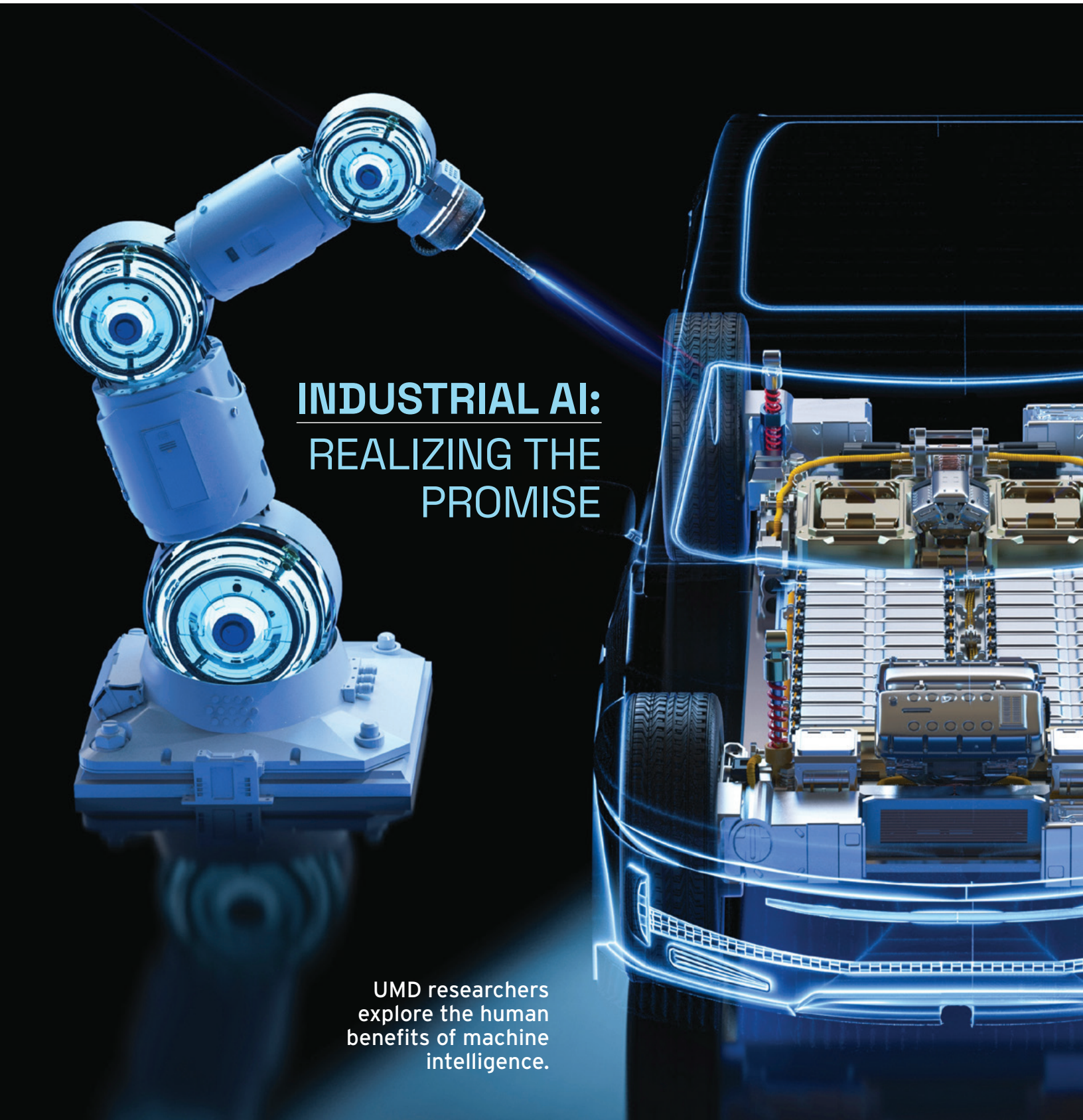
MARYLAND MECHANICAL ENGINEERING | **FALL 2023**

METRICS



INDUSTRIAL AI: REALIZING THE PROMISE

UMD researchers explore the human benefits of machine intelligence.

