THE UNIVERSITY OF TEXAS AT DALLAS

ERIK JONSSON SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

TxACE

TEXAS ANALOG CENTER OF EXCELLENCE

10th ANNIVERSARY

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MEMBER INSTITUTIONS
2008 – 2018

10th ANNIVERSARY

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ANNIVERSARY

TxACE TENTH

TxACE has every reason to proudly celebrate its 10–year anniversary. As industry and consumer necessity continues to drive innovation, TxACE will be in the forefront for years to come, with new curricula and programs to support the latest technologies — whatever they may be.

"So much has been done in 10 years," says Dr. David Yeh, assignee from Texas Instruments Inc. (TI) and senior director at Semiconductor Research Corporation (SRC). "But we have a long way to go over the next 10 years. This space is still growing, still vibrant, and there is so much innovation. I'm looking forward to the future of TxACE."

Dr. Kenneth O, director of TxACE, remarks on this 10-year milestone: "TxACE is one of the shining examples of how industry, academia and government can work together to actually benefit all the people involved and society at large. That's exactly what the founders of TI wanted when they created UT Dallas. This is the occasion to celebrate what we have accomplished, review how we can be better and, more importantly, renew and refresh the vision for the next 10 years."

TxACE 10-YEAR ACHIEVEMENTS: A SNAPSHOT

TxACE starts at a modest pace with six to eight projects during the first year.

The Center has supported more than 200 research tasks.

200 students supported by TxACE have earned a PhD.

The Center has supported more than 130 principal and co-principal investigators at 42 academic institutions over the past 10 years.

TxACE presently consists of 51 principal investigators from 24 academic institutions worldwide; four of these institutions (Southern Methodist University, Texas A&M University, the University of Texas at Austin, UT Dallas) are from Texas.

TxACE CREATIONS

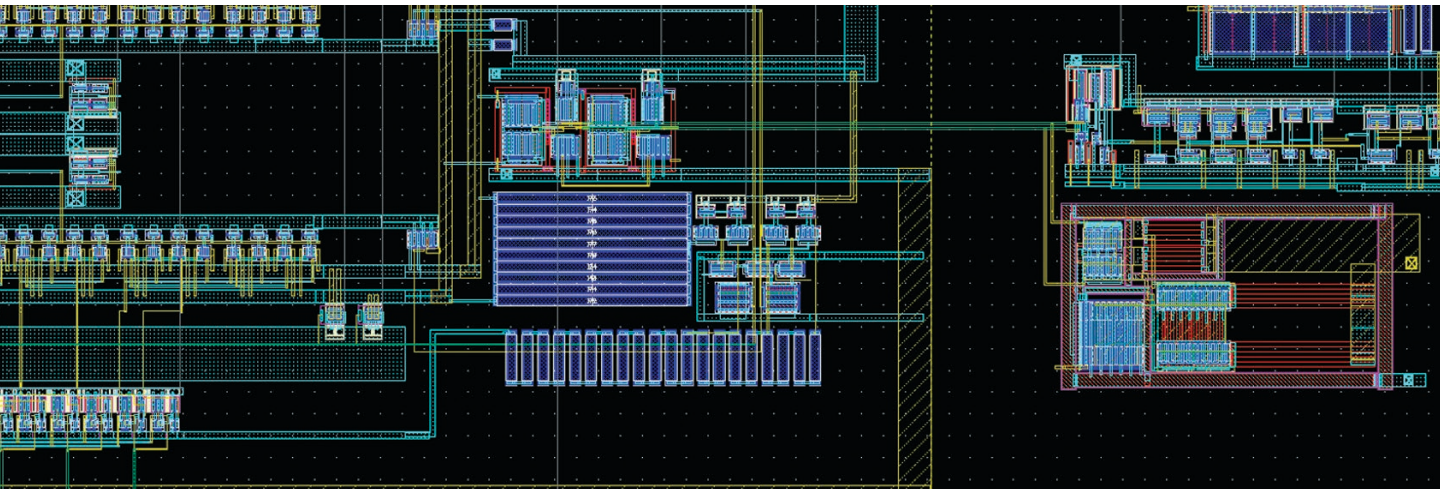
An electronic device created using Schottky diodes in Complementary Metal-Oxide Semiconductor (CMOS) technology that detects electromagnetic waves to create images at 300 GHz to 10 terahertz. This type of device could make night vision and heat-based imaging affordable and could eventually be used for detecting animals near a road while driving at night or estimating how many people are in a room to better control heating, air conditioning and light. This technology can also be used in consumer applications ranging from finding studs in walls to authentication of important documents to detecting counterfeit money.

