

IOWA STATE
UNIVERSITY

Department of Electrical
and Computer Engineering

IMPACT REPORT

2018 - 2019

The Future Is What We Do





Greetings from Coover Hall in Ames, Iowa!

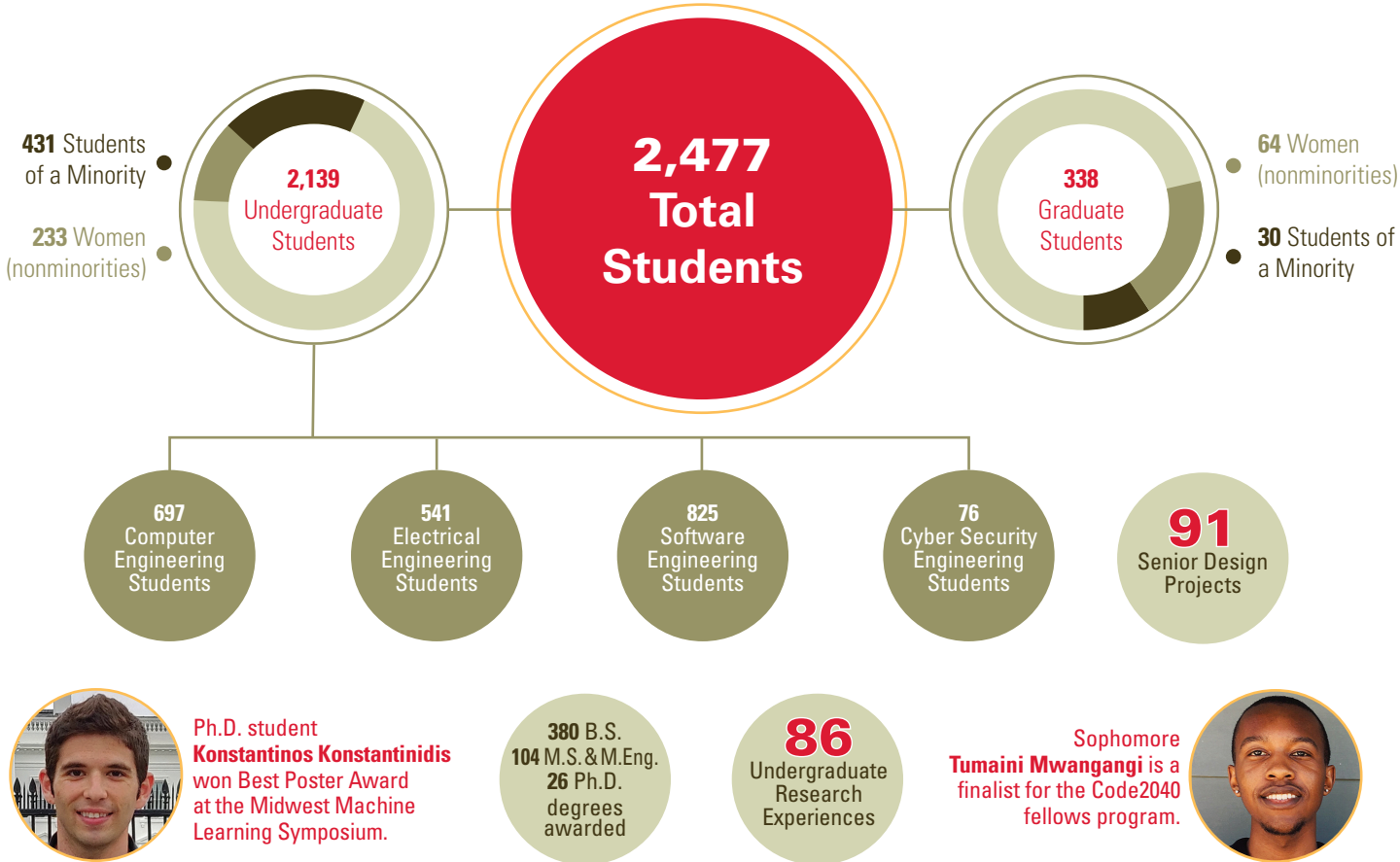
The Department of Electrical and Computer Engineering at Iowa State University witnessed a very busy 2019 with several new initiatives: The department completed its five-year strategic plan and began its implementation; established a one-of-its-kind ECE Hall of Fame to honor the achievements and contributions of its alumni, faculty and staff; increased the number of fellows of professional societies – now reaching to over 32 fellowships; hired five new faculty, including a chaired professorship; and launched the undergraduate degree program for a B.S. in Cyber Security Engineering.

