will pave the way for the adoption of coded caching in large scale video and audio streaming websites, thus improving the efficiency of the national network infrastructure."

Caching is a technology used by almost everyone with computer access on a regular basis. Coded caching improves the efficiency of traditional caching methods by transmitting fewer amounts of data, which leads to faster transmission.

"One commonly used technique to facilitate content delivery is caching," Ramamoorthy said. "The main idea in conventional content caching is to store relatively popular content in local memory, either on the desired device or on a device at the edge of the network. Upon request, the system first searches the cache for the required file. If a match is found, the request is served from the cache itself, and the traffic from the server to the cache is reduced. This reduces the overall network congestion."

Ramamoorthy's research will attempt to minimize per-user delays, in instances such as video-on-demand playback.

"Content distribution over the internet is an important problem and is the core business of several enterprises," Ramamoorthy said. "The operation of such large-scale systems presents several challenges, including storage of the data, ensuring reliable availability and efficient content delivery… There are practical issues of critical importance that need to be examined in depth before [coded caching] can be deployed in practice. The funded project will address these issues."

Ramamoorthy plans to use this NSF funding to support graduate students who are working on his project, as well as to pay for travel to conferences and workshops for publicizing their results. He thanks his students for their assistance in winning the award.

Their hard work has paid off, and the proposal was seen favorably by the NSF panel.

HEGDE NAMED FELLOW

BY MEGAN SAGER

Chinmay Hegde, assistant professor with the Department of Electrical and Computer Engineering at Iowa State University, has been named a Black & Veatch Building a World of Difference Faculty Fellow in Engineering.

His research, focusing on algorithmic aspects of machine learning, was impactful in his nomination. It involves designing algorithms for extracting meaningful information from massive amounts of data and quantifying when and how these algorithms work.

"Whether or not we realize it, algorithms for machine learning are increasingly impacting our everyday lives. Machine learning systems already control how we receive our information and how we buy stocks," Hegde said. "In the very near future, machines will automatically drive our cars and trucks, control our power grid and determine what doses of medicine to give to a patient."

The research Hegde and his peers have been working on helps ensure that machine learning algorithms are built upon solid foundations. The team also works to keep the algorithms safe to use, behaving in a predictable and robust manner and scalable to the "big data" regime where there is a massive amount of raw data.

"The Black & Veatch Foundation provides support to young engineering faculty at Iowa State, across departments, to advance their careers. I am excited to collaborate with them in the near future," Hegde said.

"I have been at Iowa State for two years, and it has been a whirlwind," Hegde said. "Easily the best part of my job is the chance to interact with so many brilliant researchers and students on a daily basis. I am also involved in several very exciting collaborative projects at Iowa State University, like the ISU self-driving car project. Our aim is to build a smart fleet of autonomous vehicles. Stay tuned in the coming months."

CONGRATULA

ECpE alumni were honored at the Iowa State University Alumni Association 2017 Honors and Awards Ceremony during Homecoming.

Anson Marston Medal by the College of Engineering

James L. Melsa, Electrical Engineering '60; Naperville, Illinois

James L. Melsa, dean emeritus of the ISU College of Engineering, is a distinguished scholar, an award-winning educator and a visionary corporate leader. During Melsa's time as dean from 1995-2004, the College of Engineering reached new record enrollments and increases in research expenditures and endowed professorships. Melsa also oversaw significant growth in research and teaching infrastructure, including Hoover and Howe Halls and the CAVE virtual reality lab. Before joining Iowa State, Melsa held three vice-president roles for 11 years at Tellabs Inc., a global supplier to the telecommunications industry.

Melsa is a fellow of the Institute of Electrical and Electronic Engineers (IEEE) and the American Society for Engineering Education (ASEE). He also has an extensive record of leadership in national and international engineering groups, serving as president of ASEE, the IEEE Control Systems Society; Eta Kappa Nu, the national electrical and computer engineering honorary, and the American Association of Engineering Societies.

Outstanding Young Alumni Award by the College of Engineering

Michael Beckman, Electrical Engineering '07, MS '08; Allen, Texas

Since beginning his career at Texas Instruments in 2008, Mike Beckman has led and contributed to numerous company strategic initiatives, which have helped improve the quality, innovation and value of the semiconductor products that TI releases companywide. He leads many worldwide cross-functional R&D teams that develop, support and market analog semiconductors used in thousands of customers and products within personal electronics, automotive, industrial and communications markets.

Beckman was named vice president and general manager of Linear Power at TI in 2017 and has been general manager of the division since 2014. Prior to that he held various other roles at TI, including produce line manager and systems engineer. Along the way, he has served as a mentor for many new-to-the field engineers at TI.

John V. Atanasoff Discovery Award by the College of Liberal Arts and Sciences

Srinivas Aluru, MS Computer Science '91, Ph.D. '94; Atlanta, Georgia

Srinivas Aluru is a professor in the College of Computing and co-executive director of the Institute for Data Engineering and Science at Georgia Institute of Technology. He co-leads the NSF South Big Data Regional Innovation Hub, which serves 16 southern states and Washington D.C. He conducts research in high performance computing, large-scale data analysis, bioinformatics and systems biology, combinatorial scientific computing and applied algorithms.

