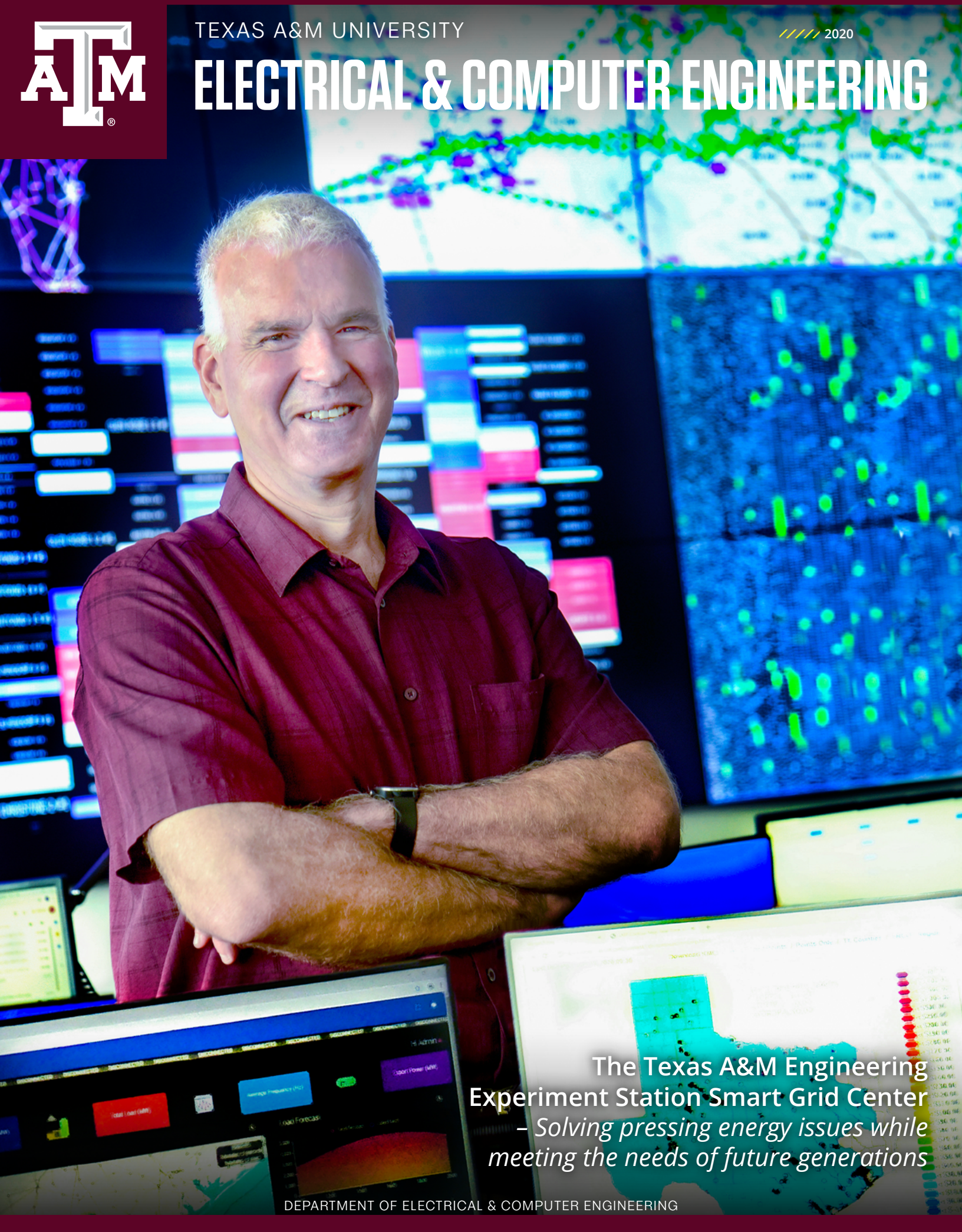
TEXAS A&M UNIVERSITY

2020

ELECTRICAL & COMPUTER ENGINEERING



The Texas A&M Engineering Experiment Station Smart Grid Center

– Solving pressing energy issues while meeting the needs of future generations

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

TEXAS A&M UNIVERSITY
Department of Electrical
& Computer Engineering

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Texas A&M Engineering Communications 2020

The Engineering Quad: A beautiful green space to meet, relax, eat and study

COVER: *Dr. Thomas Overbye*
Professor, TEES Eminent Professor
Director of the Smart Grid Center

from the DEPARTMENT HEAD

With over 80 faculty members (six are members of national academies and 35 are fellows of professional associations like the Institute of Electrical and Electronics Engineers), the Department of Electrical and Computer Engineering at Texas A&M University is poised to provide an excellent educational experience to over 1,200 undergraduate and 800 graduate students. We are addressing concerns regarding our undergraduate student body by boosting the quality of our students and doing our part to ensure student success in several areas.