DEAR FRIENDS,

It has been my privilege to lead UMD's Department of Mechanical Engineering, first as acting chair from September 2010 until May 2011, and later as permanent chair. I have enjoyed working with our terrific faculty and staff members, as well as with the administration of the A. James Clark School of Engineering, as we pursue a shared goal of excellence in research and education. This January, I will be returning to my regular faculty duties, while the department welcomes a new chair, Professor Harry Dankowicz. I am grateful to all of you whom I have interacted with during the past thirteen years, whether in curriculum planning, faculty hiring, managing departmental resources, or representing UMD ME within the broader engineering community.

I'm pleased to note that the department is thriving. The most recent *U.S. News & World Report* undergraduate rankings place us at #14 among ME programs nationwide, and #9 among public universities. Our graduate rankings are also robust, at #17 (overall) and #9 (public). However, rankings are only one measure of a department's strength. A more important consideration is the caliber of the faculty. UMD ME has been able to attract high quality faculty with a commitment both to innovative research and teaching. They are drawn to College Park for many reasons, including location, the resources available at UMD and at the Clark School, and our reputation as a dynamic, yet collegial department. In many cases, they have come to Maryland because of our five established centers: the Center for Advanced Life Cycle Engineering, the Center for Environmental Energy Engineering, the Center for Economic Concepts Development, the Center for Risk and Reliability, and the Center for Sustainability in the Built Environment.

To those five, we have recently added a sixth. And it is shaping up to be a powerhouse. The Industrial AI Center, now housed in ME under the direction of Clark Distinguished Chair Jay Lee, has had collaborations with some of the world's leading companies, including automakers like Ford, GM, Hyundai, Nissan, and Toyota, as well as tech giants such as Foxconn. Samsung, and Siemens, in harnessing the transformative power of intelligent machines. At UMD, the Center will be a magnet not only for industry partners, but also for undergraduate and graduate students seeking to build careers in this emerging domain—the full potential of which is only beginning to be unveiled.

The new center is the focal point of this issue of *Metrics*. You'll also find updates on other important research work being conducted in our department, with applications that include healthcare, environmental monitoring, and thermal management of computing devices. UMD mechanical engineers, for instance, have been tapped for ARPA-E's COOLERCHIPS program, which aims to develop ways to reduce the energy footprint of server systems. UMD associate professor Katrina Groth, meanwhile, is helping to spearhead the safe and reliable utilization of hydrogen power, seen by many as an important contributor to clean energy. UMD Elkins and full Professor Miao Yu is pursuing important and innovative sensor work to help monitor the health of the environmental ecosystem. These are only three examples of the forward-looking, impactful research featured in this issue.

This is a vibrant, dynamic program and I'm proud to be part of it. I look forward to continuing our work together.

Best regards,

B. Balachandran

Balakumar Balachandran
CHAIR AND MINTA MARTIN PROFESSOR
DISTINGUISHED UNIVERSITY PROFESSOR
DEPARTMENT OF MECHANICAL ENGINEERING