Previously, Aluru served Iowa State University for 14 years as a faculty member in the ECpE department. He held the Mehl Endowed Professorship, the Richard Stanley Chair in Interdisciplinary Engineering and chaired the interdepartmental graduate program in bioinformatics and computational biology. Aluru was a recipient of Iowa State's awards for Outstanding Achievement in Research, Mid-Career Achievement in Research, the Young Engineering Faculty Research Award, and the Warren B. Boast Undergraduate Teaching Award.

TIONS

DEPARTMENT HIRES

Outstanding Young Alumni Award by the ISU Alumni Association

Hanjun Jiang, Ph.D. Electrical Engineering '05; Beijing, China

For the past 10 years, Hanjun Jiang has been a leading researcher and innovator in the area of integrated circuits and systems. He has published more than 60 peer-reviewed journal and conference papers, as well as over 20 issued patents. Jiang currently conducts his research as an associate professor at his undergraduate alma mater – Tsinghua University in Beijing, China – the nation's top engineering university.

Jiang's leadership of a key project in the China "863" program from 2008-2011 resulted in the development of the first single-chip wireless capsule endoscope for painless gastrointestinal examination. Today the technology, which is engineered to function continuously for an unprecedented 23 hours, is used by more than 100 hospitals in China. Jiang is active in many international capacities with the Institute of Electrical and Electronics Engineers (IEEE), and has chaired the IEEE Solid States Circuits Society Beijing Chapter since 2015.

Congratulations to these upcoming award winners

Order of the Knoll Campanile Award by the ISU Foundation

Ed McCracken, '66 Electrical Engineering; Ames, Iowa, and Angel Fire, New Mexico

Order of the Knoll Faculty and Staff Award by the ISU Foundation

Dick Horton, '62 Electrical Engineering, MS '63, Ph.D. '67; Ames, Iowa

Henry Duwe, Tenure-Track Assistant Professor, Computer and Software Engineering

Hongwei Zhang, Associate Professor with Tenure, Computer Network Systems and Software Engineering
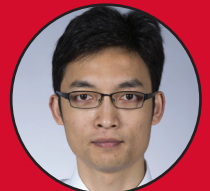
Yongxin Chen, Tenure-Track Assistant Professor, Controls

Goce Trajcevski, Tenure-Track Associate Professor, Software Engineering

Cheng Huang, Tenure-Track Assistant Professor, Microelectronics and VLSI

Andrew Bolstad, Adjunct Assistant Professor, Signal Processing and Computer Engineering

INCLUSION IN ENGINEERING

African-American students and faculty reflect on their experiences as minorities in STEM.

BY MEGAN SAGER, KRISTIN CLAGUE AND EMILY BENDA

Since Iowa State University was founded as a land-grant university in 1869, the school has strived to enable the ideals of practical education, shared knowledge and accessible higher education to all. This meant women and African-American students could attend from the when the first class began in 1869. However, African-Americans were not permitted to live in campus housing.

Students of color found off-campus living arrangements and attended classes with everyone else. Amidst all the obstacles, Claron "Hutch" Hutchison was able to attend Iowa State College (the university's name back then) and graduate with an electrical engineering degree in 1913 as the first African-American from today's Department of Electrical and Computer Engineering (ECpE). While at Iowa State, Hutch participated in class football and track and was described as "a fine fellow whose personality is liked and whose ambition is admired by all," in the 1912 edition of The Bomb, Iowa State's yearbook. In the electrical engineering department, Hutch worked on his thesis listed in the commencement program as "Design of a Hydroelectric Plant for Preston, Minnesota."

100 years after Hutch's graduation, Iowa State University has come a long way in offering access to education for all. After World War II, African-American students were able to live on campus at Iowa State. In 1997, Iowa State honored its first African-American athlete Jack Trice by officially dedicating the football stadium to him. Carver Hall was built and named for George Washington Carver in 1966, one of the most famous Iowa State graduates.

Yet Iowa State is always striving to grow in honoring the land-grant principles. ECpE's Associate Professor Phillip Jones recalls when he arrived at Iowa State in 2008 how few African-American faculty members were in the College of Engineering.

Claron "Hutch" Hutchinson graduated from Iowa State College in 1913 as the first graduate of ECpE.

ECpE's Associate Professor Phillip Jones

"The first week I was here, I got a phone call from Dr. Derrick Rollins from Chemical Engineering," Jones said. "We had a little bit of a chat, and he told me that I was the second person with an African-American background to be hired as a faculty member in the Engineering College. He said he was the first back in 1985. I knew there was not a very good representation of African-American people in academia, especially in engineering, but I didn't realize it was that skewed where I was number two in 2008."

Jones attended the University of Illinois Urbana-Champaign and Washington University. He received the Intel Minority Scholarship and the Graduate Engineering Minority Fellowship, opportunities he believes are important for today's students. While overwhelmed at first as the first person in his family to go to college, he took on the challenge and was able to focus more on his studies, thanks in part to the scholarship assistance.

Because of his experiences in his undergraduate and graduate years, as a professor today, Jones gives back to student groups at Iowa State.