Our faculty received several new large multimillion-dollar research awards in the last year, including over \$3.5 million of research funding in the power systems and grid security areas. Also, several students and faculty have received outstanding paper awards in peer-reviewed publication forums and have published in top-tiered journals, including the highly prestigious Nature and ACM/IEEE Transactions.

We are proud of our department's accomplishments, and we look forward to a productive 2020. Here in ECE at Iowa State, the future is what we do! Hoping you all have a happy and successful new year, wherever you are.

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

2018-19 BY THE NUMBERS: **STUDENTS**



HALL OF FAME INAUGURAL INDUCTION

On Oct. 10, 2019, Iowa State University's Department of Electrical and Computer Engineering established its Hall of Fame and hosted an inaugural induction ceremony to honor its alumni and faculty for their impactful contributions to the profession and society.

Since the department's conception in 1909, our faculty, staff, students and alumni have pioneered some of the most renowned modern-era technologies and made this world a better place through their leadership, service and innovation in research and education. Through this Hall of Fame, the Department of Electrical and Computer Engineering spotlights the impact of these inductees and preserves the history of their contributions, letting this stand to inspire future generations of engineering leaders.

For our inaugural class, we selected an outstanding group of 32 alumni and faculty, each with a unique career and a profound personal journey, all of whom have made transformational and pioneering contributions to our world. In this group we have our first female EE graduate from 1935, a Congressional Medal and Purple Heart recipient, members of the National Academy of Engineers and more. Several of our inductees had all the odds set against them, but they overcame many obstacles and prevailed, opening up opportunities for generations to come.

We are proud of our long list of accomplished alumni and faculty, and we look forward to nominating more Hall of Fame members in the future.

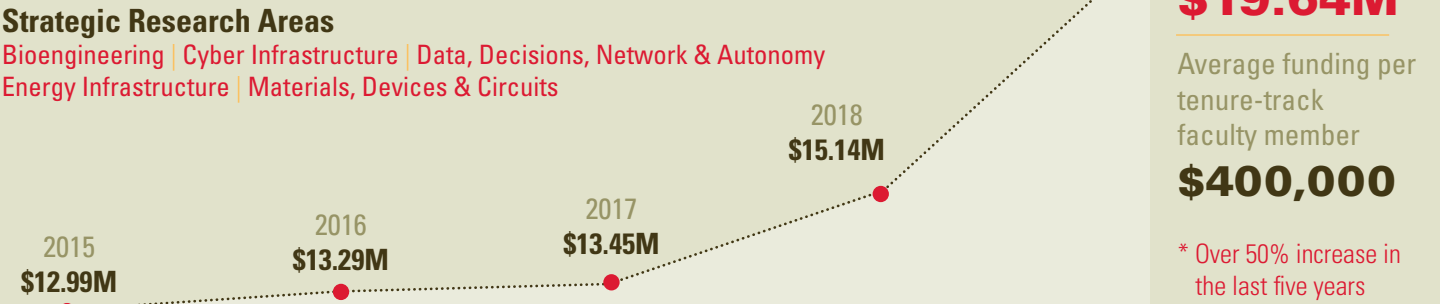
See the inductees: www.ece.iastate.edu/hof



2018-19 BY THE NUMBERS: **DEPARTMENT**



RESEARCH EXPENDITURES





ECE faculty lead the way toward building more stable resilient, efficient, safe power grids

Iowa State engineers contributed to a study of the economic value of significantly expanding the connections between the country’s eastern and western power grids. Expanding the connections could allow wind power from the Midwest and solar power from the Southwest to move back and forth across the country. The two-year, \$1.5 million study was part of a \$220 million Grid Modernization Initiative of the Department of Energy (DOE).

“We wanted to see the value of building high-capacity transmission across the grid seams for a high-renewable future of wind and solar energy,” ECE Distinguished Professor **James McCalley** said.

