METRICS

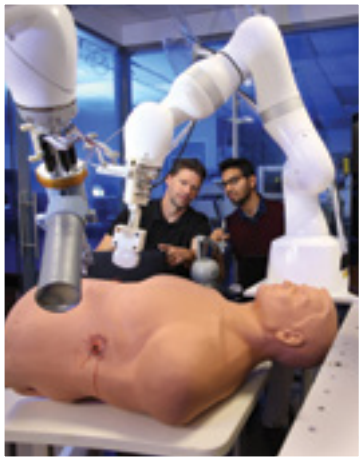
MECHANICAL ENGINEERING AT MARYLAND

CELEBRATING OVER A CENTURY OF BLAZING TRAILS TO THE FUTURE

A. JAMES CLARK SCHOOL OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING

125 YEARS

1894 2019



Chair's Message

Dear Friends,

This year is our 125th Anniversary, which we celebrate with the A. James Clark School of Engineering. In this special year, the 2019–2020 academic year, we have commenced our fall semester and classes are underway.

We were the first engineering program to be established in 1894 at the University of Maryland and continue to be a major presence in the A. James Clark School of Engineering. Over the last many years, we have had the highest number of undergraduate students in this school.

As in past METRICS issues, we reflect on the continuum that connects all graduates of the department over the 100 plus years, namely, our educational values, curriculum and research excellence. During this period, the late George Irwin, also known as the father of fracture mechanics, became a member of the U.S. National Academy of Engineering (NAE) in 1977, the first in our department. Since then, many members of the department have followed in his footsteps. In this context, it is worth mentioning that faculty member and former University of Maryland President C. Dan Mote, Jr. served as the president of NAE from 2013 to 2019.

Recently, the U.S. National Academy of Engineering listed 20 greatest engineering achievements of the 20th Century. With this list as a context, we cover the different contributions that students and faculty from the department have made in a wide range of areas, including air conditioning and refrigeration, electronics, fiber optics, health technologies, materials and nuclear technologies. In addition, we spotlight students, alumni, and faculty who have been recognized with honors and awards.

We hope you enjoy this issue.

B. Balachandran

Balakumar Balachandran
MINTA MARTIN PROFESSOR AND CHAIR
DEPARTMENT OF MECHANICAL ENGINEERING

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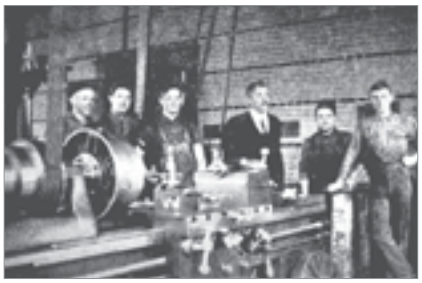
Metrics is published annually for alumni and friends of the Department of Mechanical Engineering at the A. James Clark School of Engineering, University of Maryland.

Please send letters to the editor and alumni notes to mealumni@umd.edu

THE JOURNEY

IN 1894, the Maryland Agricultural College (MAC) Committee for Instruction agreed to provide $2,500 for facilities and $1,000 for an instructor to create a four-year program in mechanical engineering, the college's first formal foray into engineering education. The Department of Mechanical Engineering existed in name-only that first year; but by the fall of 1895, students arrived to find a freshly-inked curriculum developed by Lieutenant John Donaldson Ford, chief engineer of the U.S. Navy, and a two-story, red-pressed brick building, now known as Taliaferro Hall. Professor Harry Gwinner, an engineer with the Watts-Campbell Engine Co., was the first (and with Ford, the only) practicing professor in those early years, and later became principal of the program. The program's first recipient of a mechanical engineering degree was John Hanson Mitchell (B.S. 1898), who joined Gwinner after graduation as an instructor, later taking the helm. As the program grew, a handful of young engineers—all recent graduates, like Mitchell—were added to the faculty to accommodate the growing enrollment. By 1903, there were 72 mechanical engineering students.

Turn-of-the-century students in ME quite literally built the school. Early projects included the installation of a 40-horsepower automatic cut-off engine to power the pattern and machine shops, and the boilers for the university steam plant. Below, Harry Gwinner with students.



In 1895, in-state tuition, including room and board, medical and lab fees, was $155 for the year.

OVER THE NEXT 125 YEARS, the program grew dramatically. It was not only the first of eight programs at the University of Maryland's School of Engineering, it was—and continues to be—the biggest. Today, it is home to approximately 1,200 students and nearly 450 graduate students, including around 250 doctoral students. The department's research and practical endeavors have evolved in ways no person in 1894 could have ever conceived, expanding the reach of mechanics to include complex issues and problems in human health, nonlinear dynamics, robotics, infrastructure, energy and environment and resiliency. It houses a record number of centers and laboratories, and supports institutes that tackle critical issues like systems reliability, energy efficiency and personalized medicine. Students of the program construct, compete and win in a myriad of competitions—from a next-gen Hyperloop pod and Formula One racecars to energy-efficient systems and net-zero homes.

What hasn't changed is the department's mission to help students make their mark on the world. Faculty and staff gladly offer tools and knowledge to design and build, the business skills to commercialize, scale up and create, the exercises to think critically and creatively, and the foundation in ethics and reliability to guide the quality of their work. Its legions of alumni—arguably the department's finest achievement—go on to make their own success stories in a number of diverse fields, pushing the boundaries of ME's 1894 beginnings. In 2019, mechanical engineering at Maryland is interdisciplinary, collaborative and innovative, tackling the challenges of today to deliver a better future.

ME@UMD: 125 YEARS OF IMPACT

IN 2019, THE NATIONAL ACADEMY OF ENGINEERING LISTED 20 INNOVATIVE FEATS OF ENGINEERING THAT SHAPED THE 20TH CENTURY. Ranging from electricity and fiber optics to highways and the television, these advancements conceived the impossible, transformed the national landscape and enhanced our quality of life. Here is how UMD's Department of Mechanical Engineering contributed to these engineering achievements, and how it continues to shepherd them into the 21st century:

STARTING FROM SCRATCH

"I was a new faculty member, and Bill Fourney took me to the space where our lab is today. There were no walls, just a large empty space, and I was supposed to fill it with good experiments. So, that's what we did. We started out with having just three companies funding the center and now it's over 35."

REINHARD RADERMACHER
DIRECTOR, CEEE

THE AUTOMOBILE: When the first Model T rolled off the line in 1908, it was a social and economic game changer. But what made the automobile such a marvel is not what it could do, but rather what it would become. Advanced manufacturing practices, new materials and design and more attention to reliability have transformed the automobile over the past 100 years. At UMD, the significant efforts at the Center for Advanced Lifecycle Engineering (CALCE) have made enormous strides in electronics and battery performance, reliability and longevity. Faculty, like CALCE Director Michael Pecht, have consulted with government on issues of product failure and quality, including the 2010 investigation of the sudden acceleration of Toyota vehicles. Associate Professor Nikhil Chopra is working on autonomous vehicle systems and the control of them.

THE AIRPLANE: Along with the automobile, the airplane is arguably the greatest contribution to transportation in the 20th century. UMD's aerospace engineering department, considered one of the best in the country, was born out of the Department of Mechanical Engineering in 1938. Department Chair John Younger, who had an extensive career in aircraft design and aviation, brought the first courses in aeronautical engineering to Maryland, developing a new crop of graduates adept in aircraft design and construction, vibrations and metallurgy. Frederick S. Billig, whose earned his Ph.D. in 1964, went on to pioneer scramjet propulsion, earning seven patents for super and hypersonic design. Today, faculty like Professor Bala Balachandran work on Air Force-supported research projects on the dynamics of aircraft with long, flexible wings for unmanned vehicle applications. Professor Patrick McCluskey is working with colleagues from the Department of Electrical Engineering and companies like Boeing to explore electric power solutions for commercial aircraft, such as allium nitride semiconductor-based modular power, and Associate Professor Johan Larsson is pushing the boundaries of computational fluid dynamics for aircraft applications.

AIR CONDITIONING AND REFRIGERATION: In 1991, just over six years after scientists first detected the depletion of the ozone layer, Reinhard Radermacher created the center for Environmental Energy Engineering to develop the next generation of energy conversion systems. CEEE built the first CO2 hot water heat pump in the United States and is the leading software developer for heat pump/air conditioning manufacturers in the industry. Today, the center is an international authority in air-conditioning, heat pumping, heat transfer and energy conversion system research, producing new cooling technologies, energy-efficient, compact and smart units and modeling tools that can be used to optimize system performance.

