IMPACT REPORT 2018

The University of Texas at Austin

Electrical and Computer Engineering

Cockrell School of Engineering

Dr. Ahmed Tewfik, Chair, Texas ECE

"We aim to endow our students with a deep technical foundation that allows them to succeed years after they graduate, provide them with the exposure to liberal arts that they will need to develop empathy and recognize opportunities ahead of the competition, hone their communications, presentations and interpersonal skills and develop their ability to take calculated risks."

We celebrated our first anniversary in the new Engineering Education and Research Center (EERC) at the beginning of this fall semester. One of my colleagues best captured the transformative effect of the building on all of us when he said, "the building has worked its magic on our students, staff and faculty." Indeed, our new facilities and our phenomenal human capital, students, staff, faculty, alumni and friends, are accelerating the execution of our vision to become a teaching, research and disruptive innovations department.

We aim to endow our students with a deep technical foundation that allows them to succeed years after they graduate, provide them with the exposure to liberal arts that they will need to develop empathy and recognize opportunities ahead of the competition, hone their communications, presentations and interpersonal skills and develop their ability to take calculated risks. Our new teleconferencing capabilities embedded in our classrooms have enabled us to expose our students to the technologists that are responsible for the introductions of several disruptive technologies that have truly changed the way we communicate, travel, and receive health services in the last decade. In the past year, we approved and rolled out a new honors track that challenges our students in the fields about which they feel most passionate. We anticipate that this honors track will lead to a formal honors degree over the next few years after we secure the approval of the Texas Higher Education Coordinating Board (THECB). The new courses help students connect topics they learn in different areas and break the traditional "stove piping" approach to engineering education. For example, we offered courses this past spring that tightly integrate embedded computing and software engineering with the faculty teaching the courses regularly attending lectures in the other course. Next year, we will begin to roll out a sequence of introductory courses that integrate circuits, software engineering, signals and systems, communications, physics, devices, electromagnetics, data sciences, and technical communications. These changes are a direct response to the rapid evolution of our disciplines and what we are hearing directly from the most innovative companies, venture capitalists, and entrepreneurs.

I am also happy to report again that our faculty continues to win prestigious awards and recognitions, and maintain a very high visibility in professional venues and the national and international media. The quality of our facilities and our current faculty, the close collaborations we maintain with several other departments on campus, including computer science, mathematics, physics, neuroscience, and the medical school, allowed us to recruit two highly accomplished professors in quantum computing and brain machine interfaces from Yale and the École Polytechnique Fédérale de Lausanne (EPFL), Switzerland.

This is my last message to you as chairman of this great department. I would like to thank all of you—our students, staff, faculty, friends, partners, and alumni—for your dedication, generous time and financial support. Our accomplishments are truly the story of your commitment and success.

Undergraduate Program

U.S. News & World Report Rankings

#10 Electrical Engineering

#9 Computer Engineering

1,593 Total Undergraduate Students

17% Female

16% Underrepresented Minorities

Admissions

Undergraduate

3,008 Applicants

708 Admissions

23.5% Admission Rate

Undergraduate Students by Technical Core*

*Represents completed tech core elections (sophomore/juniors)

EE 27.9%	Communications, Signal Processing, Networks & Systems	5.4%
	Electronics & Integrated Circuits	12.4%
	Energy Systems & Renewable Energy	6.6%
	Fields, Waves & Electromagnetic Systems	2.2%
	Nanoelectronics & Nanotechnology	1.3%
CE 72.1%	Computer Architecture & Embedded Systems	16.5%
	Software Engineering & Design	45.9%
	Data Science & Information Processing	9.7%

Graduate Program

U.S. News & World Report Rankings

#9 Electrical Engineering

#7 Computer Engineering

388 Total PhD Students

261 Total MS Students

18% Female

3% Underrepresented Minorities

Admissions

Graduate

2,328 Applicants

468 Admissions

19.2% Admission Rate

Graduate Students by Primary Research Area

Plasma/Quantum Electronics & Optics	3.8%
Energy Systems	10.6%
Electromagnetics & Acoustics	4.9%
BioECE	2.6%
Solid-State Electronics	11.4%
Integrated Circuits & Systems	17.4%
Integrated BSEE/MSE Program	4.5%
Decision, Information & Communications Engineering	20.6%
Architecture, Computer Systems & Embedded Systems	18.7%
Software Engineering & Systems	5.5%

Research Expenditures (2017-2018)

$22,617,514

↑30% in past five years ↑17% in past three years

59 Tenured and Tenure-Track Faculty

Texas ECE will be adding several new tenured and tenure-track faculty in the next three academic years.