Meanwhile, ECE Professor **Manimaran Govindarasu**, along with ISU’s **Sourabh Bhattacharya**, are turning to game theory to help quantify threats of cyberattacks on the power grid. They’re also developing cyber security tools that could help protect the grid and could be adapted to other cyber-physical infrastructure, such as oil, natural gas and transportation systems. Their research is supported by a grant from the National Science Foundation (NSF).

Govindarasu is also on a team, along with ECE Professors **Venkatramana Ajjarapu** (PI) and **Umesh Vaidya**, that recently received \$1 million from NSF for research on predicting power grid behavior during potential disturbances and protecting the stability of power grid systems in the future

through mathematical algorithms for measuring, analyzing and mapping grid data. With high fidelity real-time measurements, researchers and scientists can more accurately predict the reasons behind faults in power grid systems.

“In the future, if there’s an outage, can we explain why? There are so many components — anything can go wrong,” Ajjarapu said. “This project will allow us to predict power system behavior during disturbances and take proactive control actions to avoid or mitigate undesirable behavior.”

Ajjarapu is also part of a group of ECE engineers who received \$1 million from the DOE for their proposal to improve the efficiency of power systems and power lines across America. Ajjarapu is working with Assistant Professor **Zhaoyu Wang** (PI), Assistant Professor **Chinmay Hegde** and Professor **Ian Dobson** to use machine learning to take preventative measures and potentially catch power system failures before they happen.

“Everyone needs electricity,” Wang said. “Right now electricity and the power systems work, but we still have outages. The outages are due to many reasons; for example, extreme weather or even human error. With machine learning, we can reduce the risk of outages and have more of a warning before something bad may happen, allowing people to take immediate action and prevent this from happening.”

Lighting the world: DOE awards \$1.43 million to MRC, ECE to reduce light electricity by half

A team from the ISU Microelectronics Research Center and ECE recently received a \$1.43 million grant from the DOE, focused on their work to reduce the amount of electricity used for lighting the world by almost half. Electricity and cost will be reduced with OLEDs — organic light emitting diodes. The team — Adjunct Professor and Senior Scientist **Ruth Shinar** (PI), Adjunct Professor and Senior Scientist **Rana Biswas** and Professor **Joe Shinar** — is specifically investigating fabrication methods for enhancing light extraction from OLEDs.



Electric Power Research Center receives multiple energy grants to support rural power systems, help residential housing, build mobile microgrids for disaster response

ECE’s Electric Power Research Center, directed by **Anne Kimber**, works to promote and expand electric power and energy-related research through broad collaboration with industry on research grants. Kimber, along with ECE Assistant Professor **Zhaoyu Wang** (PI) and Professor **Venkataramana Ajjarapu**, recently received \$1 million from the Department of Energy for research on distributed rural wind energy, supporting rural power systems through designing optimization models and control algorithms. These innovations will allow wind farms to power local areas closer to home.

Kimber also received another grant, this time from the Iowa Energy Center, to build a residential housing efficiency toolkit to identify least energy-efficient homes, determine the best improvements for this housing stock and understand homeowner motivations in order to design programs that could lead to greater implementation of improvements.

She received a third grant, this one from the Iowa Economic Development Authority, to build a mobile microgrid for disaster response, which will be given to the Iowa Army National Guard to present renewable power for critical energy delivery while reducing dependence on conventional fuels.

“Imagine a shipping crate that you can walk up to, push a button and get electricity to power something you desperately need, like after a tornado or flood,” Kimber said.

\$3.6 million from DOE will help ECE faculty increase operational renewable energy by using intrusion detection system for electric distribution grid

ISU received a portion of a \$3.6 million grant from the DOE’s Solar Energy Tech Office for a research project with Arizona State University. The work focuses on building enhanced grid models and technologies to increase the amount of operational renewable energy.

ECE Professor **Manimaran Govindarasu** is planning to develop a methodology and tool for attack surface analysis and an intrusion detection system for an electric distribution grid. This methodology will be able to detect malicious measurements and control commands. All of these tools will be prototyped, tested and validated within ISU’s PowerCyber testbed.



“Fitbit-like” plant sensor: NSF grant could result in economical farming methods, cheaper groceries

ECE Professor **Liang Dong** was awarded a \$300,000 grant from the NSF for his research on the development of a device that he calls “a Fitbit-like device, but for plants instead of humans,” with the potential to lower the amount of money farmers put toward water. Making this device affordable could result in economical farming methods and cheaper foods on grocery store shelves.