Integrated power electronics that are used to improve the reliability of power delivery and energy efficiency for a wide variety of devices including smartphones, laptops, servers, cooling and heating systems, and more.

Millimeter wave circuits for automotive radar, which are critical to make this technology available in every new car.

Techniques to lower the cost of testing integrated circuits.

A Programmable E-nose that uses CMOS millimeter wave circuits for breath analysis, which can be used to detect stomach ulcers, kidney disease, lung cancer, asthma and more.



TxACE BEGINNINGS

The proliferation of electronics is everywhere — from consumer products to apps, sophisticated biomedical devices to artificial intelligence (AI), and in many smart devices that make up the Internet of Everything (IoE).

What all these 'things' have in common is that they process signals from the real world: analog to digital. The real world is analog — fundamentally, nature is not digital — and that's where our story begins.

During the mid–2000s, leaders of companies like TI saw that analog signal topics were becoming more critical and realized future implications would grow over time.

Yeh recalls, "TI, the SRC, and The University of Texas At Dallas (UT Dallas) had discussions about the growing importance of analog design research and decided they wanted to invest in university research in this particular area. They also decided that if we had a center of some kind, we could call attention to these particular topics and encourage innovative research."

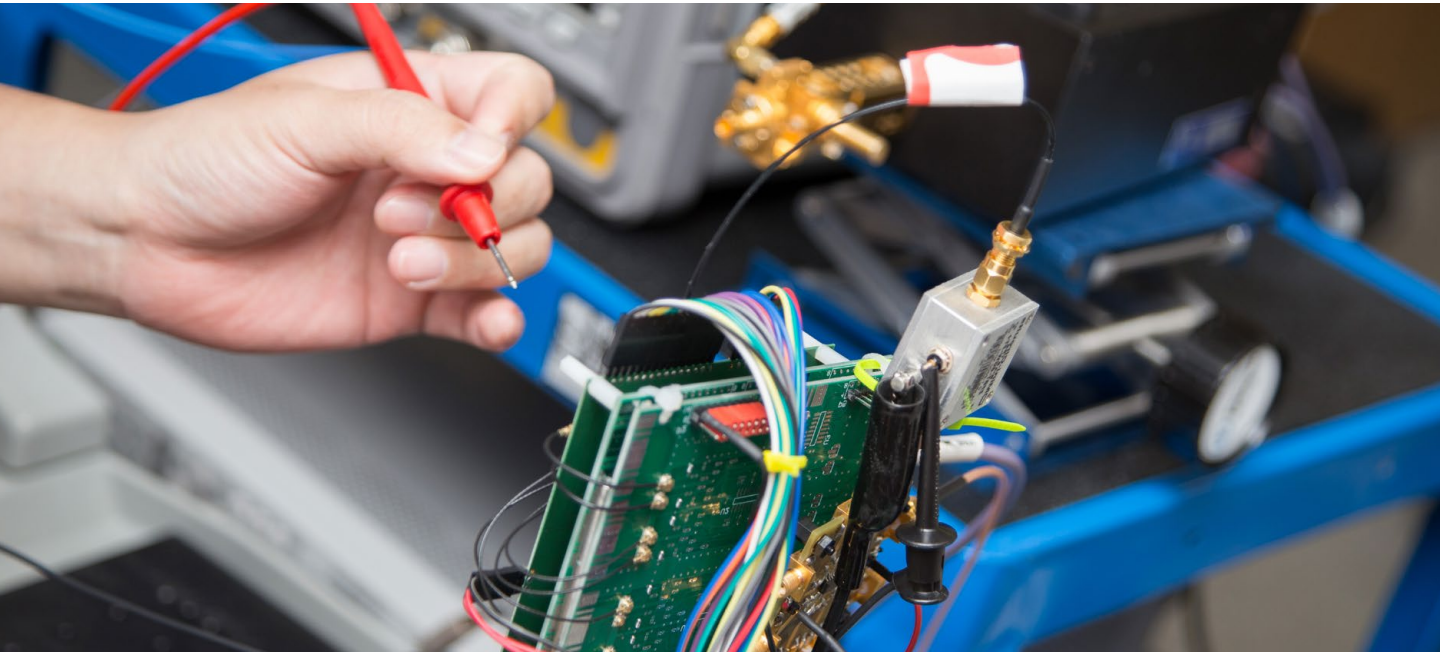
And who better to meet this need than the high–tech giant and billion–dollar corporation of TI, and the nearby, fast–growing UT Dallas?

"With TI so close, SRC and its leadership thought UT Dallas would be a good place to headquarter this particular center," Yeh says.