Students follow a common general engineering curriculum during their first year that is designed to help them integrate into the college while also allowing them to explore all 22 degree options, make informed decisions and be better prepared once admitted to a major. Arriving to us after successfully completing the common freshman engineering year, students are well equipped to tackle the challenges of the top-quality engineering education, supported by several services (like peer mentoring) in the initial stages of education, and being offered opportunities to take advantage of participating in the honors program, Research Experience for Undergraduates, or in one of the custom-designed, industry-supported capstone design projects.

Our junior faculty are recognized for their innovative and relevant research. We currently have two NSF CAREER award recipients: Dr. J.V. Rajandran, a leader in cybersecurity ("CAREER: Towards Provably Secure Design of Integrated Circuits"), and Dr. Yang Shen ("CAREER: Physics-Constrained Modeling of Molecular Texts, Graphs and Images for Deciphering Protein-Protein Interactions"). They are both moving the boundaries in very dynamic research areas and attracting some of our best graduate students. Dr. Kate Davis leads the project team from Pacific Northwest National Laboratory, Sandia National Laboratory, Sekurity, the University of Illinois at Urbana-Champaign and Vistra Energy on a new DOE project, "Deep Cyber-Physical Situational Awareness for Energy Systems: A Secure Foundation for Next-Generation Energy Management." The team will develop a next-generation secure energy management system that can detect malicious and abnormal events through the fusion of cyber and physical data and algorithms, effective integrated analytics and visualization.

We are adding to our research enterprise by active participation in the recently created Texas A&M Institute of Data Science, led by Dr. Nick Duffield. The institute will create bridges to all colleges on campus that are interested in joint activities in data science at all levels. The Texas A&M Engineering Experiment Station's Smart Grid Center is under the new leadership of Dr. Tom Overbye, with projects and activities to the tune of $10 million, which is expected to propel the center to international relevance.

We are expanding our computer engineering and systems group, which boosts our cybersecurity expertise on machine learning in all of its forms. We have multiple new projects that are making Texas A&M a hub for big data research and are increasingly tackling cybersecurity issues, both in research and in curriculum (with undergraduate courses in cybersecurity as well as master's program in cybersecurity for all engineering students).

Our faculty and academic professionals continue to receive notable grants and work on highly relevant and impactful projects. Dr. R. Stanley Williams, nanotechnology pioneer and former Hewlett Packard Enterprise (HPE) Senior Fellow, is the leader of the new HPE Center for Novel Computational Architecture Research, made possible with a multi-million-dollar equipment grant from HPE. The center will explore the development of hardware platforms for real-time applications of big data, and its products may help define the new generation of computers able to process large amounts of data in or near real-time. The quality of our research, newly introduced programs such as distance learning, and the creation of new centers are propelling us forward. We are excited about our future and expanding our research enterprise while continuing to build excellence in our student body.

Miroslav Begovic,
Department Head
Carolyn S. & Tommie E. Lohman '59 Professor

TEXAS A&M UNIVERSITY
Department of Electrical & Computer Engineering

DEPARTMENT AT A GLANCE

RESEARCH LAB SPACE

52,812 Total Square Footage

Zachry Engineering Education Complex

adds 525,000-square feet of instructional space and top-notch labs for students

*There are **four** Texas A&M University graduates serving as **CEOs of Fortune 500 companies.***

***One of the four** is a former student from the Department of Electrical and Computer Engineering.*

DEGREES AWARDED

(FALL 2018-SUMMER 2019)

281 Bachelor's

220 Master's

52 Ph.D.

ENROLLMENT

(FALL 2019)

1,314 Undergraduates

741 Graduates

FACULTY

70 Tenured/Tenure-track faculty

13 Non-tenure track faculty

6 Chairs

17 Professorships

3 Distinguished Professors

6 Members of the National Academies

35 Fellows

RESEARCH EXPENDITURES

$ 22,491,158

IN 2019

BIG DATA ANALYTICS COULD REDUCE POWER GRID OUTAGES

The power grid is one of those things that most of us take for granted, but it's time to acknowledge that it's vulnerable to power outages due to age, variability of distributed renewable generation resources and attacks. The annual cost of short power interruptions (i.e., five minutes or less) in the U.S. is $60 billion. In Canada, momentary outages (one minute or less) cost $8 billion annually, while sustained outages cost $4 billion.

To help avoid such outages, the National Energy Technology Laboratory (NETL) of the Department of Energy (DOE) announced the award of nearly $7 million to explore the use of big data, artificial intelligence, and machine learning technology and tools to derive more value from the vast amounts of sensor data already being gathered and used to monitor the health of the grid and support system operations. A Texas A&M University team led by Dr. Mladen Kezunovic, director of the Texas A&M Engineering Experiment Station's (TEES) Smart Grid Center, received a $1 million NETL grant to use big data analytics (BDA) to automate monitoring of synchrophasor recordings.

The DOE projects are expected to inform and shape the future development and application of faster grid analytics and modeling, better grid asset management and sub-second automatic control actions that will help system operators avoid grid outages, improve operations and reduce costs.

