Message from the Dean

Since this is my final Message From the Dean, I thought I would take a moment to share some of the major accomplishments of the Fairfield University School of Engineering over the last 20 months. I am proud of the work we have accomplished to lay the foundation and define the path for our future. To begin with:

• The School of Engineering was chosen by the University as one of four strategic priorities for growth over the next five to eight years; as such, we created and set in motion a five-year strategic vision for our future.
• We acquired additional space that will become the SOE Innovation Center and will house advanced research labs, industry-aligned collaboration space, and a makerspace for students.
• The US News & World Report ranking of national master’s degree-granting institutions moved the School of Engineering up to No. 75 (out of 210) in 2020, a 28-place jump from 2018.
• Our undergraduate enrollment is steadily growing; the incoming freshman class for fall 2018 was 88, for fall 2019 it was 114, and our goal for fall 2020 is 130 new and transfer students.
• At the graduate level, we will launch our new MS in Cybersecurity program in fall 2020, in response to the exploding regional and national need for cyber-specialists. Our new cybersecurity laboratory will provide an opportunity to offer cybersecurity certification programs for professionals from business, education, and industry sectors.
• We celebrated our 25th Anniversary at Fairfield University with events including a cybersecurity panel discussion, the first-ever TEDxFairfieldUniversity program, and a lecture by MIT Professor Robert Langer.
• We celebrated National Engineers Week with a theme “Industry 4.0: The Fourth Industrial Revolution,” featuring a keynote address by Dr. Mark Maybury, Chief Technology Officer, Stanley, Black and Decker.

I could easily add more, but I think you get the idea that we are on the move and will be—come a significant presence at the University as our academic reputation continues to grow. It has been a pleasure and a privilege serving as dean, and I look forward to learning of the School’s continued successes in the future.

Sincerely,

Richard H. Heist, PhD
Dean

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ON THE COVER: Biomedical engineering graduates present at TEDxFairfieldUniversity. Photo by Andrew Henderson.

INSET: The TEDxFairfieldUniversity stage was set with a theme of “Innovation and Inspiration.” Photo by Jeannine (Carolan) Graf ‘87.

School of Engineering Faculty: Dedicated to Research and Innovation

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STUDENT ACCOMPLISHMENTS

2019-20 Inductees to Tau Beta Phi, Fairfield's Engineering Honor Society

CLASS OF 2020
Ronald Chasse (CE)
Eric Connolly (SE)
Lilliana Delmonico (BE)
Connor Hehn (BE)
Joshua Heilweil (EE)
Harold Corey Loke (ME)
Jennifer McCann (ME)
Jacob Musto (EE)
Prathna Pel (CS)
Daniel Valli (CE)
Han Bin Yoo (ME)

CLASS OF 2021
Nicolas Black (ME)
Kevin Bodell (ME)
Cesar Gavilano (ME)
Hemant Maheshwari (CS)
Anne Nebbia (ME)
Phuc Nguyen (ME)
Meghan Stevens (BE)
Kathryn Stringer (BE)
Ryan Toner (CS)

2019-20 NASA CT Space Grant Awardees
Mitchell Owen
Keith McHugh

2019-20 Bernadette and John Porter Scholarship
Allison Beesley
Julian Cano Angel
Anthony Chiapetta
Caroline Cortina
Rosanna Corvino-Rosa
Nimesh Das
Alex DiRago
Michael DiMasi
Michael Forder
Charles Golden
Benjamin Gonzalez
Napo Vidyh Gurum
Uyen Tho Ho
Christopher Holtzman
Zachary Kaplan
Thuy Le
Daniel Liawek
Serena Lo
Thomas Marrinan
Sakshi Mathur
Mayara Miranda
Mark Mozdzer
Samuel Nguyen
Mohanapriya Nithyanantha
Sai Teja Patalagota
Shivani Obha Jawaharlal
Erez Osbaula
Sai Teja Patalagota

2019-20 BEI Scholarship
Allison Beesley
Julian Cano Angel
Anthony Chiapetta
Albert Cortina
Rosanna Corvino-Rosa
Nimesh Das
Alex DiRago
Michael DiMasi
Michael Forder
Charles Golden
Benjamin Gonzalez
Napo Vidyh Gurum
Uyen Tho Ho
Christopher Holtzman
Zachary Kaplan
Thuy Le
Daniel Liawek
Serena Lo
Thomas Marrinan
Sakshi Mathur
Mayara Miranda
Mark Mozdzer
Samuel Nguyen
Mohanapriya Nithyanantha
Sai Teja Patalagota
Shivani Obha Jawaharlal
Erez Osbaula
Sai Teja Patalagota