"I feel that I need to reach out a bit more to the community of students around me as much as I can," Jones said. "Even if I haven't had really bad things happen to me coming through, I want to just give [minority students] a sense that there are people that look like you that can do this, and that there's nothing inherently that makes it that you can't do that."

Jones cares deeply about modeling inclusion in his classroom and making his students feel welcome, an approach many students, including ECpE graduate student Nichelle'Le

ECpE graduate students
Cimone Wright-Hamor (L) and
Nichelle'Le Carrington (R)

Carrington, appreciate when creating a home on campus.

Carrington grew up in Macon, Georgia, almost 16 hours away from Ames. She chose to come to Iowa State because of ECpE's prestigious energy infrastructure strategic research program. However, her first months in Iowa did not start as smoothly as she had hoped.

"The first semester was tough," Carrington said. "I had to start from scratch in my studies, environment and research. A big thing in southern culture is community, and it took me a while to find that."

In building her community, Carrington helped create the Graduate Organization of Electrical and Computer Engineering (GO-ECpE) and currently serves as president. She also researches transmission and distribution of power systems under the advisory of ECpE Assistant Professor Zhaoyu Wang.

"I've surprised myself with how much I've grown with interacting with diverse groups of people and learning my field," Carrington said. "I think everyone should take the time to understand one another, especially since we have a very diverse [ECpE] department with representation from various countries."

From a professor's perspective, Jones agrees that inclusion and diversity is vital, especially in the engineering field. He once attended a conference in Washington D.C. and heard a talk from a computer scientist who shared some statistics on African-American students who graduated with a Ph.D. in computer science. The speaker referenced a number from the year 2008, the year Jones received his Ph.D., when fewer than 13 African-American students received a doctorate degree in computer science.

"After around 15 minutes," Jones said, "I started realizing that he wasn't talking about Ph.D.s from his college, or from his state. He meant from the United States of America. It took me off guard. I think most of the audience had a delayed reaction until they really realized what that number really meant."

That number meant that the year Jones graduated, he was one of just a small number of computer science doctoral students of African-American background in the entire nation.

Cimone Wright-Hamor, another ECpE graduate student, knows of this reality from her own experience. She commented on the shortage of African-Americans, both in engineering and on Iowa State's campus. As a consequence, she said, Black culture is often misunderstood and misrepresented. She said Black students can often feel a burden to represent the entire ethnicity if they are the only Black student in class.

Jones is aware of these lower numbers of African-Americans in engineering and how critical it is to welcome diversity into schools.

"It's good to have a focused effort to try to make the student and faculty body aware of the diversity we currently have and what good things have come from it, and try to promote increasing the diversity," Jones said. "It's good when they put the facts out there — what are the current stats — as where we are and where we want to go."

Iowa State has always strived to uphold the values of a land-grant university, that everyone, regardless of the color of their skin, has the opportunity for an equal education.

Wright-Hamor said recognizing and understanding diverse people is important to for this mantra to ring true. "I think we all should make an effort to step outside our own cultures and learn someone else's." c

OUTSTANDING STUDENTS

SENIOR RECREATES NINTENDO'S SWITCH

BY EMILY BENDA

Nintendo's latest device, Switch, has excited gaming fanatics all over the world. Yet what most people don't realize is the Switch can be replicated in their own homes.

Tim Lindquist, a senior in electrical engineering at Iowa State University, has a long history of creating hardware and software projects in his spare time. Last spring, he decided to pursue creating a retro game console as his next undertaking.

"I needed a project to do, and I thought this would be pretty fun," Tim said. "A lot of people make these game devices, but one thing I noticed with them is they aren't physically appealing. I wanted to make something that was functional, looked good and also made up for the Switch's lack of virtual console."

Tim said he began 3-D printing the parts in the 2017 spring semester and titled the project, "Nintimdo," as a play on his name. Because the device was longer than the printer's capacity, parts needed to be printed in four pieces and assembled together. He designed it to easily access device internals by unscrewing the front and back plates to open into two halves.

The Nintimdo has a 7-inch touch screen with buttons on either side of the screen to control the device. It features a 5 LED indicator to display battery power, backlight and volume levels. The entire show is run on a 10000mAh battery, making the battery life of the Nintimdo double that of the Switch. There is even a home button to bring the user back to the main screen and an HDMI out port for TV screening.

Tim spent the majority of the summer working on the interface buttons and peripheral circuitry of the device. This includes the LED status bar, battery circuitry and code to register button presses. Inside the Nintimdo is a Raspberry Pi 3, a small computer, installed with Retropie and EmulationStation software to run the majority of video games. However, the device is unable to play Switch games because of lack of processing power and emulation capability. With a simple hotkey press, the user can swap over to a familiar desktop environment, and by using the two USB ports on top for mouse and keyboard, the device can transform into a laptop.

Tim said he spent about $350 creating the Nintimdo, not including the multiple hardware options he explored and the Raspberry Pi he broke trying to shave down size.

Tim has since posted his code, parts list and 3D models online for anyone to build and said, "It is a great project for people looking to learn about hardware and software integration."