The Texas Analog Center of Excellence (TxACE) was officially established in 2008. Announced by then Texas governor Rick Perry, the Center was founded on a $16 million collaboration between SRC, the State of Texas, TI, the University of Texas System, and UT Dallas.

In predicting great achievements from TxACE, Dr. O, also holder of the Texas Instruments Distinguished University Chair, says, "Our facility brings together people from diverse backgrounds to enable technology that people working in one particular discipline couldn't come up with on their own. We are finding solutions to some of the great challenges the world faces today through research at this facility."

Today, TxACE is recognized as a world–class analog technology center for both traditional electronics and emerging applications. The Center has distinguished itself as the largest analog research center based in an academic institution in the world. TxACE not only provides great economic benefits for companies in North Texas, but also sustains the Dallas–Fort Worth (DFW) Metroplex as a leader in technology development and job creation.



TI AND UT DALLAS

Much has been written about the vision of TI founders, Eugene McDermott, J. Erik Jonsson and Cecil H. Green. In the early 1960s they recognized the need to grow industrially, to help expand the DFW region, and also to provide an intellectual atmosphere that would promote industrial competition and encourage creative minds to come together. UT Dallas was officially established in 1969.

But, how exactly did TxACE begin? Let's turn the analog clock back and listen to members' stories of how they remember it. They were there at the beginning — bringing the idea to fruition, securing funding, hiring the right talent, developing curricula, and sustaining an academic culture that continues to provide students real–world experience and knowledge in the field of analog technology.

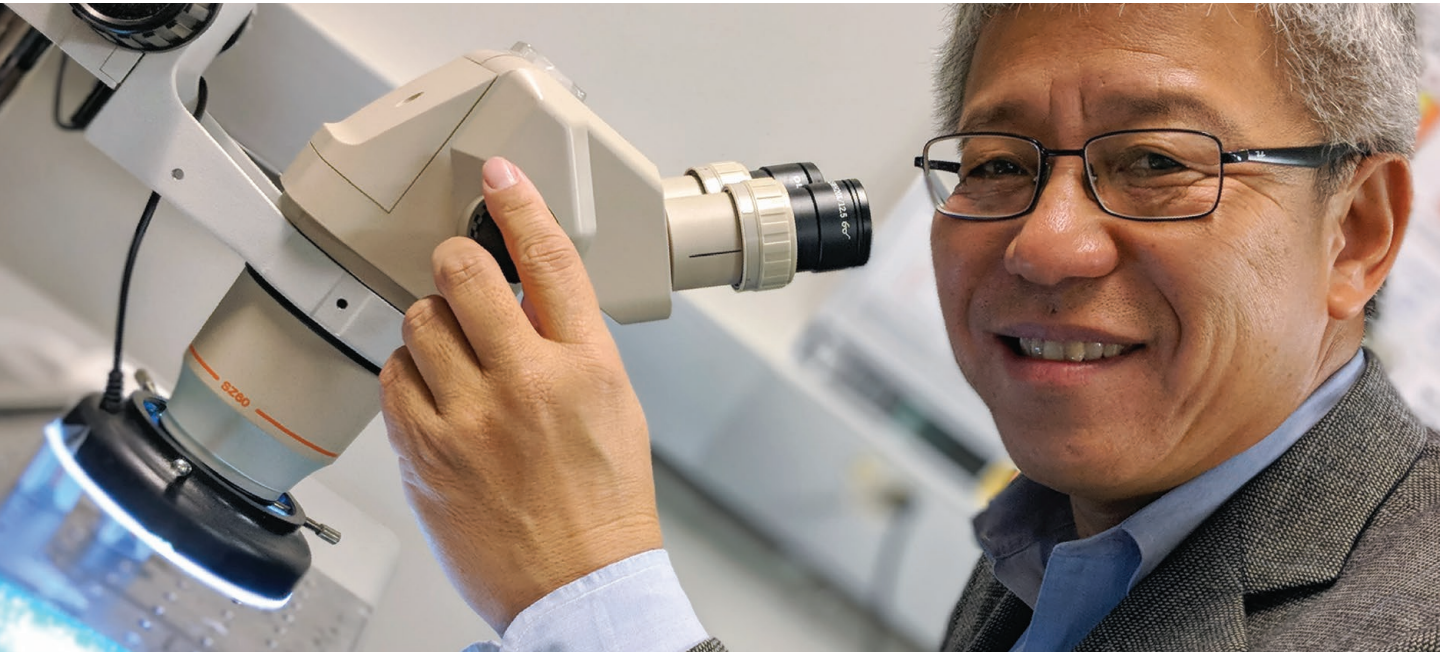
Strategic changes occurring within TI around the time of the TxACE founding reflected what was happening in the high–tech world with regard to research and development, or R&D:

"Another phase of the change was underway," says Dr. Robert Doering, research manager in the technology and manufacturing group at TI. "TI and most other semiconductor companies in the U.S. and around the world further evolved their research models toward market/product–specific internal R&D and toward university research for the longest–range exploration.