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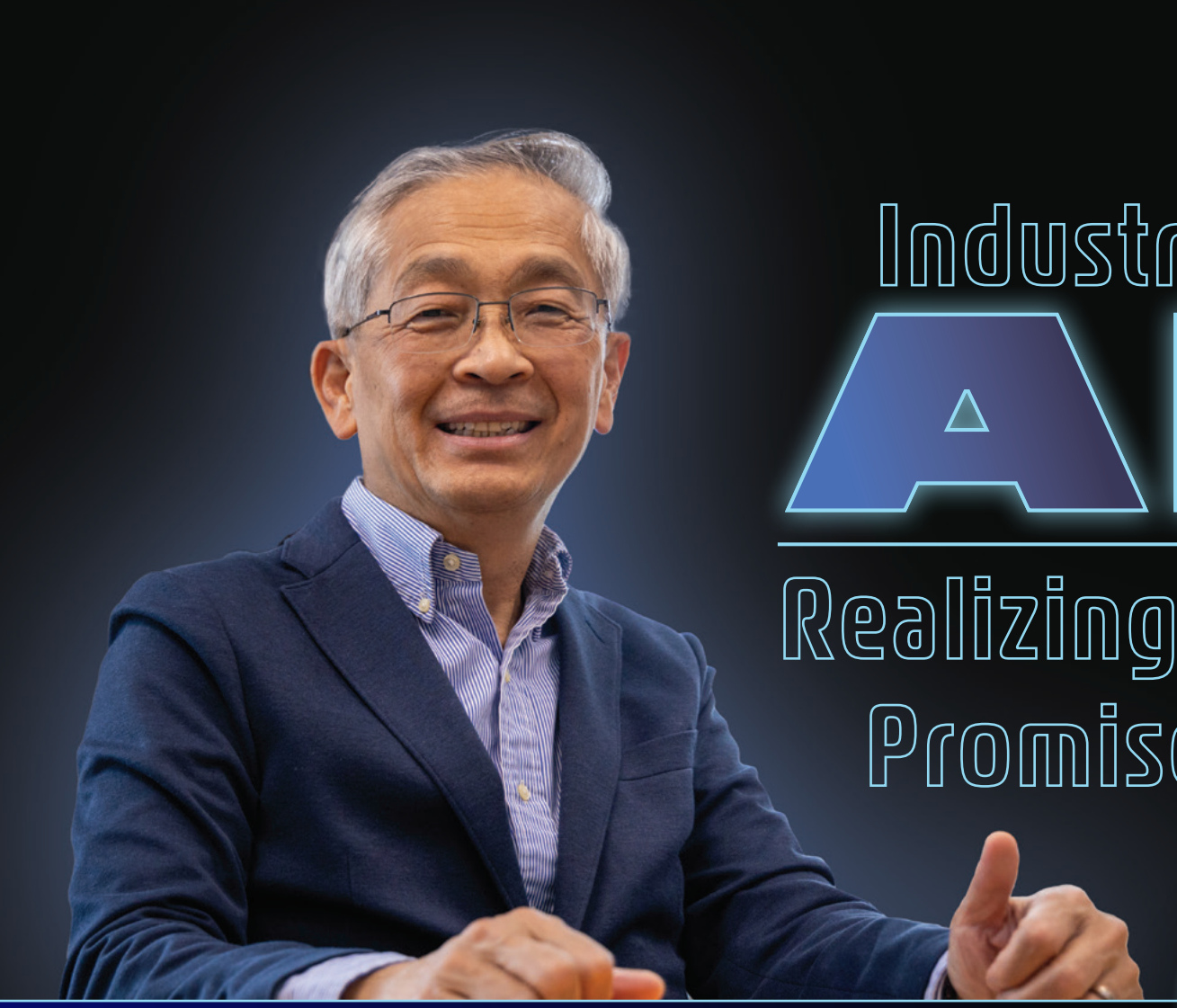
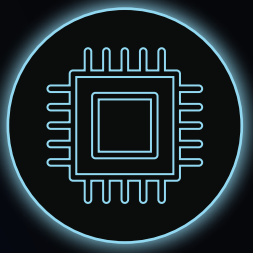


Industrial AI

Realizing The Promise



Jay Lee brings his expertise—and his Industrial AI Center—to UMD.

Birds may have inspired humans to take to the skies, but when aircraft encounter them, the results can be perilous. Around 35 bird strikes occur per day in U.S. airspace, according to the Federal Aviation Administration (FAA), with 97% of the incidents occurring during takeoff or landing. That's a tiny amount when compared to the total volume of air traffic. Still, they cause damage, whether to engines, windshields, or other parts of a plane, and it's not always easy to detect.

Hard-to-detect problems present headaches not only for aviation, but for industry in general. And it's one of the reasons why industrial AI—that is, the application of artificial intelligence and machine learning to different domains within industry—is on the rise.

"There's the visible world and the invisible world, what we know and what we don't know," says Jay Lee, Clark Distinguished Chair at the University of Maryland (UMD) and head of the Industrial AI Center now based at the university. Aircraft maintenance relies on visual inspections, with the inspectors looking carefully in order to catch the known signs of fatigue or damage. There's much that the human eye can't catch, however. On the other hand, a highly-sensitive camera can obtain imagery from an aircraft under inspection and feed these images to a computer equipped with AI.

PHOTO: JOANNA AVERY

Imagine a bustling factory that runs in the dark.