Current Faculty Includes:

2 ACM Fellows

3 NAE Members

30 IEEE Fellows

Bridging Barriers Initiative

Bridging Barriers is a university-wide grand challenges initiative that brings together experts from across the 40 acres to address pressing problems facing Texas, the nation, and beyond. With the launch of Planet Texas 2050, The University of Texas at Austin now stands shoulder-to-shoulder with research institutions from around the world that are dedicated to working in new ways and across academic disciplines to respond to major environmental and humanitarian crises.

"The toughest questions facing humanity and the world cross the boundaries of existing knowledge, and we must take an interdisciplinary approach to address them . . . Breakthroughs happen when we break down silos of knowledge. And we are doing that now."

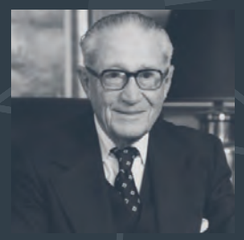
— President Gregory L. Fenves

UT Austin's grand challenges are imagined, designed, and driven by university faculty and researchers. Through Bridging Barriers they aim to:

- **accelerate collaboration across disciplines**
- **promote fundamental research that thrives in an environment based on academic freedom**
- **set the stage for practical solutions to problems that are critical for the world and that will engage our society in the coming decades**
- **address problems in humanities and social sciences to enrich and deepen our experiences of the world around us.**

Distinguished Alumni Academy

Texas ECE welcomed its inaugural class of 23 alumni into the Distinguished Alumni Academy. The Academy features distinguished alumni who made their mark in electrical and computer engineering, as well as people who achieved tremendous success in other fields.



Walter W. McAllister Sr.
BS, 1910

5-Term Mayor
San Antonio, Texas

Robert L. Mansfield
BS, 1982

Senior Vice President of Technologies
Apple Inc.

James J. Truchard
PhD, 1974

President, CEO, and Co-founder
National Instruments

Frank P. Wood
BS, 1939

Brigadier General
U.S. Air Force

Dr. José del R. Millán Joins Texas ECE Faculty

Dr. José del R. Millán will be joining Texas ECE as the Motorola Regents Chair in Electrical and Computer Engineering #2 in September 2019. Dr. Millán has made several seminal contributions to the field of brain-machine interfaces (BMI), especially based on electroencephalogram signals. Most of his achievements revolve around the design of brain-controlled robots. He has received several recognitions for these seminal and pioneering achievements, notably the IEEE-SMC Nobert Wiener Award in 2011 and elevation to IEEE Fellow in 2017. Recently Dr. Millán is prioritizing the translation of BMI to end-users suffering from motor disabilities. As an example of this endeavor, his team won the first Cybathlon BMI race in October 2016. In parallel, he is designing BMI technology to offer new interaction modalities for able-bodied people.

Helping Counselors Help Students

Texas ECE Associate Director Dr. Veronica Vasquez hosted an Educators and Counselors Day to establish a network group between educators and high school counselors. This assists counselors with advising high school students with the best information to prepare students who show interest in pursuing engineering as well as introducing the allotment of resources Texas ECE has in place for student success. Topics include a holistic review of ECE curriculum and courses that high school students should take to better prepare them for their first-year courses. Additionally, it encourages participants to reach out to departmental advisors when they need resources to advise their students.

Teaching in Bytes

Bytes Courses are envisioned as small courses focusing on specific skill sets that our students need to be successful in internships and careers that are not part of the core coursework. Topics have included **Blockchain technology and cryptocurrency, mixed signals and design with fabrication, printed circuit board design,** and **a course on developing professional skills.**

Internet of Things Lab

Texas ECE is developing a state-of-the-art Internet of Things (IoT) Lab within the National Instruments Student Project Center which will focus on hands-on education in the latest technology in interrelated computing devices and digital machines. First-Year Design Experience courses will be taught in labs and paired with lectures to teach ideation, planning, and product development.