"TI decided before TxACE was formed that the best market opportunities for us would be in analog." Doering continues, "And in embedded processing, which together enable ubiquitous systems supporting the entire analog–to–digital–to–analog signal–chain."

Dr. William Krenik PhD'93, chief technologist of custom products for TI, echoes those sentiments.

"Prior to founding TxACE, the SRC had focused largely on process development," he says. "The SRC and TI recognized that as the industry evolves, analog would become very important, and doing research focused on analog would also become important."



About the same time, UT Dallas was in the midst of an expansion period that included more than doubling research expenditures, initiating or completing $300 million of construction of new buildings, adding 17 new degree programs and raising $100 million in private funds.

"The relationship between TI and UT Dallas continued to be successful after the University founding," says Dr. Hobson Wildenthal, executive vice president of UT Dallas. "At the time of TxACE founding, TI leaders thought that no organization was focusing on analog anymore, and they needed to ensure a supply of educated analog engineers. With our legacy and growth, we were confident UT Dallas could fill that need."

Recruiting the proper talent, many of them who would become faculty members in the UT Dallas Erik Jonsson School of Engineering and Computer Science, was crucial, UT Dallas leaders say.

"It was clear that TI wanted a preeminent group of scientists working on analog systems, so with that directive in hand, I assumed the responsibility of finding the right talent to connect all the pieces together," says Wildenthal, who was chief academic officer of UT Dallas for 25 years.

Dr. Bruce Gnade, former vice president for research at UT Dallas and professor emeritus of materials science and engineering in the Jonsson School, was one of the people involved in establishing the center. He says the other big piece in establishing TxACE besides securing funding was to attract the right director.

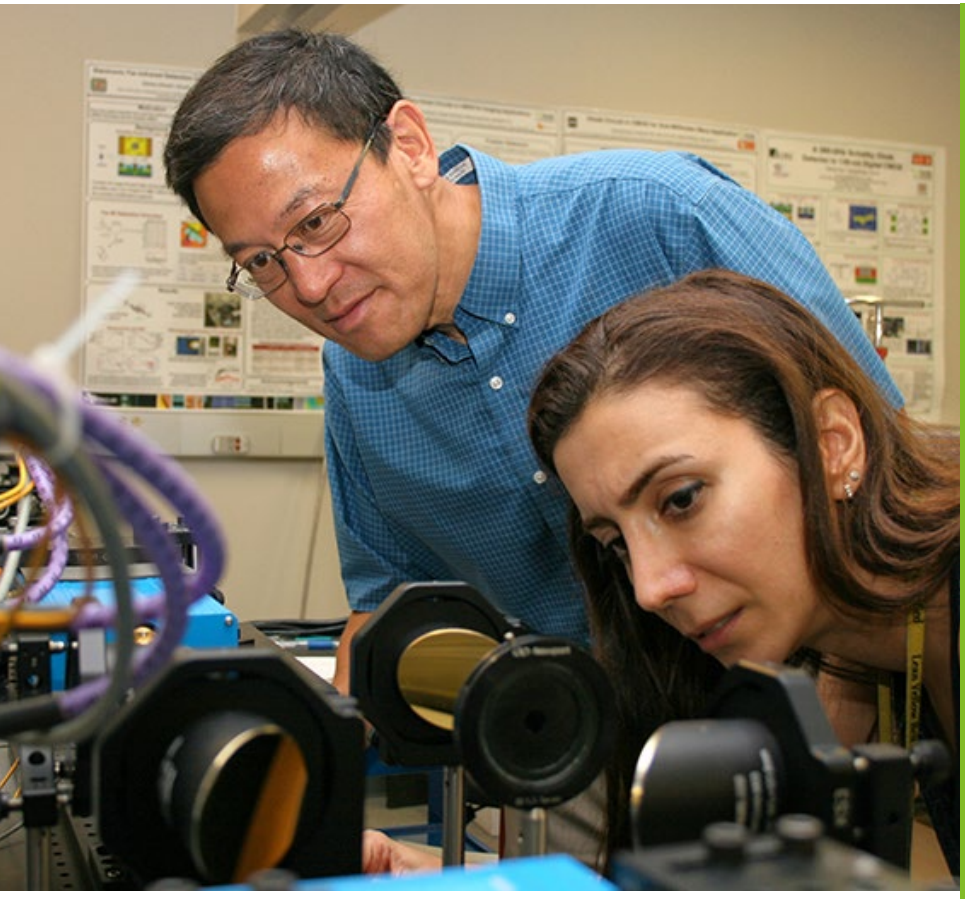
"That was Dr. O," Gnade says. "If I had anything to do with it all, hopefully it was to help convince Ken to become the director, which I think has turned out to be a tremendous win for UT Dallas."