Kezunovic, Regents Professor and the Eugene E. Webb Professor in the Department of Electrical and Computer Engineering, will lead the project "Big Data Synchrophasor Monitoring and Analytics for Resiliency Tracking (BDSMART)."

The project will use BDA to automate the monitoring of synchrophasor recordings, which will improve assessing events that may affect power system resilience. The proposed BDA will be used to automatically extract knowledge leading to event analysis, classification and prediction, all used at different stages of the grid resilience assessment: operations, operations planning and planning.

"The research is aimed at developing data analytics algorithms to automatically analyze power system disturbances based on the measurements from the synchrophasor monitoring systems," said Kezunovic. "Such analysis enables prediction of major disturbances that may cause a blackout. As a result, the use of such algorithms in the control centers will enable the electricity grid operators to maintain normal power system conditions and avoid outages."

"The research is aimed at developing data analytics algorithms to automatically analyze power system disturbances based on the measurements from the synchrophasor monitoring systems," said Kezunovic.

Kezunovic said the project will last 1.5 years, and should benefit the utility industry by helping prevent future outages since current practices are very time consuming and quite often ineffective.

"Such algorithms do not exist today, so the operators have to interpret the recordings using manual inspection, which is tedious, quite often inconsistent and most importantly, overwhelming when a large number of recordings are available," he said. "In the long run, manual inspection and analysis is not effective and requires automation."

The project's techniques are based on past work performed at TEES on automated classification of faults, location of faults and instability detection using neural network and machine learning classifiers and predictors, and the latest innovations in BDA techniques developed by Temple University. Kezunovic said they will develop the algorithms then test them using actual recordings from utility companies.

The team will engage experts from Quanta Technology (a prominent consulting firm in the area of power systems) experienced in the utility interaction to interpret the phasor measurement unit (PMU) data files to be utilized in the process. They will facilitate industry feedback leading to the development of metrics for evaluation of the proposed solution. Additionally, the project proposes a novel solution for predicting future events based on historical PMU data by extracting the sets of precursors and analyzing the development of PMU-observed disturbances over time.

The co-principal investigators on the project are Dr. Zoran Obradovic, professor at Temple University (Obradovic leads a center on data sciences and analytics,); Dr. Yi Hu, executive advisor at Quanta Technology; and Rachna Handa, innovation project leader at OsisSoft, a major supplier of data management software for control centers. "This partnership makes a strong interdisciplinary team that assures the required expertise and a path to commercialization," said Kezunovic.

Cybersecurity and solar energy: **How are they related?**

Solar energy is one of the cleanest renewable energy resources available, and it is now being utilized by the power grid. In the smart grid, the cyber and physical layers are heavily intertwined. The cyber layers, such as computers, networks, sensors and controls, and the physical layers, such as the power transmission lines and transformers, work together to generate power more efficiently. This collaboration between the different layers is extremely valuable; however, the presence of cyber layers opens up the grid to potential threats.

Dr. Le Xie and his collaborators, Dr. P.R. Kumar and Dr. Prasad Enjeti, are addressing this by working on a research project to defend the grid from potential cyberattacks through a real-time check of the actions occurring on the grid.

There has been an increase of grid intelligence, such as advanced sensors and photovoltaic (PV) panels that enhance the impact of solar power on the grid. PVs work by generating electric power through solar cells that convert energy from the sun into a flow of electrons. This is called the photovoltaic effect. The team is working to develop and demonstrate an active defense mechanism of the PV distribution system operation using a dynamic watermarking technique to monitor the cybersecurity. The technique involves injecting a probe signal onto the grid to authenticate grid actions. The team will test and validate the integrated communication, control and computational framework using an existing system.

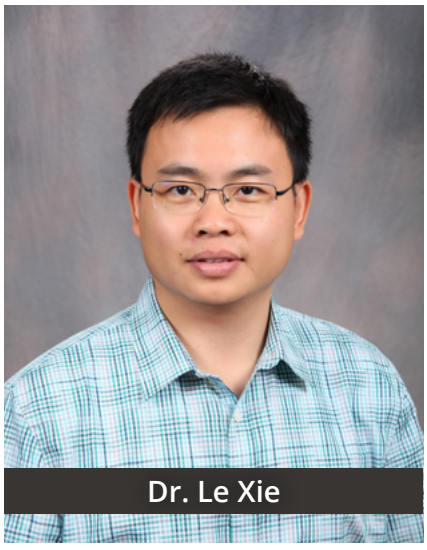
> "The goal of this project is to design and test a scalable, robust and online framework that provides much-needed secure monitoring of PV generation in the presence of potential cyberattacks in the distribution grid."

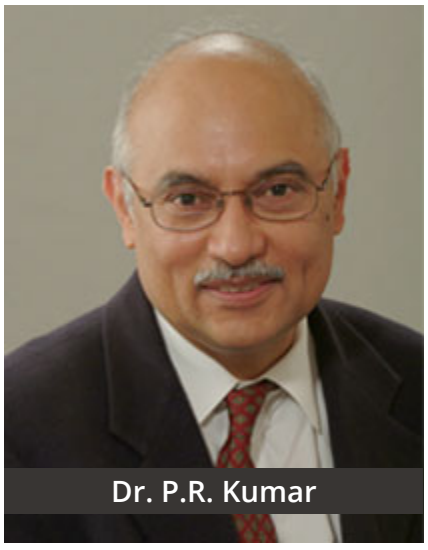
"The goal of this project is to design and test a scalable, robust and online framework that provides much-needed secure monitoring of PV generation in the presence of potential cyberattacks in the distribution grid," Xie said.