Before he worked on the Nintimdo, Tim pioneered projects with his roommate, Jakub Hladik, a senior in computer engineering. They have turned their apartment into a workshop for creating new gadgets in their free time. Their projects include a layout implementation of "SUBLEQ" processor and reinventing the RC controller with hand-tilt controls, which won them "Best Hardware Hack" at the HackISU competition and "Best Innovative Idea" at the ISU Entrepreneur Pitch Competition. ▪

HACKING AN EASIER WAY TO UNDERSTAND QUANTUM THEORY

BY MEGAN SAGER

Brendon Geils and Victory Omole, seniors with the Department of Electrical and Computer Engineering at Iowa State University, make up two of the four-person team awarded the Hacker Prize at HackHarvard, at Harvard University, on Oct. 20-22, 2017.

"I participated in my first hackathon (HackISU) in the fall of 2014, and I've been in love with them ever since," Omole said. "I like hackathons because you can start and work on any project you want, and you don't have to worry about whether or not that project is sustainable."

Iowa State is one of over 130 universities to host hacking events. HackISU is holding its eighth 36-hour programming marathon this spring, hosting over 300 students from across the U.S. The event is one of the many events sponsored by Major League Hacking.

During the hackathons, students break up into teams of up to four and spend 36 hours developing and creating devices and software or inventing new applications for electronics.

After that long stretch, teams will perform demonstrations of their finished products for a panel of judges, who deliberate on their favorite creations to choose the winners.

Geils and Omole traveled to Cambridge, Massachusetts, to compete in HackHarvard 2017 and represent half of the four-person Quantum Computer Virtualization team.

"We [Geils and Omole] started qchackers, a group for studying and programming quantum computers, in September 2017," Omole said. "Going to hackathons and creating quantum computing-related programs is part of what makes qchackers qchackers."

The team wanted to create something that would make it easier for beginners to start learning about quantum computing, as it is an entirely new and radical approach to computation.

Quantum Computing Quantum computers are powerful machines that take a new approach to processing information using quantum mechanics, which explores how the physical world works at the most fundamental levels. Quantum computing can run new types of algorithms to process information and could lead to breakthroughs in materials and drug discovery.

"For the short duration [36 hours] available to hack, we wanted to build something that people could use, but it was near impossible with the time constraint," Geils said. "The next best option was to help others understand what took us a few months using a visualization tool."

Their team was awarded the Hacker Prize, which goes to the team who uses something in a way it was not intended. Quantum computing is new, relative to other types of technology, which automatically made the group's project innovative.

"Quantum computing is such a new frontier with an unprecedented upside," Geils said.

"I believe we were awarded the prize because we worked on a real problem and laid another block for the next team to build on top of." c

Far right: Victory Omole (center-right) and Brendon Geils (R)

MAKING AN EARLY MARK ON HEALTHCARE

BY MEGAN SAGER

Few college freshmen have the opportunity to impact the world's healthcare needs, but one Iowa State University student was given that chance.

Shawn Flanigan became a joint first author on an innovative research paper as an undergraduate student at Iowa State. Beginning the research during his freshman year, the now junior studying mechanical engineering joined Santosh Pandey, associate professor with the Department of Electrical and Computer Engineering (ECpE), in researching paper devices that could potentially benefit healthcare in third-world countries.

The goal was to make these devices on paper to be more accessible to people. The paper strips could eventually be used as an at-home device that would test the quality of food and water or for healthcare, like blood and urine analysis.

"Devices and chips have been made on glass slides, which are good, but you still would need access to fabrication lab facilities," Pandey said. "These are okay, but if you're trying to do experiments where you need a lot of chips, or are in a remote area where there is no access to electricity, there is a need for an alternative."

Flanigan played a big role in the creation of these simple devices. The tests were conducted on paper strips, something that would be easily accessible to people in third-world countries.

"I was the one making all of the systems [paper strips] and doing all the tests on the systems," Shawn Flanigan said. "I would pipette onto the paper, cut the paper and would monitor the progress of the tests."

Flanigan started his paid research position during his first semester at Iowa State. Beginning his lab work in November 2015, he started this project during his second semester of college.

"I talked with Dr. Pandey about being an SI [Supplemental Instruction] leader for Engineering 160, which is a class he teaches," Flanigan said. "Pandey had asked me if I've ever thought about doing research."

It is not very common to find undergraduate students taking part in a professor's research. Graduate students typically conduct research under a professor; however, Flanigan was given the rare opportunity as an undergraduate to work with Pandey on his research.

Flanigan was first given small tasks and things to do in the lab. Pandey, like most researchers, always has potential research plans on the back burners. One of those plans was this project.

"It started with small things here and there and grew into this big project," Flanigan said.

Being a part of such a large project early in his college career has taught Flanigan a lot about collaborating with others and undertaking challenging tasks. An ECpE graduate student of Pandey, Taejoon (TJ) Kong, was listed as the other co-first author of the publication.

"TJ was a big help to me and gave me a lot of advice when we were first starting everything," Flanigan said.

Flanigan cited communication and problem solving as the two biggest takeaways from this experience. Being mindful of colleagues' opinions and keeping everyone on the same page required a lot of open and constant communication between Kong, Pandey and Flanigan. Additionally, the group always had to be prepared to overcome any obstacles.