HEALTH TECHNOLOGIES: Breakthroughs in human health are often the behind-the-scenes work of biomechanics—the technologies that deliver help and hope in the face of seemingly insurmountable challenges. UMD has made significant strides in bringing new discoveries to the medical field. In the Medical Robotics & Equipment Lab, Assistant Professor Axel Krieger and his team are fine-tuning a collection of "smart" surgical tools that mesh the expertise and skill of a surgeon with the precise movements and autonomy of robotics to improve the complex, difficult work of soft-tissue surgery. Assistant Professor Ryan Sochol's Bioinspired Advanced Manufacturing (BAM) Lab is developing miniaturized, biofluidic devices to increase the accuracy and efficacy of drug testing. Known as an "organ-on-a-chip", these miniature devices can replicate the architecture, function, materials and characteristics of different systems in the human body, such as a liver or an intestine. The "super cuff," co-developed by Associate Professor Jin-Oh Hahn, goes beyond the traditional blood pressure cuff, leveraging algorithms to measure more personalized and accurate cardiovascular risk predictors. Professor Don DeVoe and his group have collaborated with Children's National Medical Center to investigate a targeted drug delivery vehicle using microfluidic-synthesized lipid nanoparticles to treat disease or deliver topical anesthetic. ME Ph.D. aluma and Professor Miao Yu's (Ph.D. '02) group is advancing auditory technology with fly ear-inspired miniature sensors for devices requiring sound-source localization, like hearing aids.

Testudo, a live diamondback terrapin, reveals the statue of its likeness during the dedication ceremony in front of Ritchie Coliseum on Class Day, June 2, 1933.

GEORGE WEBER ('33) AND THE BIRTH OF TESTUDO

The origin story of UMD's famed Testudo statue is actually rooted in the Department of Mechanical Engineering. In the early 1930s, the University of Maryland adopted the native Chesapeake Bay diamondback turtle as its official mascot. To commemorate the new mascot, Senior Class President George Weber (B.S. '33) traveled to New Haven, Connecticut with a five-inch turtle, plucked from the shores of Crisfield, Maryland, to have it sculpted and cast in bronze by the Gorham Silver Co.—a class gift to the university. The process was overseen by engineering alum Edmund Mayo (B.S. '04). The Testudo statue was unveiled on "class day" in June of that year. It initially lived in front of Richie Coliseum, but after vandalism (and a number of abductions) by rival schools throughout the thirties and forties, Testudo was filled with 700 lbs. of cement and anchored with steel rods outside of McKeldin Library in 1949, where it remains to this day.

Weber continued his impact on campus long after graduation. After serving in WWII, he returned to campus to work for UMD's Physical Plant, where he eventually was director until 1972. He was largely responsible for managing the tremendous growth on campus, taking it from less than 200,000 square feet of floor space to over 2,000,000 in 20 years. Among the many contributions he made to campus, Weber managed the construction of Cole Field House, modular and high-rise housing, Byrd Stadium and the University Golf Course.

A picture from an article in *The Washington Times*, November 19, 1937, of a recovered Testudo that had been abducted and defaced by Georgetown University rivals.

ENGINEERING TO WIN: A HISTORY OF TERPS RACING

In 1981, Mechanical Engineering Professor David Holloway organized a project for his students to expand on his automotive engineering course. Using parts from neighborhood auto shops and junkyards, the students, who were mostly from the campus chapter of the Society of Automotive Engineers, designed and welded a baja-style automobile fit for racing—and winning—taking first place in their inaugural college race in Rochester, NY in the spring of 1982. Terps Racing is the oldest competitive team at the school; for over 37 years, legions of speed-hungry students have steered their design and metal-working prowess to glory as part of the Terps Racing team, designing and building formula-style and baja-style racecars from the ground up and racing them against college teams from around the country. Over the years, Terps Racing has participated in numerous races and established a history of competition victories, including a national championship (and new speed record) in the Sports Car Club of America Solo Formula SAE Class in 2008 and first place in the hill climb event at the Mini Baja 100. Slightly ahead of their time, UMD teams were experimenting with fuel-injected engines and methanol fuel engines in the late 80s. These days, most of the car parts are fabricated by students in the shop and the cars undergo finite element analysis and computational fluid dynamics before race day.

DRIVING A CULTURE OF DESIGN INNOVATION: DAVID "DOC" HOLLOWAY

Dr. David Holloway, known to legions of students as "Doc", was the quiet, consistent force behind decades of UMD automotive competitions, from the early days of Formula SAE and Baja-style racing to Future Truck and solar cars. Holloway, a firm believer in experiential-based learning, helped connect hundreds of students with real-world projects in automotive technology. Doc was not one to dole out suggestions or advice in the shop; he was adamant that teams "do their own thing." But he was a stickler for details and expected his students to not just evolve a design but push the envelope of engineering. "He had high expectations," remembers alumnus Scott Schmidt (B.S. '87). "He wasn't a man of many words, but you could always tell when he was unhappy because the pipe he smoked would be going like a steam locomotive."

Holloway's "project-based" model has been adopted nationally as a standard for engineering education. His generosity of time and spirit greatly enhanced the learning experience, teaching students the importance of creativity, planning, flexibility and teamwork. "Doc guided us through our project as we faced the realities of setbacks, deadlines, egos, fundraising and time management," says alumna Maureen Williams (B.S. '91, M.S. Materials Science Engineering '99), who was on the Pride of Maryland team (right)," and we succeeded because of his confidence in us as innovators, problem solvers and hard workers." Many of Doc's students went on to have successful careers at GM, Ford, Chrysler and Nissan. Schmidt went on to become the senior director of safety and regulatory affairs at Auto Alliance and, taking the lead from Doc, is now the baja-style faculty advisor for Terps Racing. "Doc made advising students seem incredibly easy," remembers Schmidt. "Now that I'm an advisor I know exactly what he had to do."

"David Holloway was an inspirational figure," says Department Chair Bala Balachandran. "His methods and approaches still resonate in the Terps Racing teams today."

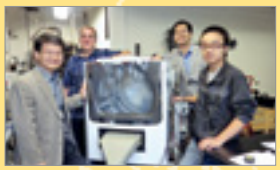
AN ENDOWMENT CREATED TO SUPPORT TERPS RACING

is being established by students, alumni, and friends in honor of David Holloway, the team's steadfast advisor for over 30 years.

SCAN THIS CODE TO LEARN MORE:

THE THRILL OF COMPETITION:

Competitions have been a highly-contagious motivator for ME students to stretch their imaginations and apply classroom knowledge in new ways. Where Terps Racing blazed a trail in the competition arena, other contests soon followed:



NEXT-GEN HOME APPLIANCES: Clark students took top prize two years running at the Department of Energy's 2012 and 2013 Max Tech and Beyond Design Competition for Ultra-Low-Energy-Use Appliances and Equipment.

TRAINS, PLANES, HYPERLOOP: Coined the "fifth form of transportation" by Elon Musk, the Hyperloop is zero-pressure, renewable "tube" travel that could conceivably transport pods at speeds upward of 700 miles per hour, shaving the commute from D.C. to Manhattan to just 29 minutes. In 2017, UMD won the Performance in Operations Award and placed in the top five for overall design during the first competition.

HOME GOODS: The University of Maryland has a long history with the U.S. Department of Energy Solar Decathlon, an elite, international competition to build a stylish and substantive net-zero home. In 2011, UMD's WaterShed, aptly named for the largest tributary in the mid-Atlantic, took top prize and scored the highest number of points ever in the history of the competition. Terps have brought home second-place wins twice—in 2017 with reACT and 2007 with LEAFHouse.

THE SPORTS-RESEARCH CONNECTION

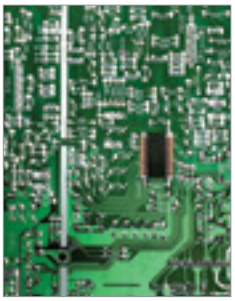
"When we won the NCAA tournament, I had companies calling me up saying, 'Congratulations, Mike, on the big win!' I had nothing to do with that of course, but it often led to them funding more research. So, some of these things go hand-in-hand."

MICHAEL PECHT, DIRECTOR, CALCE

SCHOOL "PRIDE": SOLAR CAR'S LEGACY BRINGS IT HOME IN 2019

Before the frenzy-inciting Tesla, the mild-mannered Nissan Leaf and trailblazing Chevy Volt, there was the UMD Pride of Maryland, one of 32 cars that raced the length of the United States in General Motor's first-ever solar car race, the 1990 GM Sunrayce USA. The challenge: to design, build and race a sun-powered vehicle, one that can withstand the rigors of highway travel, the occasional weather event, and 1,650 miles from Orlando, Florida to the GM Proving Grounds in Warren, Michigan. Constructed of lightweight composite, an aluminum space frame, a high efficiency electric motor and over 2,300 aerospace-grade solar cells, Pride was positively state-of-the-art by 1990 standards. In the style and comfort department, a Tesla it was not; it mildly resembled a horseshoe crab and was equally low to the ground. The solar cell-laden Pride reserved less than 1/3 of the car for the cockpit; the yoke-style steering wheel had to be removed every time the driver got in or out. Like the team that designed it, the car was tenacious; emblazoned with the Number One on its hood, Pride not only took third place in the U.S. race, it went on to place respectfully in the world competition in Australia and again in Japan.

After a 1993 cameo in the Clinton/Gore inaugural parade, Pride was temporarily lost to new activities and the passage of time. Over the next 25 years, it had a number of temporary homes, including a team member's parent's garage. This fall, the Clark School will carve out a permanent home for Pride, finally bringing it home. "This project literally changed my life," says Maureen Williams (B.S. '91, M.S. Materials Science Engineering '99). "I deeply appreciate the opportunity the University of Maryland gave me as a student to experience hands-on engineering and to be part of a groundbreaking project."