“Our device, if successful, will help obtain a high crop yield and sufficient foods for people at a low input cost,” Dong said.

NSF funding to help leverage coding-theoretic ideas to reduce communication overhead of distributed computing paradigms

The National Science Foundation awarded ECE Professor **Aditya Ramamoorthy** nearly \$500,000 for his work on coding theoretic ideas for distributed computation.

“Computing clusters that process huge amounts of data are ubiquitous in both industry and academia,” Ramamoorthy said. “The overarching goal of this project is to leverage coding-theoretic ideas to make distributed computation robust to stragglers (slow or failed worker nodes) and reduce the communication overhead of distributed computing paradigms,” states the project’s abstract.

ISU team develops materials, methods for scalable manufacturing of flexible resonant sensors, wireless readers

ECE Associate Professor **Nathan Neihart**, along with a team of ISU researchers from multiple disciplines, received a NSF grant to mature and translate a platform technology with DuPont. The ISU group launched a project to develop materials and methods for scalable manufacturing of flexible resonant sensors and their wireless readers. They are developing these sensors for detection of enzymes, proteins, biofilms, tissue types and ions. NSF states that the platform sensor technology has many potential applications in consumer, agriculture and health markets.

New Electrical and Computer Engineering Faculty



Reza Zoughi
Director of the Center for Nondestructive Evaluation and the Kirby Gray (Battelle) Chair in Engineering



Md Maruf Ahamed
assistant teaching professor



Mohammad Tayeb Al Qaseer
research associate professor



Hugo N. Villegas Pico
assistant professor



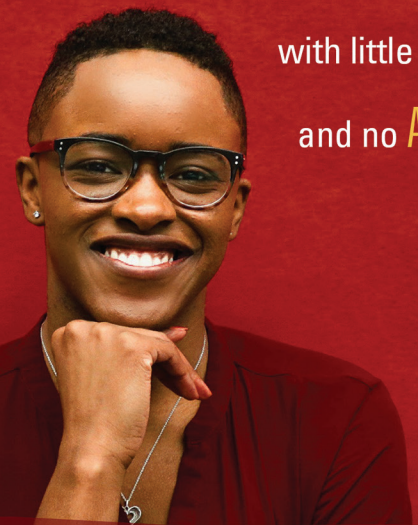
Mathew Wymore
assistant teaching professor

Womxn in ECE

inspiration from students in ECE

"**DREAM** big!

The **world** has enough people
with little dreams
and no **AMBITION**."



Simone Wright-Hamor
graduate student in computer engineering

"It's a club that allows **women**, a significant minority
in technical majors, to **COME TOGETHER**
and
be themselves."



Digital Women
student organization dedicated to encouraging,
supporting and retaining women in technical majors

"I want younger **girls** all over the world to
see people **just like them**
doing **amazing things**
in tech and
FEEL INSPIRED."



Samantha Williams
senior in software engineering

"I am a **CONNECTOR**. I'm here
to **blur lines** and
change
mindsets."



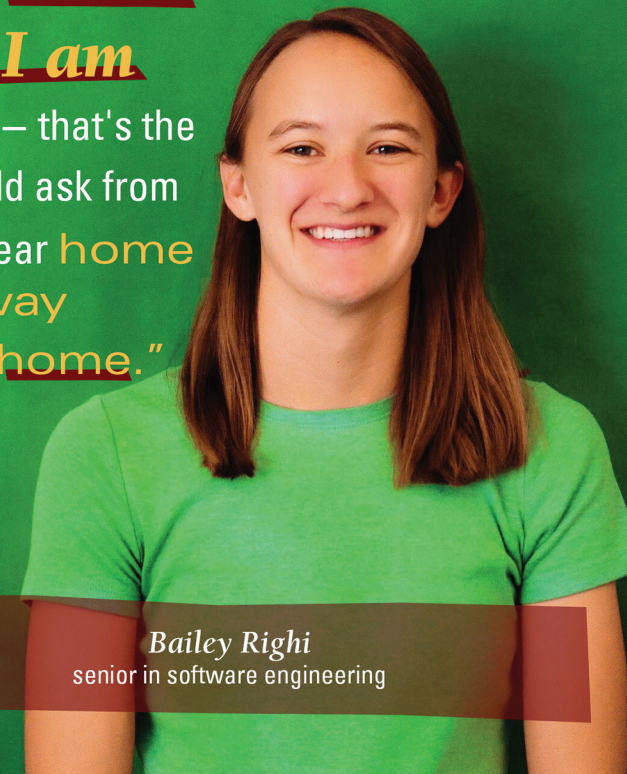
Rachel Shannon
graduate student in electrical engineering and industrial design

"We are a **diverse, unique** group of high-achieving
students, faculty and support staff who **CELEBRATE**
and provide
a **community** for underrepresented students."