2019-20 Martha Rogers BEI Scholarship
Justin CHI
Samantha Fortune
Alexander Friedman
Vanshith Gudikonda
Vashisht Kukreja
Nicholas Jensen
Kyle Klashka
Tristin O’Connor

UNDERGRADUATE PROGRAMS
B.S. in Bioengineering
B.S. in Computer Science
B.S. in Electrical Engineering
B.S. in Mechanical Engineering

STUDENT ORGANIZATIONS AND SOCIETIES

3D Printing Club
American Society of Mechanical Engineers (ASME)
Biomedical Engineering Society (BMES)
Engineers Without Borders (EWB)
Engineering Student Society (ESS)
Institute of Electrical and Electronics Engineers (IEEE)
National Society of Black Engineers (NSBE)
Society of Women Engineers (SWE)

Society of Automotive Engineers (SAE)
Society of Women Engineers (SWE)
Tau Beta Phi (Engineering Honor Society)

GRADUATE PROGRAMS
Master of Science programs at Fairfield University’s School of Engineering provide the educational foundation engineers need to build a dream career. Skilled faculty teaches how to better understand complex engineering issues within a global context, offering students the knowledge and confidence needed to solve the world’s engineering problems.

GRADUATE PROGRAMS
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CERTIFICATE PROGRAMS
Cybersecurity
Data Science and Big Data Technology
Network Technology
Web and Mobile Application Development

LEFT: Top (l-r), Dean Martel ’21, Samuel Santos ’22, Phuc Nguyen ’21, and Andrew Addison ’20 demonstrated 3-D printer capabilities during National Engineers Week.
Photo by Nicolette Massaro
Bottom, Fairfield Students enjoy an autumn walk to class.
Photo by University Media Center
Techstars Startup Weekends, in partnership with Google for Startups, are run by local organizers in more than 700 cities and 150 countries around the world. The event that took place in Stamford, Conn. last September immersed a group of graduate students from Fairfield’s Software Engineering program in a startup environment that felt more like a 54-hour crash course in how to create a product, launch a business, and connect with experienced mentors and potential investors.

The weekend began for Fairfield grad students Pawan Pillai, Serena Lo, Thuy Le, and Yanbei Xie with Friday night idea pitches, during which they met and joined forces with three additional weekend participants, Theodoros Koutsoukis, Kofi Osei, and Brahma Sen.

Together, the group spent the next two days creating their Plant Wiki app, testing it, and developing a business model. The weekend culminated on Sunday night with a demonstration before a panel of judges comprised of potential investors and local entrepreneurs.

If it’s true, as the Techstars website claims, that “the hardest part of starting up is starting out,” the co-creators of the Plant Wiki App did not just slog through the hard part — they sailed to a first-place finish and $300 cash prize.

The group’s prizewinning product, Plant Wiki, is a smartphone app that targets urban populations to assist with their gardening needs. The innovative app focuses on three primary areas: (1) plant identification and gardening tips, (2) a discussion board, and (3) an in-app marketplace. According to team member Pawan Pillai, “There are many plant and gardening apps in various app stores, but most of them are either not good or pay or subscription-based, which is not conducive to long-term use.

What sets Plant Wiki apart is that the app combines the best features of all competitors’ apps, and offers them at no charge. Said Pillai, “By keeping the app free to use, we hope to gain a large user base. At the same time, we plan to build a marketplace within the app where small and big-box sellers can sell their products directly to app users.” Revenue generated from a small commission on each sale within the app will help to keep the app free for users.

The Plant Wiki app will initially rely on 3rd party sources for plant and soil information, but the developers hope to eventually build a large dataset that can be mined for knowledge and marketplace recommendations. “The end goal,” explained Pillai, “is to build a community of plant lovers who may learn new things about gardening, share their gardening knowledge with each other, and make use of Plant Wiki’s in-app marketplace for all their gardening needs.”