ELECTRONICS: Since the first hand-held radio, industries have raced to meet the demand for better, smaller, faster and more prolific electronics; at Maryland, engineers have kept pace to make sure they maintain their integrity. Former Chair and Professor Avram Bar-Cohen's research and developments in cooling methods and heat transfer for electronics has helped pave the way for next-gen phones and other portable technologies, allowing them to perform optimally—and at increasingly smaller sizes—without overheating or deterioration. CALCE's first projects in the 1990s centered on "thermal challenges" of circuit boards, which helped companies to design products that can dissipate heat and work in various environments. Diagnostics to forecast and prepare maintenance activities in advance—in other words, fix things before they fail—monitor the health of electronics. Other CALCE research initiatives address critical 21st century challenges, such as mass production of 3D printers without impacting their performance, the development of a reliable communication system for autonomous vehicles and more durable solid oxide fuel cells (considered a game changer in global energy strategy).

THE TELEPHONE AND TELEVISION: ME alumnus Jim Dingman (BSME '22), was instrumental in the development of the Telstar satellite, which relayed through space the first television pictures and telephone calls, paving the way for satellite-based communications and cable television. He became director of Comsat and later rose to become vice chairman of the Board of AT&T. Reliability engineering Ph.D. alumnus Jeong H. Kim (Ph.D. '91) served as a president of Bell Labs for almost a decade.

FIBER OPTICS: Established by Professor James Sirkis in the 90s, the Smart Materials and Structures Research Center was one the largest research centers of its kind in the country. The center's invention, "fiber-optic three strain sensor," was awarded the Physical Science Invention of the Year in 1996 for its ability to sense deterioration in skyscrapers, bridging, utility plants and aircraft. Today, ME's Sensors and Actuators Lab, a multi-disciplinary lab founded by Professor Miao Yu, leverages innovative materials and technology to develop the next generation of sensors and systems, including miniature sensors for optical and sound source detection. Fiber-optic sensor systems for acoustic, micro-optical, pressure and acceleration measurements can be used in a number of applications such as surveillance and acoustic measurements where sound quality is critical, or to monitor building health.

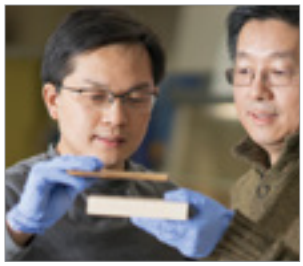
APPLIANCES: One of the first projects by the Center for Environmental Energy Engineering (CEEE) was to develop new ozone-safe refrigerants, a project funded by the EPA, Whirlpool and ATOCHEN. Early successes led to the first patent ever sold by the department—to Samsung. The center's extensive work in heat pump technology has led to promising, energy-efficient clothes dryer technology. In 2016, CEEE Director Reinhard Radermaker, Professor Jelena Srebric and Research Scientist Vikrant Aute unveiled the RoCo roving comfort, a mobile heating/cooling unit that follows users and delivers warm or cool air, depending on the individual's needs. It is the first product from UMD start-up Mobile Comfort and can reduce energy consumption in buildings up to 30%.

IT'S ALL BALL BEARINGS THESE DAYS

"For many years my research was on magnetic bearings. [Then-Chair] Al Shreeve would routinely come to me and say something to the effect of, 'Dave, you've got a lot of people fooled but you've got to tell me, what the heck is holding this thing up?' I said, 'It's magnetism, Al!' to which he replied, 'That's nonsense. But I'll let you get away with it.' He did not believe in magnetic bearings, at all."

PROFESSOR (AND FORMER CHAIR) DAVINDER K. ANAND

NUCLEAR TECHNOLOGIES: ME researcher and "father of fracture mechanics" George Irwin pioneered methods to study cracks in nuclear vessels. The Center for Risk and Reliability (CRR) works closely with the Nuclear Regulatory Commission to model and assess risk, human error and safety to help reactors pre-emptively plan for maintenance and engage in informed decision making. Today, faculty such as Assistant Professor Katrina Groth work on probabilistic risk assessment tools, which can be applied to nuclear energy systems.

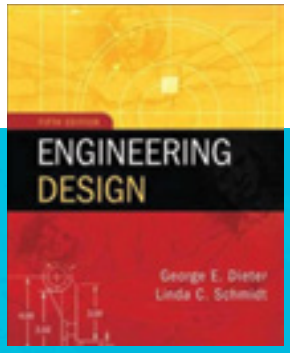


MATERIALS: Former Chair James Dally and his group in the photomechanics lab—which included fellow NAE member George Irwin—established the concept of "crack arrest toughness" for a variety of materials, developing test and evaluation methods. In 1980, A.J. Durelli and Max Frocht made significant advances in photoelasticity. Today, researchers are turning to one of civilization's oldest building materials—wood—as a sustainable, highly adaptable alternative to super-strong materials like steel. A collaboration between ME Professor Teng Li and Material Science and Engineering Professor Liangbing Hu, Super Wood's density and strength is created by removing part of the wood's natural lignin, which gives it rigidity and color, and by employing compression. Super Wood takes on the cool and smooth feel of metal, is just as strong as steel with one-sixth the weight and is a fraction of the cost of carbon fiber.

THE 1970s SLUMP

"I spent my first sabbatical in 1975 writing a book on dynamics for non-engineers. Engineering programs across the country had record-low enrollment, including Maryland. We thought we were going to have to open a technology program, which means you have to teach the courses without calculus. I did finish the book, but I never published it; when I came back in '76, we started booming. It was an unbelievable increase in students."

PROFESSOR (AND FORMER CHAIR) BILL FOURNEY



PIONEERING ENGINEERING DESIGN

In 1994, former Chair and Professor Patrick Cuniff and former Chair and Professor Jim Dally launched the Product Design Course with Black and Decker (now Stanley Black and Decker) with support from a Boeing grant. Each semester, this unique course tasked several hundred undergraduate students to take apart Black and Decker products and learn how the designs could be enhanced. Dean Emeritus George Dieter and Professor Linda Schmidt wrote the classroom staple, *Engineering Design*, now in its 5th edition. Today, Assistant Professor Mark Fuge is pushing the boundaries of engineering design through the introduction of machine learning.

IMPACT THROUGH OUTREACH

ENGINEERS WITHOUT BORDERS: Since its inception in the early 2000s, Engineers Without Borders at the Clark School has sent over 600 students to the four corners of the world—Ecuador, Brazil, Thailand, Burkina Faso, Ethiopia, Sierra Leon, Peru, Ghana, Nicaragua, Nepal and domestically—to devise novel, sustainable solutions to fundamental human needs. They have completed over 30 projects, including a biodigester that transforms organic waste into methane for cooking and fertilizer in Brazil; a pedestrian bridge in Ethiopia, allowing rural residents and livestock to travel safely across the local culvert during the rainy season; and scores of solar energy and water treatment projects.

BUILDING HOPE ABROAD

"I think my Engineers Without Borders experience was the first time I really got to see just how important understanding the functional and emotional needs of stakeholders is when you are designing structure, product, service—anything. It was quite amazing to return to the community and see kids and adults frequenting the community center buildings we constructed; the ultimate vision became a reality. I still apply this co-creative mindset today."

KATHI HENDRICK, B.S. '12

CECD CELEBRATES 20 YEARS

The Center for Engineering Concepts Development (CECD) celebrated its distinguished history and two decades of accomplishments with the 20th Anniversary and Middleton Luncheon on April 17, 2019. The event opened with welcoming remarks from CECD Director, Dr. Davinder Anand, and hosted guest speakers U.S. Senator Chris Van Hollen (D-MD) and Maryland State Senator Thomas "Mac" Middleton (D-Charles Co.), who were early supporters of the research center.

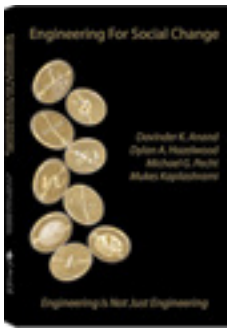
Founded in 1998, CECD was established as the Center for Energetic Concepts Development, initially a cooperative research group between the University of Maryland (UMD) and the Naval Warfare Center, Indian Head Division. In this capacity, CECD served as a platform for conducting world-class research related to the field of energetics, contributing to scientific research in national security, energy, the environment and health. The center partnered with over fifteen organizations to investigate key areas of engineering research in energetics.

In 2015, the center changed its name to the Center for Engineering Concepts Development to represent its changing role in engineering education, research and evaluating the impact of engineering on society. Over the past twenty years, under the leadership of Anand, the center has cultivated a number of impressive programs and initiatives, including the successful launch of the Engineering for Social Change curriculum.

In addition to undergraduate curriculum and research activities, CECD also supports a graduate certificate program through the Office of Advanced Engineering Education, hosts numerous symposia and has published several books. Over the years, CECD symposia have covered topics ranging from the advancement of technology, application of energetic materials and systems, and autonomy to data-driven design and engineering for social change.