Dr. O was already a leading authority in the field of analog electronics at the University of Florida. His research group was one of the first to show that Radio Frequency CMOS technology – which is used to fabricate radio circuits in almost every cellphone – is viable. CMOS technology is used to fabricate the bulk of integrated circuits including microprocessors, memory chips and imagers. Dr. O's group set records for the highest operating frequency for transistor circuits in 2008 and continues to expand the application of CMOS technology. In addition to holding an endowed chair at the University and directing TxACE, Dr. O is a professor of electrical and computer engineering in the Jonsson School.

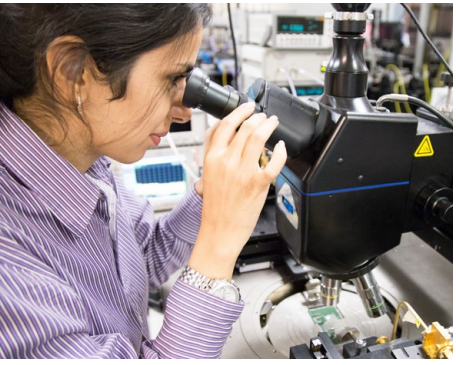
Dr. O was inspired by the industry vision of collaboration with academia.

"Analog represented an enormous opportunity, and I saw a way to contribute my expertise and impact society," he says. "I was inspired by the idea of using the local academic infrastructure to make such an impact.

"This is very much the original vision staying alive in TI. That's how it all started."



TxACE TODAY



Currently, TxACE is organized into four core areas called 'thrusts'. These areas allow students to research and develop work in their area of interest.

"When we started the Center, we wanted to concentrate on research in energy efficiency, health care, public safety and security," says Yeh, SRC research manager for TxACE. "These are topics that still resonate with the members, and here we are 10 years later. There is even more demand for innovative research to expand the fundamental capability to take analog and mixed–signal electronics into markets where previously it was not possible."

"These core areas are big societal problems," says Dr. O. "These are the kinds of problems TxACE was created to solve."

TxACE IS ORGANIZED UNDER FOUR CORE AREAS:

ENERGY EFFICIENCY

We are committed to helping alleviate global energy problems by significantly improving the energy efficiency of electronic systems and developing analog technologies that can increase energy consumption and generation efficiency.