Energized by his fellow entrepreneurs and ready to grow Plant Wiki to the next level, Pillai said, “The Techstars Startup event was a wonderful experience. We got to learn a lot about how to build a startup, and we met many mentors and advisors.”
Thanks to rapid advances in artificial intelligence (AI), robotics, the Internet of Things (IoT), 3D printing, and other technologies, the world is in the midst of a revolution that is causing both material and ideological changes to the way we live, work, and relate to one another. In his 2016 book, The Fourth Industrial Revolution, Klaus Schwab, founder and executive chairman of the World Economic Forum, described this era of progress (also known as 4IR or Industry 4.0) as one that is “blurring the lines between the physical, digital, and biological spheres.”

With a theme of “Industry 4.0: The Fourth Industrial Revolution,” Fairfield’s student engineering clubs recognized and celebrated the dizzying pace of today’s technological advances with a schedule of demonstrations, professional development forums, and service activities from February 16 to 21, during National Engineers Week 2020.

The week kicked off with a keynote address by Mark Maybury, PhD, chief technology officer of Stanley Black & Decker. Dr. Maybury’s presentation focused on the opportunities and challenges of deploying artificial intelligence at scale at Stanley Black & Decker, a $14 billion diversified industrial company with a 176-year legacy of industrial excellence founded on socially responsible innovation.

With more than 60,000 employees worldwide, Stanley Black & Decker manufactures a half million products in 60 countries. Dr. Maybury shared examples of how the company’s products increasingly leverage artificial intelligence, for example, to anticipate falls from gait analysis, perform audio event understanding to enhance security, or to provide intelligent health care companionship to enable aging in place.

He also described how the deployment of artificial intelligence at Stanley Black & Decker’s new global facilities enhances the effectiveness of supply chains, and the manufacturing and distribution of its world-first products.

Other Engineers Week highlights included student-run club activities such as the National Society of Black Engineers’ tribute to engineers of color who have paved the way for and contributed to Industry 4.0, a DIY event sponsored by members of the Institute of Electrical and Electronics Engineers, and an exploration of South American culture with Engineers Without Borders.

Students in the Society of Women Engineers club used an interactive LEGO display to demonstrate to a group of visiting high school students how soft skills — teamwork, communication, adaptability, and problem-solving — interplay with engineering and Industry 4.0 processes.

The Biomedical Engineering Society also invited the high schoolers to check out a fully engineered, interactive “Frankenstein” body, complete with detailed models of body parts and internal organs. They even invited the up-and-coming engineers to design their own body parts.

By the end of Engineers Week, the School of Engineering had successfully started a campuswide conversation on how Industry 4.0 is reshaping our culture, our social interactions, our work — and how it is challenging our notions about what it means to be human.
If you’ve ever watched a great TED or TEDx talk online, you’re probably familiar with that “aha” feeling of suddenly seeing a topic or idea in a fresh new, interesting way. That’s what it felt like to be a part of the first-ever live TEDxFairfieldUniversity event, held this past fall in the Regina A. Quick Center for the Arts.

The acronym TED stands for Technology, Entertainment, and Design — the three topics that combined in 1984 to form the first TED Talk in Monterey, Calif. Today, the nonprofit TED organization shares “ideas worth spreading,” not only through the renowned annual TED Talk conference, but also through TEDx — a program launched in 2009 as a smaller, more intimate venue for local communities to share big, TED-worthy ideas. Last year, there were more than 3,600 TEDx events around the world.

Among the nine speakers selected were alumna Dawne Ware ’89, CEO of Ware Consulting LLC and a finance and operations executive in the property casualty and re-insurance industries, who had a message about doing the right thing – even when no one is looking; David Banks, president and CEO of The Eagle Academy Foundation, Inc., whose visionary approach to the education of young men of color has been featured on CBS This Morning and CNN; third-generation CEO of U.S. market leader Bigelow Tea, whose parents had a front-row seat as she passed along important life lessons learned from her predecessor and father; and the wife and children of Mark Unger, author and owner of another family business, Unger Global Companies, whose moving TEDx talk, “First Survivor,” about confronting – and rejecting – the prognosis of “zero chance of survival” when his son was diagnosed with childhood cancer.