As it looks to the future, CECD will continue to build upon a legacy of energetics research, engage in new experiments in engineering education and create greater awareness of the social impact of engineering through innovative activities.

QUEST: Most companies who sign on with UMD's Quality Enhancement Systems and Teams (QUEST) Honors Program today do so for its 25-year reputation of creative problem-solving and student ingenuity. What they probably don't know is that QUEST was a pioneer in weaving Total Quality Management (TQM)— a term to describe the company-wide climate of product improvement and customer value—into higher education. In 1991, IBM created a national grant competition for integrating TQM into the curricula, with a caveat: each must include both business and engineering. Of the 200 universities that applied, UMD was one of eight selected; the three-year, $1 million program offered the fundamentals of product development and created an incredible hands-on program for students from both schools to collaborate on a real-world project. When the funds depleted five years later, the university took over, and the program was renamed QUEST. During its 25-year life span, students have worked on projects for dozens of high-profile, corporate clients looking to improve operations, customer experience and technology application. The in-depth research, thoughtful analysis and often innovative recommendations developed by the QUEST student cohorts result in stellar finished products for clients and a hands-on, practical experience for students.



ENGINEERING FOR SOCIAL CHANGE: The beating heart of the Center for Engineering Concepts Development is Engineering for Social Change (ESC), a philanthropically-minded program launched in 2013 by Professor Davinder K. Anand with guidance and support from the Department of Mechanical Engineering Chair Bala Balachandran. Through the lens of "engineering for good," the program has given away a total of $50,000 since its inception to nonprofit organizations. Each class of 30-40 students works in teams to identify and explore worthy nonprofits and work with them to develop a meaningful project; as a class, students ultimately choose one to receive a $10,000 grant to make that project a reality. The program is both popular and impactful; over the years, it has nudged many a student's trajectory, inspiring careers in international relief, nonprofit, or in government. Students have told Anand it has "humanized" engineering for them and greatly impacted their worldview. "The underlying philosophy of the course is to address unintended consequences of engineering," explains Anand. "Engineering does so many wonderful things, but they also do things that create problems. We need to address those, and we think engineers should be the ones to address them."

CENTER FOR RISK AND RELIABILITY CELEBRATES 35 YEARS

The partial core meltdown of Three Mile Island (TMI) in 1979 forever changed the landscape of nuclear education programs in the United States, including that of the University of Maryland. Yet ironically, it was the TMI disaster that gave birth to one of the Clark School's most successful programs: reliability engineering. Reliability became the new curriculum focus of the revamped nuclear program after TMI, but Professors Martin Roush and Mohammed Modarres saw other applications too; the inner workings of defense, chemical processes, materials, complex systems and infrastructure are all vulnerable to failures, which can significantly impact their lifespan and safety. And as the national nuclear program began to wane, they both saw the importance and opportunity that a program in reliability engineering could hold. With support from then-Dean George Dieter and a sizable grant from the Department of Energy, Roush and Modarres launched the Center for Risk and Reliability (CRR) in 1985, which now serves as an "umbrella" for much of the expertise on risk and reliability throughout the Clark School of Engineering.

At its heart is an understanding of the underlying processes that contribute to failure. CRR migrates from traditional data and observations, which was the industry standard for decades, by integrating science. Researchers utilize degradation modeling techniques, probabilistic physics of failure and accelerated failure of components to infer how the design would behave in the real world. The result creates a more accurate guide for companies and organizations to develop warrantees, pre-emptively plan for maintenance and engage in informed decision-making, setting a new standard for reliability analysis across industries.

With more than 300 reliability engineering graduates, the Master of Reliability Engineering Program is not only one of the largest programs in the world, it also pioneered the education model for risk analysis, reliability and safety of engineering systems and processes, including infrastructure, biomedical devices, automotive and aviation parts, information systems, materials and space missions.

GEARING UP FOR THE FUTURE

The Women of Terps Racing are Leading the Team Forward

Beyond building better cars, this year's leaders in Terps Racing are making strides to build a stronger community of inclusivity and diversity and a team more welcoming and supportive for women engineers.

JESSICA ROSENTHAL, FORMULA TEAM CAPTAIN

At the helm of this year's Formula Team is ME senior and Maryland native, Jessica Rosenthal. After years of disassembling things in her parent's basement, Rosenthal loved the hands-on opportunities and complex problems Terps Racing offered and teammates that were passionate about their work.

As team captain, one of her goals is to develop professional strategies for the team to increase diversity. To Rosenthal, diversity is not just about getting more women on the team, it's about making a better vehicle. "I want to have a good car, and everybody else on the team wants a good car. At the end of the day, having more women on the team, having a more diverse team, will help output a better car."

"It's also important for people to feel like they belong," she adds. "I want the space to feel inclusive, so when someone walks in, that little thought in the back of their head that says, 'I don't know if I belong here,' or 'I don't know if I fit in here,' doesn't come up because they see people that look like them on the team."

ABBY MEYER, BAJA TEAM CAPTAIN

ME junior and Baja Team Captain Abby Meyer is on a mission to increase the number of women joining Terps Racing. In coordination with UMD's Women in Engineering office, Meyer is developing more tailored hands-on engagement opportunities for female students to see what the club is all about.

She also envisions the team becoming more interdisciplinary. "In many ways we're not just an engineering team. We're a business. So we want to bring in people from not just engineering, not just STEM, but from any major to build our business."

Boosting STEM Interest

In 2017, 67% of eighth graders in American public schools were not proficient in mathematics, according to National Assessment of Educational Progress results. Proficiency scores were even lower for Hispanic students. Senior mechanical engineering major Kristen Edwards is working to reverse that statistic through a K-12 tutoring and outreach program with Parkland Magnet Middle School for Aerospace Technology in Rockville, Maryland. Launched last year with other members of the Society of Hispanic Professional Engineers (SHPE), the program helps build mathematics proficiency, confidence and early interest in STEM-related fields.

Faez Ahmed joins MIT's Department of Mechanical Engineering

Faez Ahmed, a 2019 Ph.D. graduate from the University of Maryland advised by Dr. Mark Fuge, will join MIT's Department of Mechanical Engineering in August 2020 as an assistant professor. Ahmed's research interests are in studying computational methods to improve the design process. Recently he has developed matching, ranking, and creativity estimation algorithms to help distributed teams participate in the design process. Prior to his Ph.D., he worked as a reliability engineer for Rio Tinto in Western Australia.

From left, Ashley Lakey (ME '20), Giovanna Amorim (AE '21), and Abby Meyer (ME '21).

Meyer sites Terps Racing as one of the most beneficial experiences she's had at Maryland. She credits the group with helping her develop leadership skills, but also hands-on skills like machining and fabrication, making her not just a valuable asset to future employers, but arming her with skills few women entering the workforce possess.

KRISTINA BUTTION, FORMULA TESTING SUB-TEAM LEAD

Kristina Buttion has always been curious about what makes things tick. When she arrived at Maryland, she wanted to join a group where she could work on projects with other engineers who shared her passion and curiosity. Terps Racing afforded her that opportunity. "I would ask a million questions," said Buttion. "I never felt uncomfortable. I never felt that they didn't want to answer my questions. Everyone was very open to teaching me."

Through that insatiable curiosity, it was a natural evolution for Buttion to become the testing sub-team lead by her second year. "I really liked the integration aspects of all of the components of the car, not just one piece. When something breaks, testing goes in, puts the pieces together and figures out how to fix it."

ASHLEY LAKEY, BAJA STEERING SUB-TEAM LEAD

Senior Ashley Lakey is a third-generation Maryland Terp and second-generation engineer who grew up fixing things with her dad, so ending up in Terps Racing seemed like an inevitability. As a sub-team lead, Lakey enjoys the comradery of the group and recruiting new team members, bolstering their interests and getting them excited about the project.

"It's pretty awesome, because some of the people on my team [this year] were freshman, and it's their first time trying to design something. It's so much fun to help them through that [process]." Lakey credits her time on the team with giving her real-world "street smarts" to go with the "book smarts" she gained in her classes and will use her experiences to explore a range of possible engineering paths.

Cleaning up at Design Day

Suds & Studs + Mia took first place at the Spring 2019 Design Day for their human-powered washing machine, designed for Ugandan refugee camps. Nearly 60 teams participated in the Fall and Spring Design Days this past academic year, with projects including a device to manage Parkinson's disease tremors, an autonomous system for filling potholes, a stair-climbing robotic vacuum and an automated cleaning mechanism that degreases and lubricates bicycle chains.