"There were a lot of times that things we had talked about on the whiteboard weren't going to work, and we weren't going to meet for another week," Flanigan said. "I had to figure out something; I wasn't going to just twiddle my thumbs for a week."

Being a part of a potentially impactful paper early in his college career has opened many doors for Flanigan. As far as what is next for Flanigan, he is keeping his options open and looking forward to completing another internship this summer.
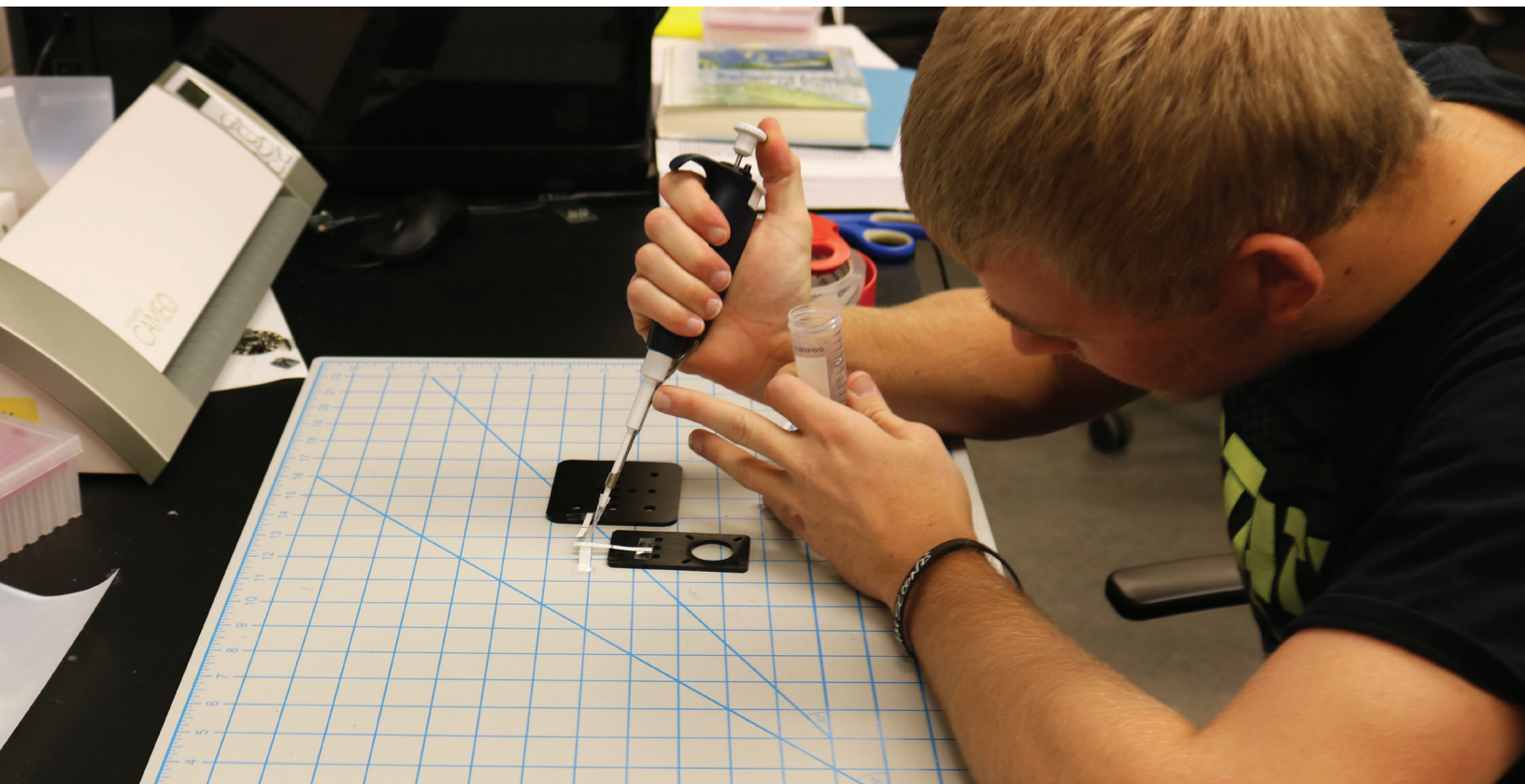
AN ADVENTURE ENGINEERED FOR TWO

BY MEGAN SAGER

It is not uncommon for children to go to the same university as their parents, but not many students can say they go to school with their parent.

Bill Kincaid, while living in the town of Monument, Colorado, is currently getting a master's degree from the Iowa State University Department of Electrical and Computer Engineering (ECpE), focused on information assurance. At the same time, his daughter Jennifer Kincaid is living in Ames, also studying engineering at Iowa State.

"Studying engineering with Jenn has been really fun. I came with her the first time she registered for classes and went through orientation," Bill said.

After receiving a bachelor's degree in finance from Kean University in New Jersey, Bill went on to work as a systems engineer at Electronic Data Systems (EDS), in Plano, Texas. He then went on to create Kincaid Technologies, Inc., which provides enterprise switching solutions and point-of-sale systems integration services for the electronic payment industry.

After selling his company, Bill felt he did not have credentials like his peers and decided to go back to school for his master's degree.