HEALTH CARE

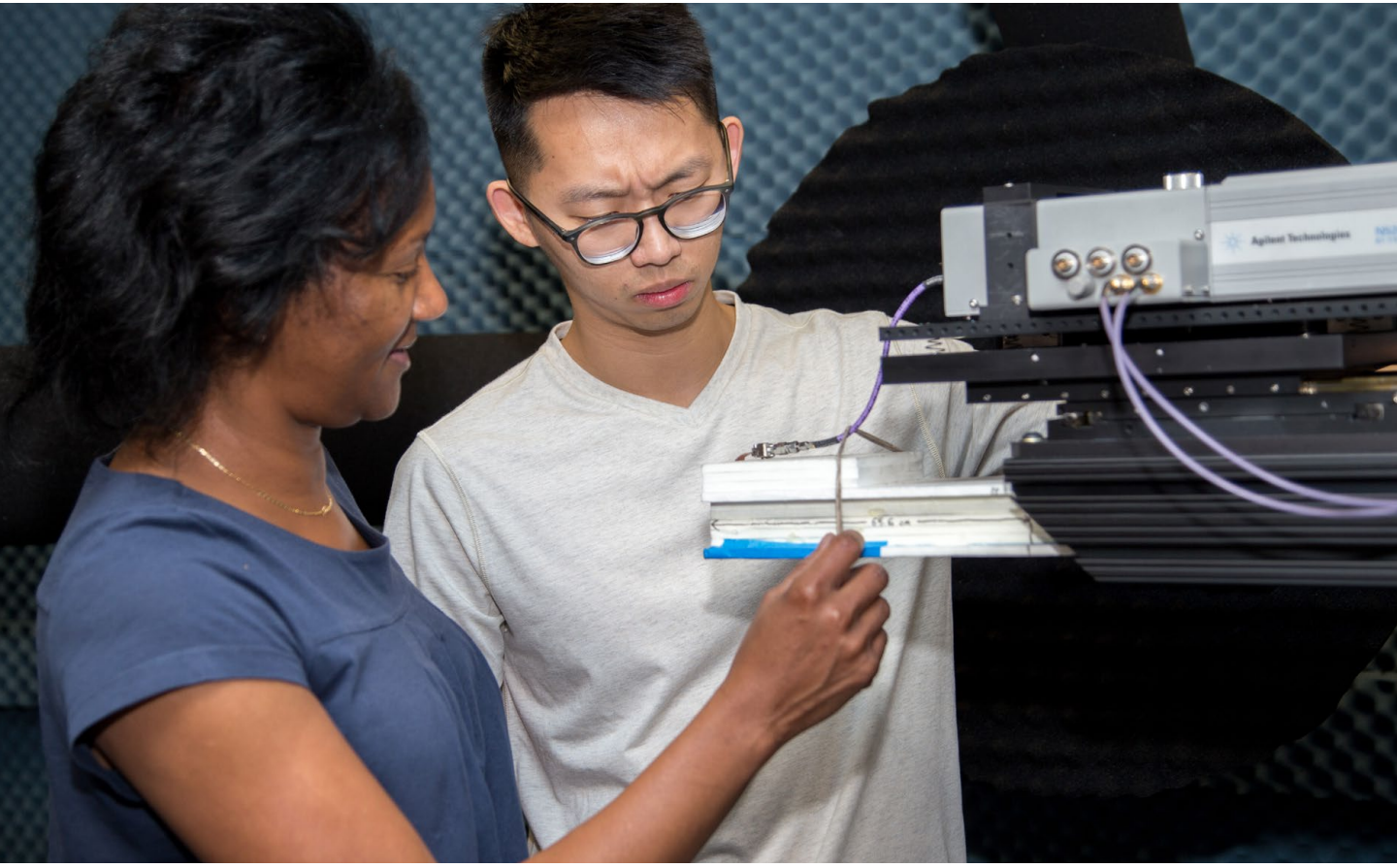
Analog and RF integrated circuit technology is the essential interface enabling the power, speed and miniaturization of modern digital microelectronics to be brought to bear on an array of medical applications, including medical imaging, patient monitoring, laboratory analysis, biosensing and new therapeutic devices.

PUBLIC SAFETY AND SECURITY

We seek to enable a generation of devices that can scan for harmful substances by researching 200-300 GHz silicon ICs for use in spectrometers and significantly reduce the cost of in-vehicle radar and imaging technology that improves automotive safety by researching circuit techniques that can lower manufacturing cost, including that for testing and packaging.

FUNDAMENTAL ANALOG CIRCUITS RESEARCH

Research topics include analog-to-digital conversion techniques, communication links, CAD tools, testing techniques and more to support the first three core areas.



The unique relationship among UT Dallas, SRC and TI offers several important benefits. Corporate managers are often faced with the question of, 'Do we have the resources to dedicate an application engineer to a project for six months that might not have a payoff?' Universities can take that risk and, in exchange, students get real–world experience. Even if the project does not yield the intended expectations, TxACE can benefit from the risk in that students still gain experience and new knowledge.

Krenik says, "In our business, we have to invest in research and development — TI believes very much in the impact of research. Our local university, UT Dallas, is very important to that mission. TxACE for us was a great opportunity to not only attract students interested in analog research, but also attract a top faculty to North Texas."

The Center helps to prepare the next generation of engineering students for global challenges. Through each assignment, TxACE enables students to interact with industry partners and to develop practical skills such as project updates and effective collaboration — a critical aspect for any team–oriented project in full–time work.

Many engineers are busy with their daily tasks and getting products to market, industry partners say. They often do not have the time to browse the research literature, whereas with TxACE, that is part of their work, to research — to stay fresh, have a broad–base of knowledge and explore the latest trends and types of technologies. Students also get an opportunity to see outside the research lab setting and view the big picture of industry practices and trends allowing them to put into perspective some of the research they are performing.

TI and other SRC members offer career opportunities for many students who graduate from TxACE.

"A number of students who have been trained at TxACE have gone to work at companies that support the research such as TI, Intel Corp, IBM, NXP Semiconductors, Globalfoundries and others," says Gnade, now a clinical professor at Southern Methodist University. "The students that are involved with TxACE and UT Dallas are making a big impact in the analog industry."

TxACE FUTURE

As technology continues to become more granular, concepts like IoE are bringing people, data and things together to make networked connections more relevant and valuable. Advanced technologies like voice user interface (VUI) used in Amazon's Echo and Alexa–powered product family continue to increase in consumer sales and popularity as more people become comfortable using them.