DESIGN DAY JUDGES

FALL 2018

Andrew Akers
Tim Arnold (B.S. '76)
Thomas Bassolino (B.S. '04)
Bruce Dale (B.S. '64, M.S. '67)
George Dieter
Bill Leasure (B.S. '66)
Matt McTigue (B.S. '93)
Jonathan Murray (B.S. '00)
Bill Sangrey (B.S. '65)

SPRING 2019

Michael Boswell (B.S. '91)
Marie Cole
Bruce Dale (B.S. '64, M.S. '67)
John Drager (B.S. '64)
Todd Hill (B.S. '99)
Joseph Jacobs (B.S. '11, UMBC)
Lance Jex
Charley Kilmain (B.S. '85)
Rachel Lilienfeld (B.S. FPE '16)
Neil Middleton (B.S. '82)
Gerald Perada (B.S. '05)
Bill Sangrey (B.S. '65)
Vivekanand Sista (Ph.D. '09)
Russell L. Werneth (B.S. '64, M.S. '68)

GRADUATE AWARDS & HONORS

Engie North America Fellowship: **JOSEPH BAKER** and **TAO DENG**

University of Maryland Graduate School Summer Research Fellowship: **DAVID CATALINI**

Best consortium student presentation, CEEE Spring Consortium meeting: **SAI VATHSAVI** and **GARGI KAIKHURA**

Harry K. Wells Fellowship: **PATTANUN CHANPIWAT**

Barbara Hulka Fellowship: **KIRAN BURRA**

RMSG Student Merit Award: **RAMIN MORADI**

Outstanding Graduate Assistant Award: **ELIZABETH PAUL** and **JAIDEEP PATHAK**

2018 Society of Tribologists and Engineers (STLE) Fellowship: **PARTH RAKESH DESAI** and **LOVELESH KAUSHIK**

2019 Society of Tribologists and Engineers (STLE) Fellowship: **PREETHI RAVULA**

The University of Maryland Association of Energy Engineers (AEE) student chapter won Best Overall Performance Student Chapter Award and Best Community Service Award at the 2018 World Energy Engineering Congress (WEEC), an international energy industry conference and exposition hosted annually by AEE. The UMD chapter returned to the WEEC conference in September to accept the 2019 Best Community Service Award.

CEEE Unveils first Daikin Energy Innovation Lab in the United States


PHOTO: GREG FIUME

Left to right: Mr. Takayuki Fujii (GM, Daikin Applied Development Center), Counselor Shigemi Ando (Japanese Embassy), Dr. Darryll J. Pines (Dean, Clark School of Engineering), Mr. Yoshiyuki Uemura (President, Daikin US Corporation), Dr. Reinhard Radermacher (Minta Martin Professor & Director, CEEE), Dr. Balakumar Balachandran (Chair, Department of Mechanical Engineering), Deputy Secretary Ben Wu (MD Dept. of Business & Economic Development), Mr. Yuji Yoneda (Executive Officer & GM, Daikin Technology Innovation Center), Mr. Masahiro Honda (GM, Daikin North America R&D Center)

On September 11, 2019, the Clark School of Engineering unveiled the Daikin Energy Innovation Laboratory as part of the Center for Environmental Energy Engineering (CEEE). The 3,600 square-foot, state-of-the-art facility brings additional space for research and student collaboration, and modern equipment including the latest heat transfer measurement capabilities, climate chambers designed for flammable refrigerants and new experiments for the development of alternative cooling technologies. The Daikin Energy Innovation Laboratory is part of a $500,000 investment by the Daikin Corporation, a world leader in HVAC and refrigeration in energy research, to fuel the next generation of experts in energy engineering.

ME's CEEE has had a longstanding relationship with Daikin; for the past 20 years, Daikin has invested more than $2.5 million in funding and equipment, sending employees to CEEE to train under Director Reinhard Radermacher and other center researchers, and has recruited close to a dozen ME graduates.

"Our continued partnership with Daikin has helped the Center to advance new technologies in heating and cooling, and has been a boon to our students," said Radermacher. "We look forward to advancing our partnership with this new lab space."

As the only university research center in the United States to bear the company's name, this new collaboration will build on the strong partnership between Daikin and UMD. With its close proximity to Washington, D.C., the lab provides an ideal proving ground for the innovative research that will inform meaningful, effective energy legislation.

Alexander J. and Valentina A. Severinsky 125th Anniversary Colloquium

In honor of the Department of Mechanical Engineering's 125th anniversary, Visiting Committee member Alexander Severinsky and his wife, Valentina, have generously supported a four-part colloquium that celebrates the department's past and explores the future of the discipline. This series welcomes leading figures in government, academia and industry who have leveraged their mechanical engineering degrees to make significant impacts in their fields, reflecting the unique, versatile and often multidisciplinary paths available to mechanical engineers. Two speakers—California Institute of Technology's John E. Goode, Jr. Professor of Aerospace & Mechanical Engineering Dr. Guruswami Ravichandran and Former NASA Astronaut and TEES Eminent Research Professor at Texas A&M, Dr. Bonnie Dunbar—shared their experiences and perspectives this past spring.

» THE DEPARTMENT WILL WELCOME TWO ADDITIONAL SPEAKERS IN SPRING 2020. LOOK FOR DETAILS LATER THIS YEAR AT https://enme.umd.edu/events/lectures-seminars-symposiums.

Support ME@UMD

UMD's Department of Mechanical Engineering provides a number of unique ways to support student success and opportunity. Through giving, alumni and friends help to ensure our lasting impact and daring vision for the next 125 years and beyond.

The funds below help to promote hands-on learning and access to education to those most in need. See other funds and learn more about how you can make a difference at **https://enme125.umd.edu/**. For questions or to make a contribution, contact Heidi Sweely, Director of External Relations, at **hsweely@umd.edu** or **301-405-1364**.

THE BARBARA J. DIETER SCHOLARSHIP ENDOWMENT

This scholarship was established in memory of the daughter of Dean Emeritus George E. Dieter and Nancy R. Dieter. It supports scholarships for undergraduate Mechanical Engineering majors that are active in the Women in Engineering Program.

CAPSTONE DESIGN AND PROJECT FUND

Each year, over 300 senior undergraduate students present project prototypes built to solve selected engineering problems. This fund helps student teams to purchase the supplies required to develop prototypes of their ideas as they move from concept to actual product.

DAVID C. HOLLOWAY SAE TERPS RACING FUND

Dedicated to the memory of Professor and Terps Racing Team Advisor Dr. David C. Holloway, this fund supports the team's equipment and travel.

MARVIN ROUSH FELLOWSHIP IN RISK AND RELIABILITY

As a pioneer in the field of reliability engineering, Dr. Marvin Roush created an educational program that would later become The Center for Risk and Reliability (CRR), serving as director from 1997-2003. This fund supports graduate student research and education in CRR.

FORD "FUTURE OF TRANSPORTATION" LECTURE SERIES

Since February 2018, the "Future of Transportation" Lecture Series has introduced students in the Department of Mechanical Engineering to new ideas in transportation, specifically around electrification, data analytics and autonomous vehicles. Generously sponsored by Ford, the four-part series wrapped up this fall and featured alumni who have made significant advances in all aspects of the transportation field.

OCTOBER 2019

Scott Drennan (B.S., AEROSPACE ENGINEERING '93)
VICE PRESIDENT OF INNOVATION, BELL

MAY 2019

Dr. Roberto Horowitz
JAMES FIFE ENDOWED CHAIR OF THE DEPARTMENT OF MECHANICAL ENGINEERING, UNIVERSITY OF CALIFORNIA AT BERKELEY

FEBRUARY 2018

Sherif Marakby (M.S., ELECTRICAL ENGINEERING '90)
CEO OF FORD AUTONOMOUS VEHICLES LLC, FORD MOTOR COMPANY

OCTOBER 2018

Dr. Vasiliy Krivtsov (PH.D. '96)
DIRECTOR OF RELIABILITY ANALYTICS, FORD MOTOR COMPANY

PHOTO: THE FORD MOTOR COMPANY

Failure *is* an Option

ALUMNI PROFILE: CARA MARTIN

Cara Martin's biggest lesson from graduate school started with a bang. "It was actually more of a pop," recalls Martin on the fateful day, when a miscalculation on a household refrigerator experiment damaged the accumulator she was testing. It was a major setback—and she'd have to come clean to the lab director, Reinhard Radermacher, who was also her advisor. "I remember summing up the courage to tell him on the way to our weekly Friday lunch. I expected him to be mad and frustrated." Instead, Radermacher told her a story about making a mistake while he was in graduate school, and that the most important thing is that she learns something from it. "It totally blew my mind. It was one of the first times I had been told it was ok to fail."

It's a story she tells a lot. "Every time I talk with students, I share that story. I want them to know it's ok to talk about failure and that we all do it. If you don't fail, you limit your opportunities to grow. And that even when you blow something up, as long as you learn from it, it's ok."

Martin isn't experiencing a lot of failure these days. With two degrees from the Department of Mechanical Engineering (B.S. '06, M.S. '07), she is COO of Optimized Thermal Systems (OTS), a consulting firm that helps clients refine and test new energy technologies for market. Since joining OTS six years ago, where she works with Radermacher, Martin has tripled the company's size and revenue, nabbing her a Leading Women Award from the *Daily Record* in 2018. She approaches OTS' clients—who range from large equipment manufacturers to mid-tier suppliers and start-ups—as unique partnerships, scoping their needs and filling in the gaps that are stalling their progress. She approaches competition the same way. "There aren't a lot of folks who do what we do, but when we do come across them, my immediate response is, can we collaborate rather than compete?"