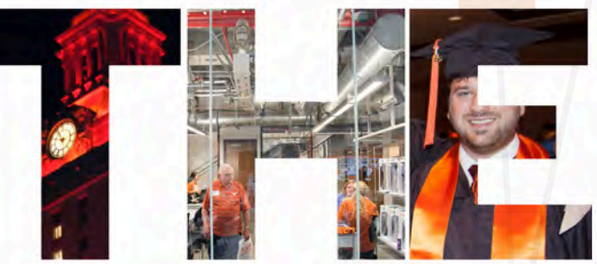
Integrated Learning

Profs. Milos Gligoric and Jonathan Valvano will teach **special integrated sections of courses in Software Design and Implementation and Embedded Systems.** Because topics of classes overlap, pairing courses and teaching them concurrently benefits and accelerates the students' knowledge of the material. Topics introduced in one class can be reinforced in the other. Taking certain courses early in an academic career also improves chances for the students to obtain competitive internships.

Honors Degree Program

Texas ECE is launching an **Honors Degree Program to provide a challenging, rigorous, and nurturing environment for our most ambitious and capable students.** The program will admit approximately 40 students per year - which will ultimately comprise about 10% of the student population. Honors courses will provide greater depth and sophistication as compared to the standard coursework, and students will come away with an advanced understanding of the curriculum.

Transforming THE CLASSROOM

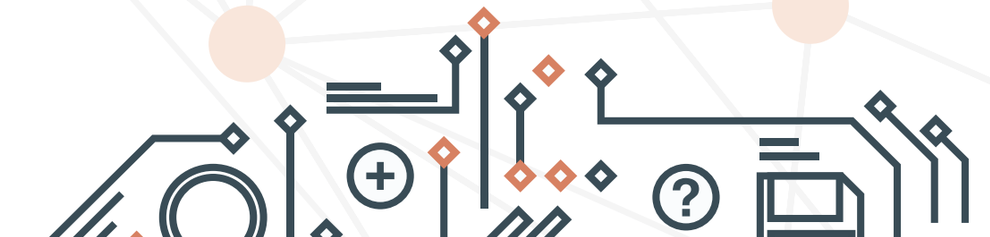


Virtually Extending the Classroom

Texas ECE is using synchronized classrooms to advance education options for students through remote learning. **The department offers a MS degree through a synchronized classroom that is simultaneously taught to a live class, as well as streamed as a virtual classroom.** The core coursework is flexible to meet the specific needs of each student, and the virtual classroom offers professionals who may not have the ability to attend live courses to advance their education and skills without sacrificing their professional opportunities.

Applied Cybersecurity Education

Texas ECE has partnered with The University of Texas Information Security Office for courses on Network Security and Privacy and Creative Security Operations using live data as the first in a series to teach students the latest technologies in cybersecurity. There is a massive shortage of cybersecurity talent across the planet, and that gap is forecasted to persist for the next several years. **These courses will provide students with applied cybersecurity skills that are highly marketable to many industries.**



First-Year Design Experience

First-Year Design Experience (FDE) is a two semester "bite-sized" course where students form groups of five and use the conceptual topics they are being taught to design components, bigger components, and, finally, systems. It is a combination of **a top-down and bottom-up learning approach that introduces them to a hands-on design experience they will use throughout their academic careers.** For example, this year's first-year students will be creating an Arduino based sensor/actuator system using the Blynk IOT Application. The FDE takes advantage of the two-story, 23,000 sq. ft. National Instruments Student Project Center for weekly lab work paired with a weekly lecture on topics relevant to the associated lab assignments.

Solar Energy Storage Problem May be Solved in New Single-System Technology

Prof. Alex Huang and his research team have developed a way to integrate solar power generation and storage into one single system, effectively reducing the cost by 50 percent.

Generating power from the sun isn't the problem. The technology has been there for decades. However, storing that power efficiently has been a challenge.

That's why the Department of Energy has awarded $3 million to engineering researchers at The University of Texas at Austin to overcome the Achilles' heel of the solar power story since day one: how to store its energy.