This project will directly fill the gap between academic research and real industry need because the research team has opportunities to test their proposed defense mechanism in a real-world testbed that has been configured based on a commercial distribution system.

The team has received a $4.4 million Department of Energy grant for this research project. The funded project is built upon the research on automatic generation control, which has been published in IEEE Transactions on Power Systems.

Xie is professor; Kumar is Regents Professor, Distinguished Professor and College of Engineering Chair in Computer Engineering; and Enjeti is TI Professor III in Analog Engineering, all in the Department of Electrical and Computer Engineering at Texas A&M University. Doctoral students Tong Huang, Jorge Ramos and Jaewon Kim, and post-doctoral associate Woo Hyun Ko are also involved in this project, alongside their faculty mentors.


Dr. Le Xie


Dr. P.R. Kumar


Dr. Prasad Enjeti

Notable Faculty Accomplishments

Dr. Miroslav **Begovic**

Dr. Miroslav Begovic, department head and Carolyn S. & Tommie E. Lohman '59 Professor in the Department of Electrical and Computer Engineering, received the 2019 Institute of Electrical and Electronics Engineers (IEEE) Power and Energy Society (PES) Meritorious Service award. This award is presented to one individual out of 40,000 members annually who has demonstrated outstanding contributions in leadership, technical activities and educational activities of the IEEE PES over the course of their membership. Begovic is an IEEE Fellow. His research expertise is in wide-area monitoring, protection and emergency control using smart grid apparatus, sustainable and resilient energy infrastructures, and managing large assets in energy infrastructure.

Dr. Robert **Balog**

Two faculty members from the Texas A&M University College of Engineering were among 54 academic inventors named to the spring 2019 class of senior members by the National Academy of Inventors (NAI). The new senior members included Dr. Robert Balog and Dr. Balakrishna Haridas. Balog is an associate professor in the Department of Electrical and Computer Engineering, and Haridas is a professor of practice in the Department of Biomedical Engineering and executive director for technology commercialization and entrepreneurship for the Texas A&M Engineering Experiment Station.

Dr. P.R. **Kumar**

Dr. P.R. Kumar, a College of Engineering Chair in Computer Engineering and a Distinguished Professor, is a fellow of the Indian National Academy of Engineering.

Kumar studies problems in game theory, adaptive control, stochastic systems, simulated annealing, neural networks, machine learning, queueing networks, manufacturing systems, scheduling, wafer fabrication plants and information theory. His research focus currently includes cybersecurity, privacy, cyberphysical systems, wireless networks, smart grid, autonomous vehicles and unmanned air vehicle systems.

Kumar is a member of the National Academy of Engineering in the U.S., and a fellow of the World Academy of Sciences.