The idea that people "work better together" is one Martin adopted early. She was one of two girls in a high school introduction to engineering class; because they were friends, she and the other girl joined forces early, winning competitions regularly by building off each other's ideas and through the support of a fantastic teacher. "We were in the minority, but [our teacher] treated everyone as equals. He taught us that we could do this and gave us all the tools we needed. Thinking back, he was really instrumental in crafting my interest in engineering."

At UMD, Martin was one of a handful of undergraduates to work with Radermacher at the Clark School's Center for Environmental Energy Engineering (CEEE), initially lobbying for a spot so that she could keep up with her German, a second major she dropped her sophomore year. "I didn't want to give it up entirely, so I more or less Googled engineering research opportunities with any German connection." Because he ran a German exchange program for UMD, Radermacher came back in the search results. In the CEEE lab, Martin found a tight-knit, supportive team. She had a neat arrangement with her lab partner from Germany, Jan Muehlbauer (M.S. '06), who would tighten up her experiments in exchange for proof-reading help. And while she initially pursued the position for the German connection, she was fascinated with the research and buoyed by the supportive, "good ideas win" atmosphere. After graduation, she kept in contact with Radermacher. She was lured back to Maryland in 2013 when Radermacher asked her to head up his consulting business, which was growing faster than he could manage. She agreed to take the leap.

Martin is very happy with where she's landed, meshing her love for engineering with the challenge of running a business. With OTS hitting its stride, she's concentrating on streamlining the operations, which includes the lab they have carefully built over the past five years. New business and non-traditional clients are breaking them out of their bubble and shaping their brand, something she is anxious to continue. And then, there's the matter of a little project in Baltimore. A need to test technology in the field has inspired Martin and Radermacher to explore a radical concept first tested by Purdue—commandeering and rehabbing a block of housing for a "living/learning lab." She sees Baltimore as the perfect concept site, offering a place to explore new sustainability concepts while simultaneously helping revitalize some of the 40,000 vacant rowhouses currently in the city. While still in early stages, it's what gets Martin excited these days. "It's a crazy idea, but it's right up our alley," says Martin. There may be some failures along the way. No doubt, Martin will learn from them.

Jeong Kim's Next Chapter

When Jeong Kim began his Ph.D. thesis at the University of Maryland in 1990, he walked into the office of Dr. Ali Mosleh, his Ph.D. advisor, with a request. "I asked if I could come see him every day, so that we could go over progress on my research," Kim recalls. Working days at the Naval Research Lab with a newborn baby at home and an idea for a start-up company percolating in the background, Kim didn't have a lot of time to waste. "I was in a hurry," he admits. The request was unheard of in academia and met at first with resistance by Mosleh, who typically met with his students every week or two. So, Kim offered a proposition. "I asked him, 'You eat lunch, right? I'll buy you lunch every day and we can meet then.'" Mosleh, no doubt seeing the eagerness, offered Kim a deal: no free meals, but they could meet over lunch every day, provided Kim had something to show him. The minute he didn't, the arrangement was off. They met nearly every day for over a year. Kim completed his Ph.D. in 1991.

The fact that he finished his Ph.D. in just two years—while holding down a full-time job and with a young family—is impressive. That this was not an exception, but rather a rule for Jeong Kim, is extraordinary. Kim came to the U.S. from Korea at age 14 speaking just a few words of English; despite this, he finished high school a semester early and was granted a scholarship to Johns Hopkins University, where he finished his bachelor's degree in electrical engineering and computer science in just three years. He pursued his master's degree while working full-time in the U.S. Navy. He was the first Ph.D. recipient in Reliability Engineering at the University of Maryland.

Kim's success in business was also fast-tracked. He started Yurie Systems, named after his daughter, in 1992, eventually selling it to Lucent Technologies for $1.1 billion. He stayed on with Lucent for the next 15 years, serving as president of various divisions—including eight years as president of Bell Labs—pausing briefly to teach at UMD and for a change of scenery. "My mentor, Dr. Bill Perry, served in government and the private sector, but anchored his life at a university; every time he had a transition, he went back and spent some time teaching. I thought that was kind of wonderful. It helps you stay engaged—not only with the students, but with people in research. It's very stimulating. So, I followed his example and came back to the University of Maryland." His lectures were often standing room only, with Kim talking with students long after the lecture was over. "I think my message was real to them. I said, 'Look at me, I speak with a broken accent, I'm a little socially awkward, and I'm not really any smarter than any one of you. And if I can do it, you can do it.' I'm sincere and students see that, and I think it's motivating. And that's what teaching is all about. It's about taking that motivation and helping them apply themselves as best they can. I enjoy that aspect very much."

Today, years of entrepreneurial and leadership success has afforded him the opportunity to mesh his love for sports and expertise in communications technology to form Kiswe Mobile. Kiswe is an interactive mobile video company that transforms the often-solitary experience of mobile sportscasts and other live events into something interactive, community-driven and fun. But it is the desire to work with a great team, to do something that makes an impact and do it together, that drives Kim. "At this stage, I don't need more fame, I don't need more responsibility, I don't need money; what I really need is fulfillment in the work that I do. I want to work with people I like and respect."

For once, Kim is no longer in a hurry. "I had no idea what I was going to do, but I started calling people up that I liked to see if they wanted to work together, and they felt the same way. We are having a wonderful time—it's a journey, right? When people come together, and say together, 'We're going to accomplish something meaningful' and they really mean it, then amazing things can happen."

THE EPIC WORLD OF TIM SWEENEY

Tim Sweeney is into free stuff—not getting it, but giving it. There was the first episode of his breakout game, ZZT, which he released for free at the age of 20 after eight years of hobbyist programming on nights and weekends. There's the Unreal Engine, a comprehensive suite of creation tools for game designers that is open sourced through his multi-million-dollar company, Epic Games, to more than seven million developers and counting. And, of course, there's the F-word: Fortnite, Epic's monstrously popular video game, where players come together as a digital community to battle for survival—and occasionally dance. It's also free on virtually every gaming platform.

For Sweeney (B.S. '93, mechanical engineering), it's not about the money; it's about building a community. So far, he's been very successful. He maintains a "meritocracy" at Epic, a model he picked up from a chance encounter at Microsoft (see inset), to foster good ideas and teamwork. Over 250 million people around the world play Fortnite, connecting virtually to spar and, as of last December, build in Fortnite's new Creative mode. Epic reached an agreement with Nintendo and Microsoft in June of 2018 for cross-play of Fortnite, getting Sony on board later that year. Sweeney has more than 52,000 dedicated (and vocal) Twitter followers. And through Epic Games, he's not only building the new frontier of gaming with an incredibly talented team in Raleigh, North Carolina, he's shoring it up through a massive grant program that funds fledgling projects. "The grant funding has really helped some indie developers get off the ground," says Sweeney, who points to Astroneer and Claybook as examples of successful projects that have benefited from Epic grants.

Born and raised in Potomac, Maryland, Sweeney taught himself how to program through online bulletin boards and a lot of experimentation, first on an Apple II and later on a PC. After finding success with ZZT, he realized he might be able to make a living at it. It was during his time at the University of Maryland, where he studied mechanical engineering, that he launched Epic MegaGames (shortened in 1999 to a less intimidating Epic Games), a name he came up with to compete with '90s heavy hitters like Apogee software. "[It was] kind of a scam to make it look like we were a big company," he told Gamasutra in 2009. "Of course, it was just one guy working from his parents' house."

While some may see Sweeney's trajectory as light years away from his mechanical engineering education, his time at UMD gave him tools he didn't realize he needed until Epic was off the ground. "I learned to program on my own, but never could have learned such a breadth of mathematics and rigorous analysis

TIM SWEENEY ON…
AN UNINTENTIONAL OUTCOME OF FORTNITE:

"Twenty-eight years ago, Epic set out to accomplish many things, and we've achieved some of them. I have to admit, though: popularizing dancing among kids came as a complete surprise and wasn't an actual goal."