Having served three U.S. Army tours as a trauma surgeon in Afghanistan and Iraq, Dr. T. Sloane Guy, MD, MBA, brought a unique perspective to his TEDx talk, “Innovation Inspired by Adversity: Robotic Surgery’s Third Wave.” Dr. Guy, who today works as a surgeon, professor, and director of Minimally Invasive & Robotic Cardiac Surgery at Sidney Kimmel Medical College of Thomas Jefferson University Hospital in Philadelphia, described how the established medical profession first renounced the young doctors pioneering minimally invasive surgical techniques in 1984. Today, their innovation is now widely considered to be “the most revolutionary medical procedure in two years.” Summing up his vocation to teach, perform, and advance the science of minimally invasive robotic surgery, Dr. Guy said that a quote from Keanu Reeves: “I could either watch it happen or be a part of it.”

Cybersecurity expert Aidan Kehoe, co-founder and CEO of Skout Cybersecurity challenged young leaders in business and the community to “change the world by caring about it more every day,” in his TEDx talk, titled “Feeling Safe in Scary Times.” To the great interest of the engineering students in the audience, he estimated that there are currently 3 million open jobs in cybersecurity worldwide – almost a half million of them in the U.S.

From a wide range of vocations and backgrounds, all of the invited speakers shared one important asset: an idea that would inspire debate and spark conversation. For bioengineering major Lilliana Delmonico ’20, it was a thought-provoking twist on how to handle the expectations of others when asked, “What do you want to do with the rest of your life?”

For Donna Coletti, MD, MS, FACOG, scholar-in-residence at the Kanarek Center for Palliative Care in Fairfield’s Marion Peckham Egan School of Nursing and Health Sciences, it was the personal story behind her unlikely professional career path from obstetrics and gynecology to palliative and hospice care.

For Stephen Badylak, DVM, PhD, MD, deputy director of the McGowan Institute for Regenerative Medicine at the University of Pittsburgh, it was the idea that innovation and inspiration are “typically borne out of an unmet need.” In the field of regenerative medicine, which Dr. Badylak defined as “trying to replace missing or injured body parts with functional tissue,” he noted that every innovative step forward comes with mistakes and identified limitations that then supply the next unmet need. “The way we’re going to continue forward,” he said, “is by continuing to be inspired by our limitations.”

Innovation & Inspiration
at TEDxFairfieldUniversity

I watch and share the TEDxFairfieldUniversity talks at:
fairfield.edu/tedxfairfielduniversity

ABOVE: Seven of the nine presenters (l-r): Lilliana DelMonico ’20; Stephen Badylak, DVM, PhD, MD; Dawne Ware ’89; Mark Unger; Aidan Kehoe; Donna Coletti, MD, MS, FACOG; and Cindi Bigelow H’16.
As he celebrates a decade of service to Fairfield University, Professor Shahrokh Etemad, PhD, is on a roll. For starters, he was named a fellow of the American Society of Mechanical Engineers (ASME) in October. “Being a fellow of ASME is a unique and prestigious honor,” said School of Engineering Dean Richard Heist, PhD, “since fellows comprise only about 3.5% of the ASME membership.”

Dr. Etemad has been an ASME member since 1995, and said the Society has been a valuable resource for learning about leading-edge technology and for exchanging information with colleagues from other institutions and research centers. “The field of mechanical engineering was already big,” he said, “and it is now getting bigger. Renewable energies such as solar and wind are now on our roof and in our backyard. New fields of advanced manufacturing and industrial automation are part of the fabrication process; robotics have penetrated into the medical and advanced electronics field. Composite materials and nano-materials are replacing the traditional materials on vehicle, aerospace, and household equipment. New autonomous vehicles are taking off.”

The following month, Dr. Etemad was inducted into Tau Beta Pi, the nation’s second-oldest honor society (established in 1885) and the only one to represent the entire engineering profession. In addition to distinguished scholarship, field achievements, and exemplary character, Dean Heist noted that Tau Beta Pi seeks members who “foster a spirit of liberal culture in engineering colleges.”

Dr. Etemad is a big proponent of student and faculty involvement in honor societies and technical societies like ASME, as a way to enrich classroom learning, gain leadership experience, and stay on top of fast-changing engineering fields. “I am a believer in life-long learning,” he said. “I hope these awards will set an example for junior faculty that a PhD degree should not be their last milestone.”

Prior to becoming a full-time School of Engineering faculty member in 2010, Dr. Etemad worked at research divisions of Honeywell-Textron, Carrier-United Technologies, and Precision Combustion, Inc. He has published 40 technical articles and has been awarded 29 patents.