Former electrical engineering student recognized by ExxonMobil

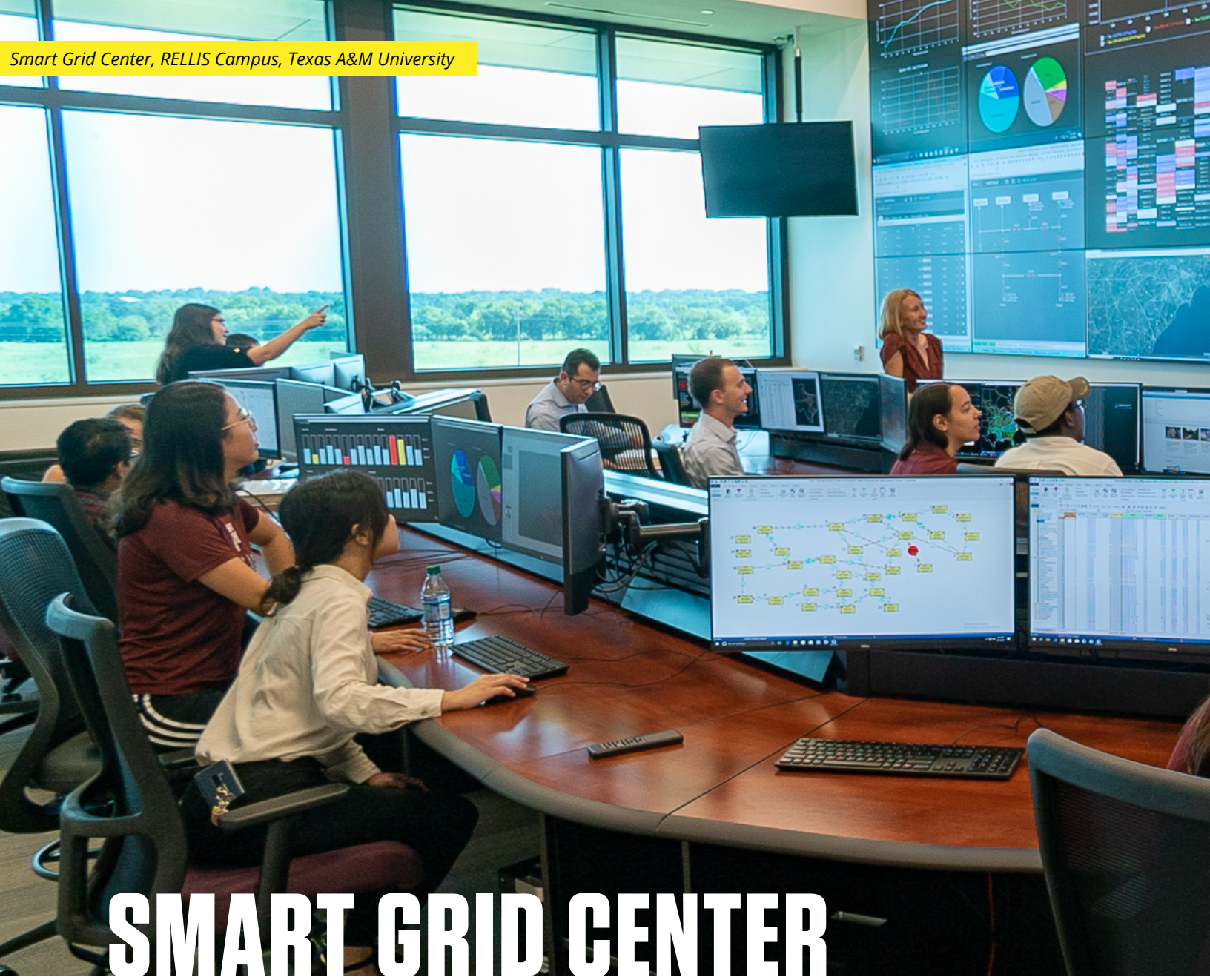
Harsh Junega

Harsh Juneja, a former student of the Department of Electrical and Computer Engineering at Texas A&M University, has been honored with ExxonMobil's Pinnacle Award for 2018. He was recognized for his outstanding work and dedication as a member of the engineering services team at the Baton Rouge refinery. This distinguished accolade recognizes engineering innovation that fundamentally changes the way that work is done at ExxonMobil.

"Harsh was always very curious on a wide range of technical subject matters and also hardworking," said Dr. Prasad Enjeti, TI Professor III in Analog Engineering and associate dean for academic affairs. "It's an incredible, and perhaps the most rewarding, feeling to see your students, whom you mentored and worked with closely, succeed in their profession."

Currently a section supervisor in the operations support department, Juneja oversees a team of 13 chemical engineers that support ExxonMobil's fluid catalytic cracking, sulfur recovery, alkylation and various distillation technologies at their Baton Rouge refinery.

"Since my education and core competency is in electrical engineering, this role keeps me challenged and provides new opportunities to expand my knowledge of chemical engineering while developing strong management and leadership skills in order to best serve my team and the company," said Juneja.



Smart Grid Center, RELLIS Campus, Texas A&M University

SMART GRID CENTER

The Smart Grid Center is a part of the Texas A&M Engineering Experiment Station (TEES), formed to expand on the smart grid-related efforts of TEES in an area of intense national interest in ensuring the reliability, sustainability and security of the electric energy supply. The Smart Grid Center galvanizes a number of smart grid-related activities that are underway in The Texas A&M University System and brings them under a coordinated umbrella to form partnerships essential for smart grid research, education and training. These partnerships are funded through various projects in excess of more than $10 million over the next five years.

A few notable projects include the $2.7 million, three-year U.S. Department of Energy Cybersecurity for Energy Delivery Systems project that Dr. Kate Davis is heading centered on enhancing the reliability and resilience of the nation's critical energy infrastructure; a $1 million National Energy Technology Laboratory project that Dr. Mladen Kezunovic is leading, "Big Data Synchrophasor Monitoring and Analytics for Resiliency Tracking," that will help reduce power outages; and Dr. Le Xie's $4.4 million project, "Secure Monitoring and Control of Solar PV Systems Through Dynamic Watermarking," that will develop and demonstrate a cyber-resilient operation for power distribution systems with massively photovoltaic generation.

With 12 faculty members whose interests are closely related to the center, several dozen who have participated in past projects and around 60 graduate students involved, the Smart Grid Center is poised to increase the volume of research that supports the development of this critical infrastructure for national security and the economy.

Smart Grid Center, RELLIS Campus, Texas A&M University

Former student's research impacts current satellite technology

Though traditional dish antennas have been used for many years, they are hard to deploy in a satellite launch due to their size, and they are mechanically complex. Enter the microstrip reflectarray antenna (MRA).