ALUMNI ON CAMPUS: CAREER PATHS

FALL

Christopher Straight (B.S. '84),
SENIOR DIRECTOR OF PRODUCT DEVELOPMENT, STRYKER/K2M

Matt McTigue (B.S. '93),
FORMER SENIOR SALES ENGINEER, DIGITAL GUARDIAN

Laleh Jalali (B.S. '89),
PATENT ATTORNEY, ALLIANCE IP

Paul Lara (B.S. '01), SHIP STRUCTURES BRANCH HEAD,
NSWC CARDEROCK DIVISION

Rhonda Sundlof (B.S. '99),
HARDWARE ENGINEER, IBM

SPRING

Mary Larson (B.S. '09, M.S. '11),
THERMAL SYSTEMS DESIGN ENGINEER, GE AVIATION

Chris Bunai (B.S. '10),
CHIEF TECHNOLOGY OFFICER, INDUSTRIAL INDICATORS

Richard Bauernschub (M.S. '95),
DIRECTOR OF ENGINEERING, TEXTRON SYSTEMS

Paul Hess (PH.D. '02),
PROGRAM OFFICER, OFFICE OF NAVAL RESEARCH

TIM SWEENEY ON… INSPIRING GOOD IDEAS:

"In 1995 I was invited to show Unreal to Microsoft's graphics team. I arrived and found myself demoing to Bill Gates along with the Windows graphics engineering team and Microsoft Research luminaries. After I presented Unreal, they launched into a vigorous debate about Microsoft's graphics strategy; they were so into it that they didn't think to kick me out of the room. In that hour, I saw a small team of very young engineers slowly prevail in the argument against the much more senior researchers, many of whom were the founders of modern computer graphics. It struck me as exactly the kind of meritocracy a company should strive to be, where the best ideas win, and not rhetoric or politics or resumes. I've always strived to maintain that ethic at Epic Games."

without studying engineering," he says. "It was an interesting experience, because during my studies I really didn't understand why I was learning vector calculus and these other esoteric things. But when I started to write 3D rendering code, it turned out to be the secret sauce."

An interest in hiking led Sweeney to his latest project. For the past decade he's been quietly buying up swaths of forest in his new home of North Carolina at risk for development. So far, he's salvaged 50,000 acres. "Land conservation is the one unquestionably practical and cost-effective thing we can do to protect ecology and the future habitability of the planet. You can spend $100 on land conservation and less than $5 of it is lost to overhead."

Back at Epic, exciting developments emerged this past spring on the show circuit, such as advanced video game physics to better portray collisions and explosions, which Sweeney hints is just the beginning. "Ray tracing and physics will continue to bridge the gap to photorealism," he explains. "The shortcomings now are in the networking layer, enabling hundreds of players (or more) to experience these richer worlds together."

Without a doubt, his people at Epic are working hard at it; after all, their community is waiting.

VISITING COMMITTEE

LIST OF MEMBERS:

Dr. George Dieter
Dr. Howard Harary
Mr. Steve Hogan (B.S. '95)
Dr. Roberto Horowitz
Mr. Robert Kaplan (B.S. '82)
Mr. Charley Kilmain (B.S. '85)
Ms. Maria Korsnick (B.S., NUCLEAR ENGINEERING '86)
Mr. G. Lee Lushbaugh (B.S. '75)
Ms. Nancy Margolis (B.S. '81)
Mr. Thomas Marsden (B.S. '87)
Mr. Michael Miller (B.S. '79, M.S. '84), CHAIR
Dr. James Moreland (B.S. '88)
Ms. Sheila Mortazavi (B.S. '95)
Dr. Alex Severinsky
Ms. Susan Skemp
Ms. ToniAnn Thomas (B.S. '82), VICE CHAIR
Dr. Kon-Well Wang
Mr. David Wilson
Mr. Manolo Zuniga (B.S. '83)

Alumnus to Develop Solar-Powered Desalination Module

Bahman Abbasi, an assistant professor at Oregon State University (OSU), is developing a desalination module that is mobile and powered by the sun. Abbasi, who earned his doctorate in mechanical engineering at UMD in 2010, recently won a $2 million award from the U.S. Department of Energy to create an end-to-end system that can produce potable water from a highly concentrated brine.

Abbasi is leading a team of researchers from OSU, UMD, Michigan State University, and the University of Nevada, Reno to advance an economical module that can move around easily and will not need electricity to operate.

"It's something I had in mind for some years, and pitched it to a number of places," he said. "The place that was most welcoming was OSU. It demonstrates that the university takes a wider view in looking at how it can contribute to meeting challenges for a sustainable future."

Computer simulations have demonstrated that the desalination concept has

PHOTO: COURTESY OSU

strong potential. "I imagine an off-the-grid, economic desalination system could be of great use to many places, especially certain coastal regions where there is strong demand for clean water," said Abbasi.

The cooperative project, which is currently underway, is slated to last for three years.

WANT TO SHARE YOUR STORY?
CONTACT HEIDI SWEELY
301-405-1364 or hsweely@umd.edu

George Dieter Turns 90

Emeritus Dean and Professor George E. Dieter celebrated his 90th birthday on December 5, 2018. A former president of the American Society for Engineering Education, Dieter served as dean of the engineering school in the early 1980s. He published the engineering staple *Engineering Design* (coauthored with Professor Linda C. Schmidt), which focuses on material selection and understanding and implementing the design process. It is currently in its fifth edition. Dieter was instrumental in expanding the college's footprint, transforming its research efforts and in connecting the expertise of the college with public/private sector challenges. He was honored with the President's Medal in 2004 for his outstanding service and contributions to the university community, and was inducted into the National Academy of Engineering in 1993.

"We wouldn't all be here sharing in engineering education if it wasn't for Dean Dieter," said Darryll J. Pines, Clark School Dean and Farvardin Professor of Engineering. "He's been advising me for 10 years on engineering education. He's an institution. We love him dearly. We are grateful for all of his years of service here at the University of Maryland."

Hosam Fathy Joins Department of Mechanical Engineering

Professor Hosam Fathy joins the ME faculty this fall as a full professor. Fathy comes to UMD from the Penn State College of Engineering, where he specialized in sustainable energy systems. During his time at Penn State, he held appointments with the Materials Research Institute and the Institutes of Energy and the Environment.

FACULTY APPOINTMENTS AND PROMOTIONS

Professor **KENNETH KIGER** was named Clark School Associate Dean of Undergraduate Affairs

Professor **HUGH BRUCK** was named Clark School Associate Dean of Faculty Affairs

Professor **ABHIJIT DASGUPTA** was named ME Director of Graduate Studies and Associate Chair of Academic Affairs

Professor **JUNGHO KIM** was named ME Director of Undergraduate Director of Undergraduate Studies

SIDDHARTHA DAS was promoted to associate professor with tenure Vincent Nguyen was promoted to senior lecturer

HENRY HASLACH was promoted to research professor rank

FACULTY AWARDS AND RECOGNITION

Senior Research Scientist **MICHAEL OSTERMAN** received the 2019-2020 Provost's Excellence Award for outstanding contributions and accomplishments to research.

Professor **ELISABETH SMELA** was one of five women recognized with a Campus Women of Influence Award at the University of Maryland's Celebration of Women event in March.

Professor **JELENA SREBRIC** was elected a Fellow of the International Building Performance Simulation Association (IBPSA).

Assistant Professor **KATRINA GROTH** was selected for the new inter-department Faculty Development Program for Cross-Disciplinary Research in Probabilistic Risk Assessment for Nuclear Facilities.

Associate Director of the Center for Environmental Energy Engineering **YUNHO HWANG** has been selected as the co-operating agent for International Energy Agency Annex 54. He was also named associate editor for the newest ASME Journal of Engineering for Sustainable Buildings and Cities.

Professor **MIAO YU** received a 2019 USM Regents Faculty Award for Excellence in Research/Scholarship/Creative Activities, the highest honor bestowed by the Board of Regents.

New research by Assistant Professor **SIDDHARTHA DAS** was featured on the January 28 issue of *Soft Matter*.

Regents Professor and Glenn L. Martin Institute Professor **C. DAN MOTE, JR.** received the 2019 Viterbi Lifetime Achievement Award in recognition of a lifetime of extraordinary professional accomplishments and contributions to the field of engineering. He served as the president of the U.S. National Academy of Engineering from 2013 to 2019.

Machine Learning's Translational Medicine


PHOTO: JOHN CONSOLI

At the moment of traumatic injury, emergency medical technicians respond first. They stabilize the patient during ambulance transport, while specialized trauma teams prepare to receive the patient at a hospital. Yet according to Assistant Professor of Mechanical Engineering Axel Krieger, the ride to the hospital is the riskiest part for the patient.

Estimates suggest that one-third of trauma fatalities likely would have survived if they had access to hospital-level care sooner, says Krieger. To improve the health-giving capacity for trauma patients during the ambulance ride, Krieger wants to equip the ambulance with a medical robot enhanced by machine learning (ML). "Imagine you have a patient in the emergency vehicle, and a robot scans the patient and obtains ultrasound images," says Krieger, who is a member of the Maryland Robotics Center. "This can provide a critical level of life-saving diagnosis and care not yet possible during an emergency ambulance ride."

The robot scans and visualizes the injury, then compares and analyzes the scans with its ML algorithm—which was trained using data from similar real-life patient images. It focuses on anatomical areas known to be especially vulnerable to hidden injury and bleeding—such as the pelvic area and space between the lungs, spleen, and liver—to determine severity of wounds based on location, depth, and interaction with vital anatomy. It also computes volume of blood loss and assesses hemorrhagic potential. The en-route analysis helps produce an injury profile useful in triaging the patient, perhaps in the ambulance, and most certainly upon arrival at the hospital.

To develop this ML-based intelligent scanning robot, Krieger and several Clark School graduate students collaborated with trauma experts at the University of Maryland Medical Center's R. Adams Cowley Shock Trauma Center. The research is still experimental and not yet approved for clinical use with patients, but Krieger believes it will be soon.