"Three major factors contributed to me studying engineering at Iowa State. First, my best friend was a graduate of Iowa State and has always spoken highly of his experience," Bill said.

"Second, I was looking for the best online school in engineering but one focused on providing students 'hands-on' practical experience. Third, I needed a school to work with me around my schedule. DSU and my professors Dr. [Doug] Jacobson, Dr. [Tom] Daniels and others have been very good to me."

Having a program that could accommodate Bill's busy work and travel schedule was an important factor for him when he was looking for a distance program.

Because of the classes Bill has taken at Iowa State, he was able to get his Certified Information Systems Security Professional (CISSP) accreditation. Bill is also accredited in Payment Card Industry (PCI), Point-to-Point Encryption Qualified Security Assessor (P2PE QSA) and Payment Card Industry Professional (PCIP), thanks to his classes at ISU.

On any given Sunday, you can find Bill and his daughter spending their days together. With Jennifer in Ames, their tradition continues with the help of technology. The pair always "Skype" on Sundays to watch a Broncos game together.

Jennifer is a junior studying materials engineering, and was drawn to ISU's engineering program because of her father.

"My dad was actually already a student here, and he mentioned it to me when I was applying for college," Jennifer said.

"I saw the numbers for the program—job placement rate after graduation above 95 percent and 70 percent have a job lined up before they graduate—and thought it was astonishing," Jennifer said. "I remember thinking, 'They must have a well-respected program to have so many students and have those numbers.'"

Jennifer works as an undergraduate researcher with five others to assist graduate students of Adjunct Professor of Materials Science and Engineering, Iver Anderson.

Jennifer has a particular interest in the biomedical field and finding materials to work in human bodies, like creating new organs or prosthetic.

"I want to make a difference in the world someday, and I believe I can accomplish that with a degree in materials science engineering," Jennifer said.

"I don't think Jenn could be any happier with her choice of Iowa State University, both scholastic and community experience in Ames," Bill said. "I am so very pleased, as her father, to see her both happy and successful in the present, while she studies and gains valuable work experience to prepare for her future."

ALUMNI SPOTLIGHT: ANITA WOODROFFE

Anita Woodroffe (EE '90) shares her story of her ECpE education and career journey.

BY EMILY BENDA

Anita Woodroffe grew up near Denmark, Iowa, where her parents had a sawmill business for over 50 years and lived next to her grandfather's legacy farm, "The Elms." She was the youngest of five children, all of whom attended Iowa State University in the engineering and agricultural colleges, following in the footsteps of their older relatives. Coming from a long line of Cyclones, Anita made the decision to also follow her family's legacy.

She attended Iowa State and graduated with a degree in industrial administration (emphasis in marketing and management) and a minor in economics in 1980. She went on to work in Fort Madison and Iowa City as a department manager of ladies' and children's clothing in a family-owned Midwest discount chain store, assisting the buyers in New York's garment district. But after a while, Anita felt she needed a change.

"While working in Iowa City with college students, I felt I was being left behind in the high-tech world," Anita said. "It was a time when computers were becoming a household name." She decided to go back to her alma mater to pursue what she thought would be the most interesting and challenging field: Electrical engineering, concentrating in electromagnetics. Thus, Anita enrolled in Iowa State's Electrical and Computer Engineering department (ECpE).

While she was studying at ECpE, Anita remembers walking to the Memorial Union on hot summer days. She loved the solid wood furniture and marble floors that made it an inviting spot to study. She was also inspired by the international graduate students who were studying and conversing about events from their homeland.

Today, Anita's name and several other Woodroffe names can be found on the Memorial Union wall.

During the 1980s, Anita was one of few women studying electrical engineering, breaking the barriers many women experienced in the technical fields. As an older student, she was driven to do her best and often could be found in the lab on spring days or asking professors for help during their office hours. She fondly remembers her professor David T. Stephenson, who later worked with Anita as her master's thesis adviser.

"I never would have thought he would remember me, but turns out, he had a picture of me on his bulletin board in his office. I was working on a circuit project with other students in my class," Anita said. "He made the class fun."

After graduating in 1990 with her bachelor's in electrical engineering, Anita became an instrumentation and controls engineer and later a quality assurance engineer at Iowa's only nuclear plant, Duane Arnold Energy Center. She achieved a master's of business administration and later her master's in system engineering from Iowa State while working and raising her two sons, Alexander and Gunnar.

Anita's adviser, Stephenson, said it was a pleasure working with Anita while she completed her master's in systems engineering.

"I was impressed with Anita's dedication and initiative as she pursued her master's work," Stephenson said. "Her 'creative component' dealt with an electromagnetic interference issue in the electrical power industry, and her report was impressively detailed and broad in scope, including economic factors. Her motivation showed in her attention to

Anita Woodroffe currently works as a SCADA Engineering III at Alliant Energy.

details, including making timely on-campus visits to discuss her work and present the final report."

Anita went on to become a senior project engineer at Corn Belt Power Cooperative, performing roles in transmission planning, interconnection studies and North American Electric Reliability Corporation (NERC) reliability standards. With a love of working in the nuclear industry, she found her way back to Duane Arnold Energy Center as a Work Week Manager. She returned to Alliant Energy as a Supervisory Control and Data Acquisition (SCADA) Engineer III to develop the corporate strategy for monitoring and controlling of the electrical distribution system and has settled in the NERC compliance area.