NASA's current use of MRAs is largely influenced by the work of former student Ron Javor and Professor Emeritus Dr. Kai Chang. Although prior to their work there were several published theoretical studies of MRAs, there was little cited work illustrating the actual design or performance of such antennas.

WHAT SETS MRAS APART

Dish antennas are very large and act like a flashlight used to aim radiated energy in a specific direction. An antenna feedhorn is placed at the focal point of the dish, acting like the bulb of a flashlight that delivers radio waves between the transmitter, receiver and the parabolic reflector.

"Since 2010, there has been an accelerating resurgence in space exploration, research and development."

Comparatively, MRAs are flat, which means they can conform to the surface of a satellite. They can also be scaled to large sizes and eliminate the focal point precision needed for a traditional feedhorn. In addition, MRAs have the ability to 'electronically beam steer'— or change the direction of – the radiated energy across a field of view without any mechanical movement.

Javor graduated with his master's degree in electrical engineering in 1994. At that time, the process for an MRA to continuously and smoothly direct a beam across the field of view was challenging due to the lack of resources and technology. In his thesis, Javor developed a comprehensive, experimentally verified design procedure for the microstrip reflectarray antenna, which had never been done before. He included a solution for this, but it required complex electronics not available at the time. In recent years, however, there have been electronics commercially developed to make this idea a reality.

LOOKING FORWARD (AND UPWARD)

Due to its many capabilities, the door has just opened for the development, research and application of printed reflectarray antennas.

"Since 2010, there has been an accelerating resurgence in space exploration, research and development," Javor said. "NASA has since developed and deployed a novel and compact integrated solar array reflectarray antenna (ISARA) satellite whereby the microstrip reflectarray antenna is on the backside of the solar panels yielding a very efficient design."

TryEngineering Summer Institute

Students from around the state of Texas and the world gathered on the campus of Texas A&M University last summer for the Institute of Electrical and Electronics Engineers (IEEE) TryEngineering Summer Institute, hosted by the Department of Electrical and Computer Engineering. The camp is structured with two, two-week camp sessions that allow students to experience life on a college campus and see what electrical and computer engineering and Texas A&M have to offer.

The camps focus on STEM-related coursework and provide opportunities to experience hands-on design challenges and projects, learn firsthand from experts in the field, form friendships with other students and get a behind-the-scenes look at innovative engineering environments such as the Zachry Engineering Education Complex.

TryEngineering Summer Institute students not only enjoy the impressive facilities on campus, they are also near the heart of the United States' space program, and past students have enjoyed visits to NASA's Johnson Space Center.

Fifty-two students attended both sessions hosted at Texas A&M last summer. One camper said, "I enjoyed the summer institute because it gave me a great experience, and I enjoyed the lessons and activities provided throughout my time at camp. It showed how college life was and really got me brainstorming about what I would like to do in the future."

"It has been wonderful having the IEEE TryEngineering Summer Institute on campus this summer. Seeing the campers' excitement and interest in working on, completing projects and learning engineering concepts makes us excited for the future and for what these young people will contribute to the engineering community," said Windy Lala, electrical and computer engineering undergraduate advisor.

"Seeing the campers excitement and interest in working on and completing projects, and learning engineering concepts makes us excited for the future and for what these young people will contribute to the engineering community."

Several IEEE professionals attended the speaker and panel sessions, in addition to current NASA engineers. This was the second summer that the Department of Electrical and Computer Engineering hosted TryEngineering. The University of California, Riverside hosts the California camp and Vaughn College of Aeronautics and Technology hosts the New York camp.

The goal of the TryEngineering Summer Institute is to spark enthusiasm in engineering and technology in the next generation of problem solvers and difference makers, and position these innovators for long-term success in academics and in life. TryEngineering Summer Institute is a partnership between IEEE and Branded Camp Services.

A camper at the Institute

SMALL DECISIONS, BIG OPPORTUNITIES:

Electrical engineering student takes education to new heights

Jeremiah Lockhart, a sophomore in the Department of Electrical and Computer Engineering at Texas A&M University, is a self-proclaimed ordinary kid from Duncanville, Texas. Taking a chance on a once-in-a-lifetime opportunity, he applied for and was awarded an extraordinary scholarship – the Gates Scholarship – that will bolster him as he pursues his education at Texas A&M.

Out of around 30,000 applicants, Lockhart was one of just 300 students selected to receive the prestigious Gates Scholarship. With it, Lockhart is able to focus on his studies and extracurricular opportunities without any student loans or financial burden. To be eligible for the scholarship, applicants must be in the top 10% of their high school class, have Pell Grant eligibility, exceptional personal success skills and proven leadership ability. Applicants undergo a rigorous three-phase process, which concludes with only 300 students awarded.

“My parents worked so hard and have sacrificed so much for me since I was a kid to get me where I want to go and just to get to tell them that they don’t have to pay a thing for me, that they can relax and retire, and that I won’t be a financial burden and have everything taken care of, it was a great blessing from God,” Lockhart said. “I’m really happy to be given it.”

Lockhart has been drawn to electrical engineering since he attended an engineering camp in eighth grade.