ECSEL
electrical, computer and software engineers as leaders

"I feel **COMFORTABLE** with
who I am
here – that's the
best I could ask from
a 4-year **home**
away
from **home**."



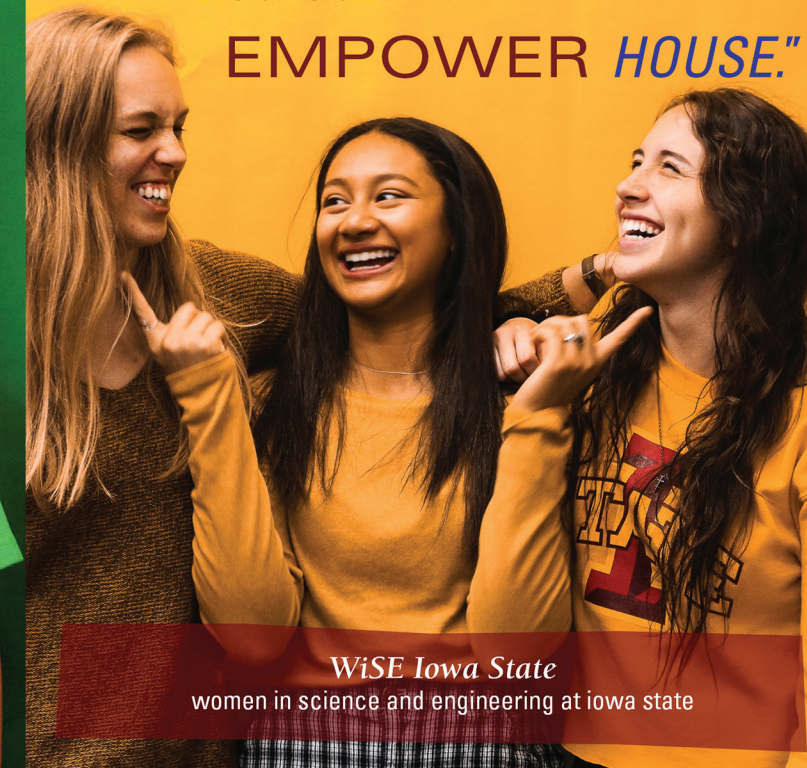
Bailey Righi
senior in software engineering

"I want to **break the stereotype** of
what an innovative
LEADER looks like and
show the world what
WOMEN ARE CAPABLE of."



Chinar Kaul
senior in computer engineering

"We are an
EMPOWER HOUSE."



WiSE Iowa State
women in science and engineering at iowa state

From **daring, driven** individuals to student-run
organizations dedicated to empowering **champions of possibility**,
womxn in ECE are designing the future, one
innovation, inspiration and dream
at a time.

IOWA STATE UNIVERSITY

Department of Electrical and Computer Engineering

2215 Coover Hall
2520 Osborn Drive
Ames, IA 50011-1046

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UNIVERSITY

Ashfaq Khokhar

Professor and Palmer Department Chair

Editor: **Kristin Clague**

Contributing Editor: **Sarah Hays**

Photography: **Sarah Hays** and **Dan McClanahan**

Graphic Design: **William Beach, Sarah Hays** and **Brittany Veto**

More Info: www.ece.iastate.edu

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NEW MAJOR CYBER SECURITY ENGINEERING

In fall 2019, our department launched a new bachelor's degree program in cyber security engineering, with a total of 76 students currently enrolled. When pursuing this new four-year degree, students will develop a solid infrastructure for computer engineering, while also applying the problem-solving mindset of an engineer, enabling them to solve the complex cyber security challenges of the future.

LEARN MORE:

ece.iastate.edu/cybersecurity