Today, Anita is proud that her oldest son, Alexander, is attending Iowa State, studying engineering before settling in the business college. Knowing college is not for everyone, Anita is thrilled her youngest son, Gunnar, joined the United States Air Force, currently in the Precision Measurement Equipment Lab (PMEL) tech school. Both sons were Eagle Scouts and attended community college.

She encourages young women to pursue careers in technical fields and to work hard, because "nothing is worth it unless you have to work for it." She also has advice for everyone pursuing certifications.

"Earn your EIT (engineer-in-training certification) and your PE (professional engineer certification) as soon as you can," Anita said. "It will be easier as you are fresh out of school, your body is conditioned in studying and taking long exams and you don't have family obligations to distract you from your professional goals. Always keep learning." C

FATHER-SON ISU ALUMNI SPEND CAREERS PIONEERING TECHNOLOGY

BY KRISTIN CLAGUE

Brian Sander (L) and his father Wendell Sander (R) sit in Brian's office at Apple Inc.

Whenever you click the volume up and down on your earbuds, you can thank two Iowa State University Electrical and Computer Engineering (ECpE) father-son alumni for creating that technology. Wendell Sander and son Brian Sander worked together at Apple Inc. on this earbuds project when Brian was vice president and Wendell, his father, worked for him. But long before that, in the 1970s, Wendell was only the 16th employee at Apple, and he became the "Father of the Apple III" computer, released in 1980.

Born and raised on an Iowa farm, Wendell came to Iowa State in the 1950s and earned his bachelor's degree in electrical engineering (EE) in 1956. He went on to receive his master's degree and Ph.D. in EE in 1962 and 1963, respectively.

"We got taught the fundamentals. In other words, how to solve problems," Wendell said, about his time with the ECpE department. "But to solve problems, I needed tools, and they were really good at getting me the tools I needed."

Those fundamentals provided Wendell the expertise and motivation to join Apple's team. Back in the 1970s, Wendell approached Steve Jobs, co-founder of Apple. Wendell demonstrated a Star Trek game on an Apple I computer to Steve.

"Wendell Sander…had become intrigued by Apple after adding some memory chips of his own design to the Apple I," wrote Michael Moritz in the book "Return to the Little Kingdom: Steve Jobs, the Creation of Apple, and How it Changed the World." "He wrote a Star Trek program to amuse his children, demonstrated it to Jobs while Apple was still in the garage, and eventually, after thirteen years with Fairchild [semiconductor company], decided to let his passion guide his star."

At that point, Wendell knew he wanted to work with Apple, and he joined the company in 1977; he was hired to work on the Apple II, but he went on to design the Apple III.

"A brilliant hardware engineer by the name of Wendell Sander…won his way into Apple after impressing Steve Jobs

Wendell Sander poses with his baby son Brian at his own Ph.D. graduation in 1963.

with a souped-up version of the Apple I," wrote Luke Dormehl in the book "The Apple Revolution: Steve Jobs, The Counter Culture and How the Crazy Ones Took Over the World." "When he [Wendell] was asked to come up with a codename for the project…he decided to call it Sara, after his daughter."

Back to Wendell's other child, Brian, and his graduation from Iowa State in 1985, when he received his bachelor's degree in EE from ECpE. Brian went on to work for The Engineering Department, a Silicon Valley startup. There, he worked on a handheld computer project, which eventually led him to work on iPods at Apple, following in his father's footsteps. Brian oversaw all systems engineering for iPods and met with Steve Jobs every two weeks. Brian was then promoted to Vice President at Apple, and Wendell came back to Apple, where he worked for his son on the earbuds volume control project. To this day, these same earbuds ship with all Apple computers, iPods and iPhones worldwide that use headphones. Wendell now has approximately 100 patents to his name

"Looking back in retrospect, it's an interesting experience of time to have gone through, and an interesting place to be in the middle of everything when it's happening," Wendell said.

Brian, like his father, credits his education at Iowa State for helping him reach success.

"It was really the theoretical foundation I got from the school that really became the foundation that helped guide me through the career," Brian said. C

Watch Brian and Wendell tell the story online by scanning this QR code!

REMEMBERING AZIZ FOUAD

BY EMILY BENDA

Abdel-Aziz A. Fouad, distinguished professor emeritus of the Department of Electrical and Computer Engineering (ECpE) at Iowa State University, passed away at the age of 89 on Oct. 21, 2017.

Aziz was a pioneer in the electrical engineering field of power systems dynamics and stability, most notably in his visionary contributions to academic research, teaching and publication, collaboration between academia, the power industry and early explorations of technology and social change. Aziz was elected to the U.S. National Academy of Engineering (1996), was named an Anson Marston Distinguished Professor (1990), received the Anson Marston Medal from the ISU Alumni Foundation and is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE).