Consumer growth continues to rise steadily for devices like smart thermostats, home lighting systems and remote controls. In business, demand has increased for alternative payment apps, smarter supply chains and investment from both large and small companies for AI and machine learning. Every industry presents unique possibilities, new capabilities, richer experiences, and unprecedented economic opportunity for individuals, businesses and entire countries. Analog will play a role in each of these areas.

"Analog electronics is a very important part of TI right now," says Krenik, "TxACE is focused on analog, and we have so many reasons why doing research in analog is fundamental. We live in an analog world. We believe TxACE has some incredible contributions that they'll be making over the years to come."

FUTURE TxACE RESEARCH

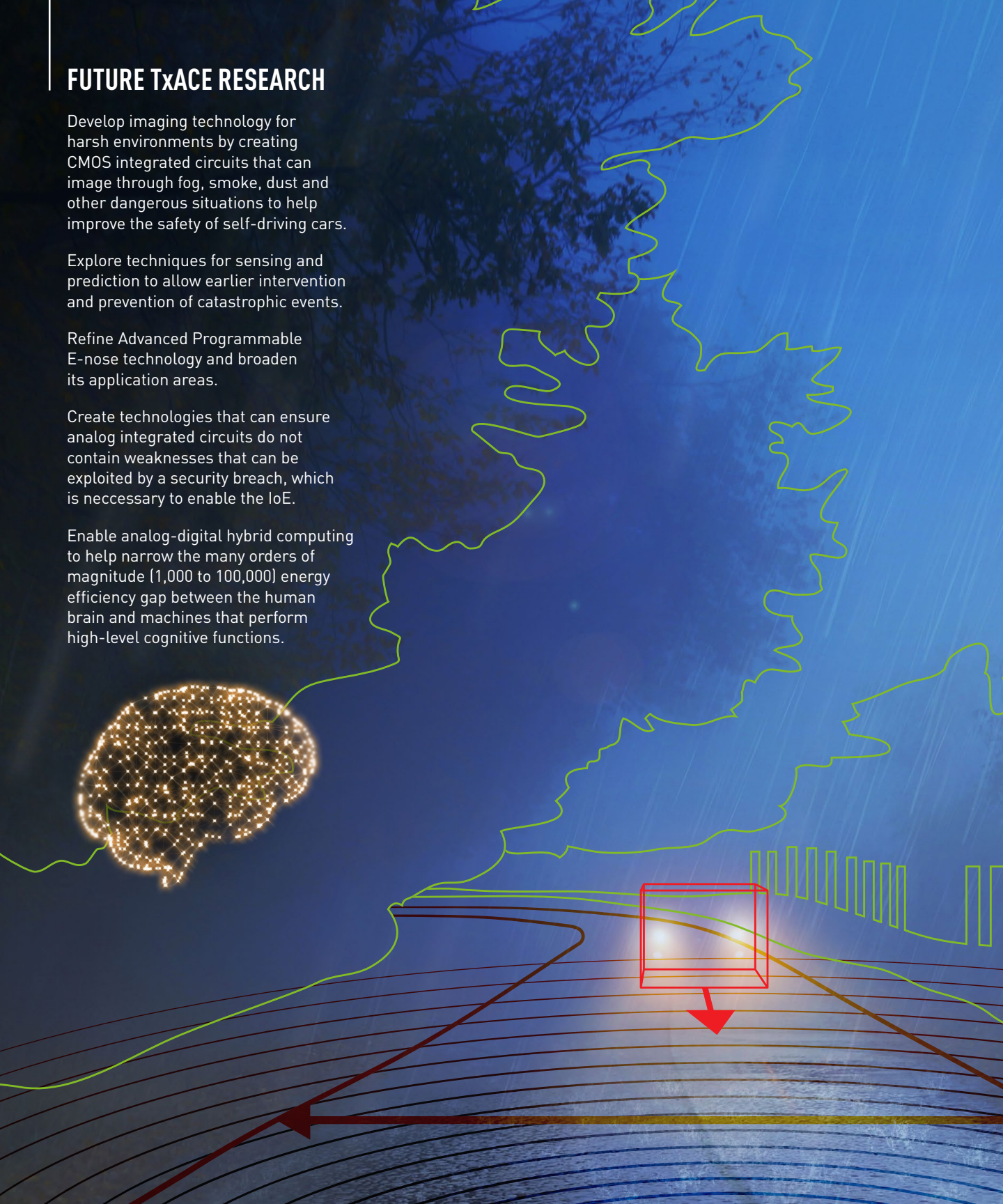
Develop imaging technology for harsh environments by creating CMOS integrated circuits that can image through fog, smoke, dust and other dangerous situations to help improve the safety of self-driving cars.