"It's the translational aspect to patient care that really excites me," he says. "If we can help more people survive, this is the best use of our work."

Super-Strong Degradable Paper Wins Invention of the Year

Mechanical Engineering Professor Teng Li and Professor Liangbing Hu (Department of Materials Science and Engineering) won the 2019 University of Maryland (UMD) Invention of the Year Award in the physical sciences category for their team's high performance graphite-paper composites.

The team developed a lightweight, strong and tough composite, assembled using fine graphite flakes that are dispersed into nano-fibrillated cellulose (NFC) and dissolved in room temperature water. The resulting graphite-NFC slurry is then printed into large sheets that, once fully dried, are not only stronger than most steel, but also six times as light, yielding a strength higher than any existing metal or alloy currently available. The material is fully degradable, offering a promising solution to the global plastic problem, in addition to being low-cost. Their team also includes Professors Yubing Zhou and Chaoji Chen from the Department of Materials Science and Engineering and Robert Foster, EVP of development for Trinity Rail Group.

Li's work was also featured on the cover of *Extreme Mechanics Letters* in 2018.

Microemulsions Open New Doors for Energy Efficient Chillers

Since the 1950s, absorption chillers have been a promising alternative to traditional air conditioners and refrigerators by using waste or solar heat—rather than mechanical compressors that rely on electricity—to generate cooling. But today's absorption chillers haven't changed much in 70 years; while the concept matches contemporary needs for sustainable, energy-efficient cooling technology, absorption chillers require significant residual heat to produce even a small amount of cooling, limiting their application for mainstream use.

But new research in Professor Bao Yang's Micro/Nanoscale Heat Transfer and Energy Conversion Laboratory might finally put absorption chillers on the map. Yang and his colleagues, including CEEE director Reinhard Radermacher, have been developing a new type of absorption chiller that utilizes a recently-discovered microemulsion/water working pair, a radical improvement from the lithium bromide/water combination of current chillers. Microemulsion absorbents can absorb water vapor (refrigerant), and release the water as liquid without vaporization or boiling when heat is supplied. With previously-used adsorbents like lithium bromide, the refrigerant—or water—is desorbed through vaporization, consuming three to four times more thermal energy than microemulsions.

This new combination could one day lead to energy efficiency increases of up to 200% over today's absorption chillers, making them viable alternatives for mainstream use. Yang and his team envision that the final absorption chiller could efficiently air condition buildings using the waste heat from a gas turbine, water heater, or solar heat. The team's continuing work is supported by the Advanced Research Projects Agency–Energy (ARPA-E) and by Office of Energy Efficiency and Renewable Energy (EERE), Department of Energy (DOE).

NEW MULTI-MATERIAL 3D NANOPRINTING STRATEGY COULD REVOLUTIONIZE OPTICS, PHOTONICS AND BIOMEDICINE

Engineers at the University of Maryland have created a new multi-material 3D nanoprinting technique that was featured on the inside front cover of the July 21 issue of *Lab on a Chip*.

The team's new technique—capable of printing tiny multi-material structures a fraction of the size of a human hair—offers researchers a faster, cheaper and more accurate means to 3D print these highly complex structures because the process uses a very simple molding process that is widely used in most microfluidics labs.

To demonstrate their new approach, the researchers 3D nanoprinted a variety of multi-material components, including a five-material DNA structure, a multi-material "micro-cello" and a four-material micro UMD logo.

"By providing researchers with an accessible way to 3D nanoprint multi-material systems that is not only much quicker, but also more precise than conventional methods, this work opens doors for emerging applications that demand microstructures with multiple materials, and in turn, multiple functions," said Ryan Sochol, an assistant professor in mechanical engineering and bioengineering at UMD's A. James Clark School of Engineering.

In one application of this new approach, Sochol's Bioinspired Advanced Manufacturing (BAM) Laboratory is working with the Food and Drug Administration to apply this strategy to 3D nanoprint parts of the human eye that include complex anatomy with varying optical properties.

In the past decade, scientists have struggled to 3D nanoprint structures with more than one material, as conventional techniques are limited in terms of time, cost, labor and multi-material resolution. While 3D printing technologies have advanced greatly in recent years, printing at very small scales remains difficult.

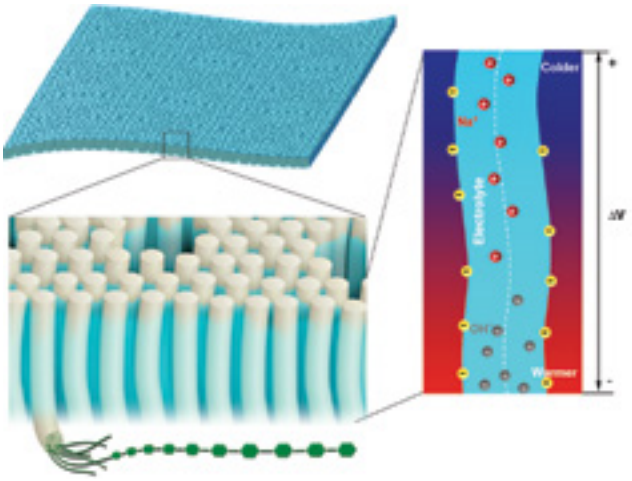
"Unfortunately, prior challenges have resulted in only a handful of advancements based on multi-material 3D nanoprinting, with the vast majority including only two materials," said Andrew Lamont, a Ph.D. student in bioengineering, who developed the approach as part of his doctoral research. "But with our strategy, researchers can easily 3D nanoprint systems with high numbers of integrated materials at speeds and sizes not possible with conventional methods."

The Clark School team has filed two U.S. provisional patents for their strategy, which is based on a process called "in-situ direct laser writing" and work published earlier this year. The multi-material structures are 3D nanoprinted directly inside of microchannels, with distinct liquid materials loaded into the channel one at a time for material-specific printing. Once the printing process is finished, the microchannel enclosure can be removed, leaving behind fully integrated multi-material 3D structures in a fraction of the time, yet with better precision than the state of the art.

Wood-Based Technology Creates Electricity from Heat

A new heat-to-electricity device that runs on ions could someday harness the body's heat to provide energy. Developed by ME Associate Professor Siddhartha Das and material science engineering colleagues Professors Liangbing Hu and Robert Briber, a piece of wood is transformed into a flexible membrane that generates energy from the same type of electric current (ions) found in the human body. This energy is created using charged channel walls and other unique properties of the wood's natural nanostructures. As demonstrated in their March 2019 paper in the journal of *Nature Materials*, this new wood-based technology can use a small temperature differential to efficiently generate ionic voltage.

To create the right ionic environment, the team leveraged the tiny channels found in trees that move water from root to stem. They used basswood, a fast-growing tree with low environmental impact, and removed two components—lignin, which makes the wood brown and adds strength, and hemicellulose, which winds around the layers of cells, binding them together. This gives the remaining cellulose its signature flexibility. This process also converts the structure of the cellulose from type I to type II, which is a key to enhancing ion conductivity.



A membrane, made of a thin slice of wood, was bordered by platinum electrodes. A sodium-based electrolyte was infiltrated into the cellulose, regulating the ion flow inside the tiny channels and generating an electrical signal. "The charged channel walls can establish an electrical field that appears on the nanofibers and thus help effectively regulate ion movement under a thermal gradient," said Tian Li, the first author of the paper.

Li said that the sodium ions in the electrolyte insert into the aligned channels, which is made possible by the crystal structure conversion of cellulose and by dissociation of the surface functional groups.

"We are the first to show that this type of membrane can be used as a high-performance ion selective membrane by nanofluidics and molecular streaming and greatly extends the applications of sustainable cellulose into nanoionics," Li summarized in the paper.

ASSESSING RISK AND RELIABILITY FOR HYDROGEN SYSTEMS

Assistant Professor of Mechanical Engineering Katrina Groth, (B.S. Nuclear Engineering '04 and M.S. Reliability Engineering '08) is assessing risk and reliability for hydrogen systems in a number of areas, including storage, delivery, and distribution. Hydrogen fuel cells produce zero emissions, which is a strong incentive for using them in transportation and portable power applications. Groth, who is also a core faculty member of the Center for Risk and Reliability, is advancing hydrogen codes and standards, as well as models and data to enhance a larger understanding of hydrogen safety.

In her paper, "HyRAM: A methodology and toolkit for quantitative risk assessment of hydrogen systems" (cowritten with Ethan Hecht while she was at Sandia National Laboratories and published last year in the *International Journal of Hydrogen Energy*), Groth describes a methodology and accompanying software toolkit that provides a platform for integration of state-of-the-art, validated science and engineering models, and data relevant to hydrogen safety. In her new role as an assistant professor, she is using this work as a foundation for broader research into using diverse sources of data to inform risk assessment for complex systems.

"The HyRAM toolkit offers a standard methodology for conducting quantitative risk assessment and consequence analysis for assessing the safety of hydrogen fueling and storage infrastructure at the design and permitting stage," she explains. "It integrates science and engineering models from multiple disciplines and puts it in the hands of the decision makers who are developing standards to enable these technologies."

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