When asked to compare today’s field of mechanical engineering to the one he studied as an undergraduate, Dr. Etemad pointed out that the equations haven’t changed since his days as a student engineer, but technology has made the learning process and execution “an order of magnitude quicker.”

“As a result,” he said, “I expect our students today to be more productive and deliver a faster turnaround.”

Beyond the classroom, Dr. Etemad’s expectations for School of Engineering graduates remain high. “I anticipate our students moving up the organisational ladder quickly when they leave Fairfield University. I always tell them to pursue higher education; they should target a master’s degree within a year or two and a half, and a PhD within four years. For those pursuing industrial careers, I encourage them to set their sights on the title of Senior Engineer within five years.”

“I am a believer in life-long learning. I hope these awards will set an example for junior faculty that a PhD degree should not be their last milestone.”

Shahrokh Etemad, PhD Chair of Mechanical Engineering

Shahrokh Etemad, PhD, celebrates a decade at Fairfield University with a pair of national recognitions.

“Life-long learning. I hope these awards will set an example for junior faculty that a PhD degree should not be their last milestone.”

Shahrokh Etemad, PhD Chair of Mechanical Engineering
AT Fairfield’s School of Engineering, students learn that to become competent engineers, they need to be willing to take risks, solve complex problems, and navigate around difficult situations when they arise. Judging from their success at the Charles F. Dolan School of Business’s annual Fairfield StartUp Showcase, student engineers are also finding out that these skills translate well in the competitive world of business entrepreneurship.

Now entering its ninth year, the Fairfield StartUp Showcase is the University’s entrepreneurship competition where teams of students present their ideas, make business pitches to a panel of investors, and compete for seed money in front of a live audience.

Before making it into the Shark Tank-style competition, selected StartUp teams go through a year-long sequence of educational, networking, and mentoring events designed to help them ideate and articulate their business models in order to attract partners to help them launch their businesses.

With an idea to use his engineering and robotics background to create a more accessible platform for delivering camera movements on movie and television sets, electrical engineering major Michael Lynders ’19 teamed up with partners Matt Fanelli ’20 and graduate students Parth Bhavsar M’19 and Kacper Laska ’18, M’19 to enter last spring’s competition. Using a grant from the CT Innovation organization, they built a prototype of Lynders’ concept, the AutoDolly.

The AutoDolly is a mobile camera tripod with tilting and vertical axes that applies collaborative robotics to enable operators to provide smooth cinematic motions. Its groundbreaking technology uses three specially designed wheel modules and sensors that allow it to glide in any direction and turn on a dime.

Lynders’ idea for the AutoDolly sprang from witnessing the time-consuming challenges that filmmakers encounter when setting up equipment between scenes. The product uses technology that replaces the need to physically move equipment between shots, which he hopes will save independent filmmakers both time and money: “On stage, time is money. Production value increases with more shots per day. With fewer hours spent on stage, money can be saved on set wages and other expenses.”

At the end of the StartUp Showcase competition, the AutoDolly team was awarded first place and $10,000 in seed money, plus an additional $1,000 after being voted the audience favorite. They plan to put the funding toward building a fully-functioning device and expanding their marketing team. Their StartUp Showcase experience has taught them that in both engineering and entrepreneurship, it pays to wisely assess risks and challenges, and pivot when necessary.

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SENIOR DESIGN PROJECTS SPRING 2020

Team 2 is working with ASML to create a Reticle Simulation program for inside a lithography system. The simulator projects an animated light flow as it moves between stations, to detect errors and reduce human time consumption.

Team 3 is working with the FAA on new paradigms to increase air traffic safety by aiding in the process of simulating conflicts with recorded flight data using Jenetics, an open source Java-based Algorithm Framework Replacement.

Team 4 is working with the University of Florida to develop an educational convective transfer experiment for integration into the undergraduate mechanical engineering lab curriculum.

Team 5 is working with the University of Florida to develop a needle protection device that will provide a safe and effective way to remove dental hypodermic needles working prototype of a needle protection device that will provide a safe and effective way to remove dental hypodermic needles.

Team 6 will combat energy overconsumption and enable consumers to make more mindful decisions regarding their energy usage, by placing a device to provide real-time energy consumption data.