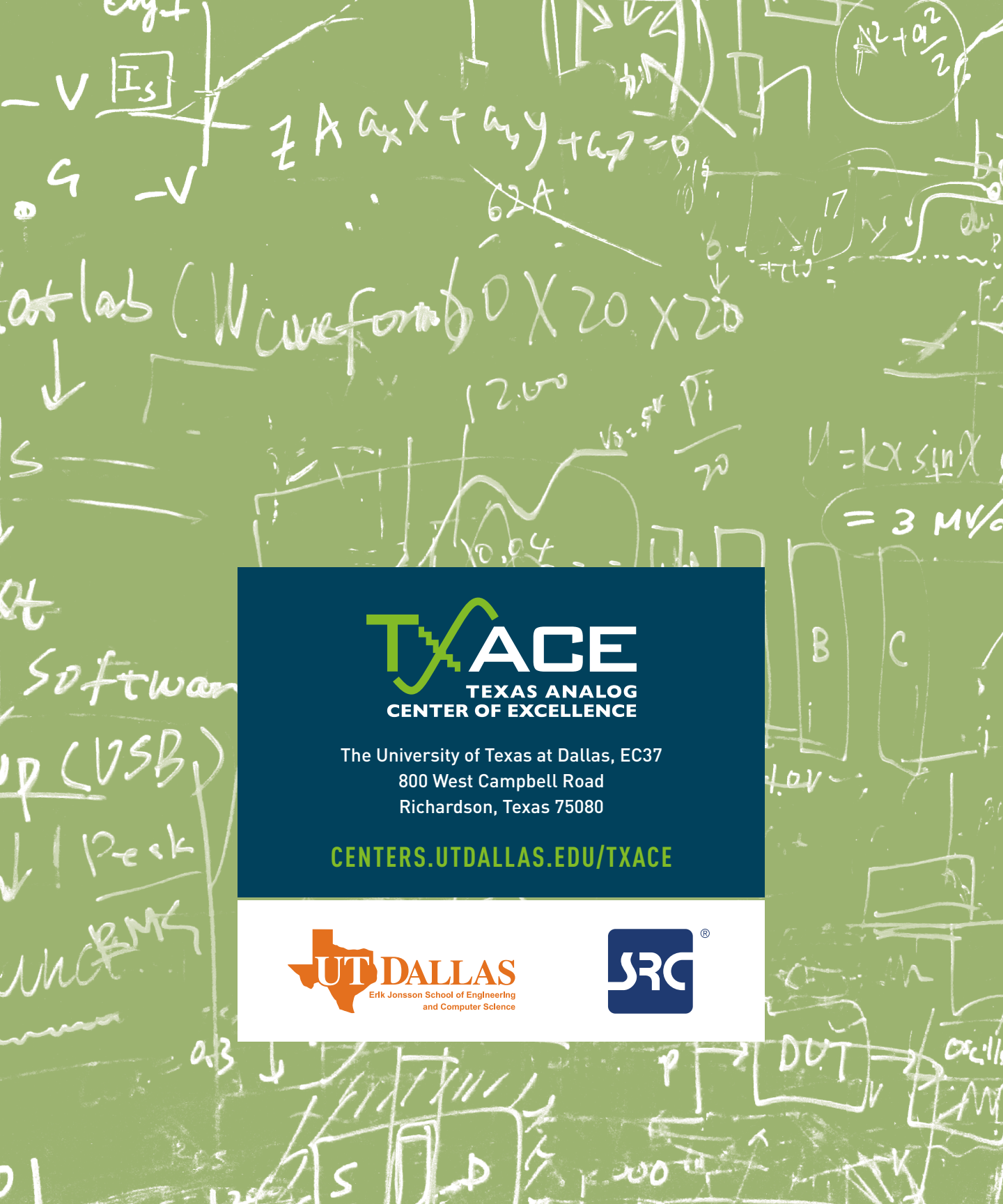
Explore techniques for sensing and prediction to allow earlier intervention and prevention of catastrophic events.

Refine Advanced Programmable E-nose technology and broaden its application areas.

Create technologies that can ensure analog integrated circuits do not contain weaknesses that can be exploited by a security breach, which is neccessary to enable the IoE.

Enable analog-digital hybrid computing to help narrow the many orders of magnitude (1,000 to 100,000) energy efficiency gap between the human brain and machines that perform high-level cognitive functions.





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