“When I made that first circuit and saw the LED light up because of how I coded it, I fell in love with electrical engineering,” he said.

From there, he pursued the electrical engineering track in high school and decided to continue that trajectory at Texas A&M. Lockhart feels that his electrical engineering degree from Texas A&M will allow him to reach his dream of becoming an electrical engineer. He recognizes that though it’s not easy, it’s worth it and will position him to achieve great things in his future career.

“The way they teach us is not easy,” Lockhart said. “It’s tough, but it’s for a purpose. It really gets your brain to understand the purpose behind (the lessons), how to implement it and how to put it all together to reach the market. I’m really excited about that and, long story short, I just love it. It challenges me enough that I won’t get bored with it and it’s provided enough satisfaction that all the work I put into it is one of the best experiences I’ve had. I want to use the skills from the electrical and computer engineering department to help mold me into an emboldened innovator that is ready to take on the world’s problems and develop impactful solutions.”

He is not only passionate about this field but also for letting other students know that what he has accomplished so far in his academic career is possible if you put the work in.

> “Do not let other people define who you are, do not let where you come from define who you are or what you amount to be in life. Just because you are from this small town where most people are minorities or low income doesn't mean you're destined for mediocrity.” **–Jeremiah Lockhart**

“Do not let other people define who you are, do not let where you come from define who you are or what you amount to in life,” he said. “Just because you are from this small town where most people are minorities or low income doesn’t mean you’re destined for mediocrity.”

Lockhart is also an officer in the National Society of Black Engineers at Texas A&M where he is working to help college students excel academically, succeed professionally and positively impact the community. He is also working with the superintendent of his high school to encourage high school upperclassmen to apply for these big scholarships.

“I don’t want anyone feeling how I felt,” he said. “I’m not a special person, I don’t deserve this, but that’s no way of thinking because anything is possible if you believe in yourself.”

Jeremiah Lockhart

Q&A with first generation student, Luis Sanchez

The College of Engineering at Texas A&M University is home to more than 20% first-generation undergraduate students. Below is a conversation with Luis Sanchez, a sophomore in general engineering, about his college experience.

Q: What's it like to be a first-generation college student?

A: I feel like my experience as a first-generation student might be a little different than most. I've always really done what I have to do. I've always had the mentality of, "OK, you know you're going to do this, and you know you want to go to college and you know you want to have a good job that can sustain you," because I come from a low-income family, so it's been different. I know I want to have that extra step to my parents' education, so I've always had the mentality of, "I know I have to do this, so I have to push through this regardless of what I'm going through." But sometimes I feel a little discouraged or a little doubtful and I remind myself, "OK, you're doing this and you're a first gen. You should be proud." It helps me push through – reminding myself that I'm a first gen and seeing that all my family is looking up to me and telling me, "You can do this," even though they don't understand exactly how it is because they didn't go through registration of classes or the struggle of studying.

Q: What student organizations are you involved in?

A: I am a mentor for the Century Scholars Program. Another club that I am in is the Energy Club. For the Century Scholars Program, each section is like a class; we have a section leader and there are four other mentors. I am one of them. What we do in the class is just show all the incoming freshmen the resources that Texas A&M has and also give them guidance and tips on how to get through different situations during the first year. We go out with our mentees at least once a month to get involved with them and build a bond with them and introduce them to the new lifestyle (of being a college student) since most of them are first-generation students.

Q: Why are you interested in the Department of Electrical and Computer Engineering?

A: I chose electrical engineering because I'm really passionate about the environment and sustainability. I want to go into the energy industry and renewable energy sources in hopes of expanding solar and the wind turbines to more neighborhoods and cities so that we won't have to rely so much on fossil fuels.

Q: What advice would you give to other first-generation students?

A: I would tell a first gen that it's definitely doable, regardless of your parents or everyone else who you've seen that hasn't gone to a university. There are resources and people that can help you, and because other people have gone through it, they can help you through it as well.

Luis Sanchez

Dr. Kate Davis with students Braxton Williams, Patrick Wlazlo, Philip Smith, Ryan Jones and Nicholas March and John Zenick

Texas A&M student team shines in **DOE CyberForce Competition**

A team of students from Texas A&M University placed 10th in the nation out of 108 teams at the Nov. 16 Department of Energy (DOE) CyberForce Competition™, which is a cyber workforce development competition that focuses on the defensive/hardening nature of energy cyberinfrastructure.

The DOE partnered with current national laboratory staff that has successfully hosted four successful cyber defense competitions to exercise interactive, scenario-based events to create this competition. The national labs that hosted were Argonne National Laboratory, Brookhaven National Laboratory, Idaho National Laboratory, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, National Energy Technology Laboratory, National Renewable Energy Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory and Sandia National Laboratory, which is the location at which the Texas A&M team participated.