Aziz was co-author of two widely-read books, "Power System Control and Stability" and "Power System Transient Stability Analysis Using the Transient Energy Function Method." Throughout his 35 years teaching at Iowa State he taught multiple classes, including creation of several early computer-based educational courses, and he authored over 100 publications in his field. Aziz also served as a visiting professor at the University of the Philippines, the Federal University of Rio de Janeiro, Brazil, and the Electric Power Research Institute of Palo Alto, California.

One of his most significant contributions to the industry and academia was the co-founding of Iowa State's Power Affiliate Research Program in 1963, now known as the Electric Power Research Center.

ECpE Professor Jim McCalley said Aziz's legacy will continue to be remembered at Iowa State for years to come.

"Aziz was an excellent educator and researcher," McCalley said. "His vision provided the basis for rigor, innovation and industry interaction that is still very much alive today among the ISU Electric Power and Energy Systems faculty and students. Perhaps his most enduring influence was his willingness to spend a great deal of time and effort on mentoring students and younger faculty colleagues."

Aziz was born in Cairo, Egypt, in 1928, received a bachelor's degree in engineering from the University of Cairo (1950), immigrated to the USA in 1952 and received a master's degree from the University of Iowa (1953) and a Ph.D. from Iowa State (1956). While at the University of Iowa, Aziz met his wife of 56 years, Maria Elisabeth (Leal) Fouad, who passed away in 2009. Aziz and Elisabeth are survived by their two children, Nadya Fouad and Sam H. Fouad, five grandchildren and two great-grandchildren.

Aziz's daughter Nadya said her father was deeply committed to Iowa State and established a family connection to the university.

"He felt a strong connection to the [ECpE] department," Nadya said. "But he also had a strong camaraderie with faculty from all over the campus." **C**

Learn about ECpE's honorary symposium for Aziz Fouad in 2014 by scanning this QR code!

ECpE Harpole Professor Jim McCalley sits with Fouad at Fouad's honorary symposium in 2014.

STANLEY CHAIR NAMESAKE PASSES

BY EMILY BENDA

Richard H. Stanley died Nov. 17, 2017, at University Hospitals in Iowa City, Iowa. He was an alum of the Iowa State University Electrical and Computer Engineering Department and recipient of the Iowa State College of Engineering Anson Marston medal and namesake of the Stanley Chair in Interdisciplinary Engineering. The Stanley Chair was established to encourage the commitment to the concepts and practice of interactive interdisciplinary work in the College of Engineering.

Stanley was born on Oct. 20, 1932, in Muscatine, Iowa, to Maxwell and Betty Stanley. He married Mary Jo Kennedy on Dec. 20, 1953, at the First Presbyterian Church in Muscatine.

Stanley earned mechanical and electrical engineering undergraduate degrees at Iowa State University and a graduate degree from the University of Iowa. In 1956, he helped create the Stanley Foundation with his father, mother and siblings as an organization focused on fostering world peace with freedom and justice.

According to the Muscatine Journal, President and CEO of Stanley Foundation Keith Porter said Stanley worked to keep the foundation's original values alive as he took over as president and chairman of the board after his father's death.

"'The one constant has been this belief that global problems can't be solved by any one nation working by itself," Porter said. "Max and Dick really believed we had to find ways for countries to work together, trust each other and see there's really no other way to address those issues.'"

Stanley's commitment to helping others did not go unnoticed.

Stanley was chair of Stanley Consultants, which provides engineering, environmental and construction services worldwide. He also served as vice chair of the board of HON Industries, Inc., a Fortune 1000 manufacturer and marketer of office furniture and hearth products, and a Director of Dover Resources, Inc., a subsidiary of the Dover Corporation and a diversified manufacturer of industrial products.

While Stanley contributed a great deal on the global scale, he helped bring people together within his local community, Muscatine.

The Muscatine Journal reports, "Judi Holdorf, executive director of the Community Foundation of Greater Muscatine, said Stanley's work and the Stanley Foundation encouraged her to move to Muscatine.

'I was very impressed that Muscatine would have a foundation for international peace,' she said.

Stanley, she said, contributed his money, time and expertise to the Community Foundation. For example, he was an early contributor to the Cares and Shares Endowment, which was formed after the 2007 tornado and 2008 flood that hit the area, to help the community quickly respond to emergencies."

Stanley's commitment to helping others did not go unnoticed. He has been awarded the Hoover Medal by the Hoover Medal Board of Award; the Distinguished Award of Merit from the American Council of Engineering Companies; the Herbert Hoover Centennial Award from the Iowa Engineering Society; and has been inducted into the University of Iowa College of Engineering Distinguished Engineering Alumni Academy.

He served on a number of Iowa State University boards and committees, including the ISU Alumni Association Board of Directors and the College of Engineering Industrial Advisory Council, and has sponsored a number of ISU scholarship programs. Stanley is survived by his wife, sister, two children and eight grandchildren. **C**

Richard Stanley was highly regarded at Iowa State as the recipient of the Anson Marston medal and namesake of the Stanley Chair in Interdisciplinary Engineering.

@ISU_ECpE

Have a story to share? Connect with us on social media or contact our Communications Specialist, Kristin Clague, at kclague@iastate.edu.

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Pictured
Team PrISUm's solar car raced across the Australian Outback in the 2017 Bridgestone World Solar Challenge. Four ECpE students participated in the event.