Team 7 will design and construct a system that unpacks small charms from individual bags and separates them from all of the plastic debris without any harm to the charms.

Team 8 will develop an educational heat transfer experiment to integrate into the undergraduate mechanical engineering lab curriculum.

Team 9’s project enables imaging of 3-dimensional objects on various surfaces, to determine position and height of objects through Fourier analysis of the resulting image.

Team 10 will innovate a new way to remove dental hypodermic needles using Eddy Currents to help damp a wide range of unwanted vibratory behavior, and build a prototype system on the basis of respondents to Class of 2019 survey.

Team 11 will create a device to oppose and damp a wide range of recorded vibrating movement using Eddy Currents to help design of a passive system, to combine with a travel multiplier for added efficiency.

Team 12’s project enables imaging of 3-dimensional objects on various surfaces, to determine position and height of objects through Fourier analysis of the resulting image.

Team 13 will fabricate of a MALDI Matrix Sprayer for Fairfield University SOE graduates.

FAIRFIELD SOE GRADUATES
A SAMPLING OF COMPANIES THAT HIRE FAIRFIELD SOE GRADUATES

120 Undergraduate student-to-professor ratio

100% Placement Rate six months after graduation

$67,499 Median starting salary for Fairfield University SOE graduates

2% full-time service program

82% employed 16 full-time graduate program enrollment

16% full-time graduate program enrollment


FACULTY DEDICATED TO RESEARCH AND INNOVATION

Uma Balaji
Associate Professor and Chair of Electrical Engineering
PhD, University of Virginia, VA, USA
• Renewable Energy
• Energy Conversion, Heat and Mass Transfer
• Thermal-Fluid Sciences
• Computational Fluid Dynamics

Douglas Lyon
Professor, Chair of Electrical and Computer Engineering
PhD, Northeastern University, Boston, MA
• Electric Power Systems
• Power Systems Security
• Energy Storage
• Energy Conversion and Propulsion

Shrekh Etemad
Professor and Chair of Mechanical Engineering
PhD, University of Waterloo, Ontario, Canada
• Energy Conversion and Propulsion
• Renewable Energy
• Turbulent Combustion
• Computational Fluid Dynamics

Msafiri Qari
Assistant Professor, Mechanical Engineering
PhD, University of Texas at Austin, TX
• Fluid-Structure Interaction
• Turbulent Combustion
• Micro/Nano Manufacturing

Shivangi Desai
Assistant Professor, Electrical and Computer Engineering
PhD, Massachusetts Institute of Technology, Cambridge, MA
• Content Delivery Networks
• Network Architecture and Design
• Networking Protocols

Sriharsha S. Sundarram
Associate Professor, Mechanical Engineering
PhD, University of Texas at Austin, TX
• Fluid-Structure Interaction
• Turbulent Combustion
• Micro/Nano Manufacturing

Srirangarajana S. Sundaram
Associate Professor, Mechanical Engineering
PhD, University of Texas at Austin, TX
• Fluid-Structure Interaction
• Turbulent Combustion
• Micro/Nano Manufacturing


VISION

The School of Engineering will be:
- a recognized leader in modern, externally-based educational and research institution
- known for innovative, applied research that, together, fosters a student-centered and research-focused educational experience that prepares graduates for successful and rewarding careers in service to others.

MISSION

The School of Engineering is dedicated to:
(1) Providing transformative educational experiences that prepare our graduates for successful careers; (2) advancing engineering knowledge through applied research; and, (3) supporting the University’s mission of whole-person development (cura personalis) by incorporating into our students the service-to-humanity character of the engineering profession, prepared to meet the future challenges of a rapidly evolving, technology-based society.

VALUES

“Our Ethics in Action”
- Excellence
- Engagement every level
- Innovation across all disciplines
- Character as a foundation of Leadership
- Diversity and Inclusion in all things
- Service to a lifelong goal

PURPOSE

We believe a strong, experientially based curriculum, supported by faculty with an applied research focus will lead to:
- Enhanced academic reputation.
- Increased scholarship (i.e., scholarship of application, teaching and learning).
- Students, imbued with the service-to-humanity character of the engineering profession, prepared to meet the future challenges of a rapidly evolving, technology-based society.

SPRING 2020 | SCHOOL OF ENGINEERING UPDATE