The competition features realistic components such as a cyberphysical infrastructure, lifelike anomalies and constraints, and actual users of the systems, and is structured with four teams that have different objectives and one panel. The Blue Team interacts with the Green Team to ensure proper IT support is administered as well as provides a creativity pitch to the Chief Information Security Officer (CISO) panel; the Green Team acts as users and/or operators of the energy infrastructure by testing the usability and availability of the Blue Team's systems; the White Team, usually national laboratory personnel, are the IT administrators and architects of the competition; the Red Team actively attacks the Blue Team's infrastructure in order to disrupt the availability and usability of the system; and the CISO panel allows Blue Team members to pitch their level of creativity and innovation in their defense strategy. The Texas A&M team was the only team at their location to keep the Red Team from entering into their system.

Nicholas March

The students competing on the team were members of the Texas A&M Cybersecurity Club and included junior Braxton Williams from the College of Education and Human Development; senior Patrick Wlazlo from the Department of Engineering Technology and Industrial Distribution; senior Philip Smith from the Department of Electrical and Computer Engineering; junior Ryan Jones and senior Nicholas March from the Department of Computer Science and Engineering; and Cybersecurity Club president John Zenick from the Mays Business School. Dr. Kate Davis, assistant professor in the Department of Electrical and Computer Engineering, served as the team's coach. The Texas A&M Cybersecurity Center, which sponsored the Cybersecurity Club in this competition, seeks to advance the collective cybersecurity knowledge, capabilities and practices, doing so through groundbreaking research, novel and innovative cybersecurity education, and mutually beneficial academic governmental and commercial partnerships.

Levi McClenny

Student regent pilot analyzes materials through interdisciplinary program

Since 2015, the Data-Enabled Discovery and Design of Energy Materials (D3EM) training program at Texas A&M University has been developing interdisciplinary leaders across the College of Science and College of Engineering.

D3EM is led by Dr. Raymundo Arroyave, Presidential Impact Fellow and professor in the Department of Materials Science and Engineering.

"One of the most rewarding aspects of the program is the fact that we have such a diverse group of students with all kinds of life experiences," said Arroyave.

Funded by the National Science Foundation, the program focuses on empowering graduate students with the skills needed to create and apply data-driven approaches to the development, design and application of advanced materials and machine learning for energy-related technologies. Through fellowship, research and networking opportunities, it bolsters the students of today as they work toward a more sustainable tomorrow.

Levi McClenny serves as a pilot and platoon leader for the United States Army Reserves.

Levi McClenny, a doctoral candidate in the Department of Electrical and Computer Engineering who holds a D3EM fellowship and was recently appointed student regent, has utilized the program to gain insight as to what happens at the microstructure level in materials. In doing so, he is working under the mentorship of Dr. Ulisses Braga-Neto, associate professor in the electrical and computer engineering department, to investigate how to develop and manufacture better materials designed to accomplish specific tasks for the future.

Needless to say I was ecstatic (to learn about the student regent appointment), this is an opportunity I have had my eyes on for years and it's incredibly exciting to see years of work pay off.

"The D3EM group has been using

data to learn a substantial amount about materials compositions and processing methods, and has derived methods that are currently being fielded by entities such as NASA, to create materials with specific properties that are useful for very specific applications," said McClenny. "The D3EM research is a testbed for proof of concept that we can learn real, practical and pragmatic methods of utilizing materials data to our advantage."

In addition to creating, he is also looking into how materials break down.

In a collaborative project between the D3EM and the Army Research Lab, McClenny is investigating how machine learning can be applied to the fracturing process of materials in order to predict when breakage or deterioration will occur in military vehicles and, ultimately, prevent it from happening in the first place.

For example, a military aircraft is comprised of a myriad of components – each in different stages of wear and tear. By building smart vehicles that can begin to detect their own deterioration, pilots and engineers will be able to better determine the overall state of their vehicle, which will help with maintenance and operational requirements.

Through his experience with D3EM, McClenny has been given the opportunity to pursue his research passions while also honing his professional and technical skills to be able to effectively communicate within, collaborate and lead an interdisciplinary team now and into his future career.

"Better material implies better structures, and probably cheaper to manufacture as well," said McClenny. "As we learn more about how to manufacture materials to the exact specifications we desire, we can remove the design constraints that exist with some materials used in modern structures, machines and medicine. Doing so would allow us to manufacture the exact material required for a task and can have significant implications in improving the designs of the future and optimizing the designs of the past."

"Levi is a perfect example of the students we aspire to train as he not only brings his expertise in computer science and machine learning into a materials science program, but his military perspective brings a sense of purpose to some of the problems we study as part of the program," said Arroyave.

Harnessing his diverse experiences and dedication to a better future, McClenny is now taking steps toward his new appointment as student regent.

"Needless to say I was ecstatic (to learn about the appointment). This is an opportunity I have had my eyes on for years and it's incredibly exciting to see years of work pay off," said McClenny.

"The D3EM group has been using data to learn a substantial amount about materials compositions and processing methods, and has derived methods that are currently being fielded by entities, such as NASA, to create materials with specific properties that are useful for very specific applications. The D3EM research is a test bed for proof of concept that we can learn real, practical and pragmatic methods of utilizing materials data to our advantage." **– Levi McClenny**

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