"These functionalities will ensure the power grids of tomorrow can host a higher percentage of solar energy," said Huang.

The project will develop the next generation of utility-scale photovoltaic inverters, also referred to as modular, multifunction, multi-port and medium-voltage utility-scale silicon carbide solar inverters.

First-of-its-Kind Chemical Oscillator Offers New Level of Molecular Control

Prof. David Soloveichik and his research team show how to program synthetic oscillators and other systems by building DNA molecules that follow specific instructions.

DNA molecules that follow specific instructions could offer more precise molecular control of synthetic chemical systems, a discovery that opens the door for engineers to create molecular machines with new and complex behaviors. Researchers have created chemical amplifiers and a chemical oscillator using a systematic method that has the potential to embed sophisticated circuit computation within molecular systems designed for applications in health care, advanced materials, and nanotechnology.

Soloveichik, along with Niranjan Srinivas, a graduate student at the California Institute of Technology, and the study's co-authors, have successfully constructed a first-of-its-kind chemical oscillator that uses DNA components — and no proteins, enzymes or other cellular components — demonstrating that DNA alone is capable of complex behavior.

"DNA can be used in a much more active manner," Soloveichik said. "We can actually make it dance — with a rhythm, if you will."

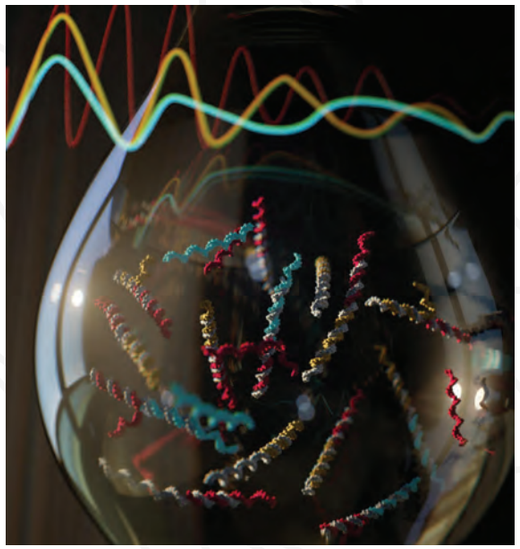


Image courtesy of Ella Maru Studio and Cody Geary

SAVES: Situation-Aware Vehicular Engineering Systems

SAVES is a research center that addresses the challenges of wireless, networking, and sensing in vehicular systems. The center provides a common framework for the development of advanced vehicle connectivity, infrastructure to support connectivity, technologies for sensing, including imaging, radar and location, and applications of connectivity.

Cooperative Mapping for Automated Vehicles

Localization is essential for automated vehicles, even for simple tasks such as lane-keeping. A key enabler for large-scale up-to-date maps will be enlisting the help of the very vehicles who need the map—consumer vehicles—to build and update the map. This project explores the possibility of using multiple vehicles equipped with the kinds of sensors that are (or will be) common on cars (optical cameras, radar, IMU, and GNSS) to perform cooperative SLAM for improving and updating a point-feature map 3D map of the environment.

Automotive Radar Using WiFi and DSRC Signals

Recent mandates for automation in vehicular transportation safety have increased demand for radar applications such as forward collision detection and avoidance. The majority of current implementations of vehicular radar are mmWave radars, which are expensive and exhibit multiple security vulnerabilities. We have demonstrated the feasibility of a secure and cost-efficient IEEE 802.11-based system with radar capabilities via implementation and testing. Measurements demonstrate that our solution delivers meter level accuracy for single-target detection with significant potential cost reduction of future releases of vehicular radar.

Research Experiences for Teachers

RET is an intensive summer research and professional development opportunity where a K-12 teacher is paired with a UT faculty member and graduate student to work on a research project. The program's goal is to have teachers leave as confident STEM educators to inspire the next generation. Design lessons and pieces of curriculum are prepared so that teachers can learn to bring engineering into math classrooms. Subjects this year included solar cells, flexible electronics, device physics, carbon nanotubes, and graphene.

The University of Texas at Austin
WHAT STARTS HERE CHANGES THE WORLD

Department of Electrical and Computer Engineering
The University of Texas at Austin
2501 Speedway, Austin, TX 78712

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