An uncomfortable environment for humans, to be sure—but feasible when automated systems do the bulk of the work. Some industries have already begun to experiment with "lights-out factories" staffed almost entirely by robots; Phillips, for instance, operates a lights-out electric razor factory in the Netherlands, utilizing a team of 128 robots and nine human supervisors. At a FANUC group factory in Japan, robots build robots, completing an average of 50 per shift. The factory can be run without human supervision—or lighting—for up to a month.

The AI's algorithms, trained on massive databases, and supported by advanced computational power, can identify problems that could otherwise go unnoticed for years thus providing early warning long before failure occurs.

It's not just aviation that stands to benefit. Similar approaches can be used to inspect bridges, tunnels, roadways, and railway tracks. Indeed, Lee and his team are collaborating with UMD civil and environmental engineering (CEE) researchers, led by CEE chair Nii Attoh-Okine, to explore such applications.

Wind turbines offer another example. Factors such as temperature and humidity can affect their performance. Turbines located in high altitude areas, such as the mountains of West Virginia, accumulate ice that can damage the blades over time. Inspecting turbines is even more difficult than in the case of roads and airplanes, due to their remote locations. A drone-equipped camera, however, can take high-resolution imagery, while an intelligent machine can quickly perform the calculations needed to pinpoint wear and tear. As with airplanes and roads, "we're able to catch problems before they become catastrophic," Lee said.

Going from the large to the small, AI can also help improve the reliability of semiconductors. Lee and his team have developed an AI-powered methodology, known as response service approximation, that surpasses existing trial and error methods, which can require days to complete. "With our approach, we can finish the job in a matter of hours," Lee said.

Smarter Machines, Expanding Scope

Public awareness about the potential of AI took a quantum leap earlier this year, with buzz about ChatGPT dominating many a water cooler conversation or Reddit subthread. In fact, industries have been integrating AI into their operations for many years already, tapping the potential of intelligent machines to help with wiring parts, assembling appliances, bottling beverages, mixing medications and filling prescriptions, and harvesting fruit.

But implementing AI can present challenges. To overcome them, dozens of leading companies around the globe—including Foxconn, Samsung, and Siemens as well as major automakers such as Ford and Toyota—have drawn on Lee's expertise and that of his team.

Lee's center can help companies develop AI systems, whether in the form of robots that assemble products or smart machines that inspect for wear and tear. Just as importantly, the center can assist them in managing the formidable volumes of data needed to support these systems.

All industrial AI systems, from Amazon's mobile robot helpers to the automated crab picking systems being developed at UMD's Fischell Department of Bioengineering, depend on databases. AI depends on data in much the same way that humans rely on education and knowledge acquisition—junk in means junk out.

"We're able to catch problems before they become catastrophic."

That's one of the biggest challenges constraining more widespread adoption of AI, Lee said. "Think of donating blood. If the type hasn't been properly labeled, you can't use it. It will just go to waste. The same applies to databases that support AI. Companies will come to us and say 'we have lots of data but don't know what we can do with it.' We help them formulate useful and usable data."

AI depends on data in much the same way that humans depend on education and knowledge acquisition—junk in means junk out.

Both at his prior institution, the University of Cincinnati, and now at UMD, Lee has been working to tackle the industrial data challenge through an approach he dubs Domain GPT—in effect, a domain-specific equivalent to the popular language model app. He now plans to establish an Industrial AI Data Foundry, featuring more than 100 industrial data sets, with the objective of scaling up AI education and research. But effective Industrial AI hinges on more than a massive accumulation of data: it needs a robust conceptual framework. Lee has advocated a "three Ds" approach that he dubs Data, Domain, and Discipline.

Data gathering, he believes, should be guided by the needs of a particular industry or sector—for example, automotive manufacturing or electrical engineering. Discipline—that is, quality evaluation of the data—must also be incorporated into the framework to ensure good results. Machines that train themselves on spurious or poisoned data are unlikely to perform well.

"Historically, AI has focused on data in and of itself—that is, on bringing in large amounts of data and then using it to train the machine," Lee said. "In the context of industry, though, we need to do more than that. We need to ensure the data is relevant to the context, and that it's data of sufficiently high quality. This is what I mean by the 'three Ds,' and it's what I teach my students."

UMD to Become Industrial AI Hub

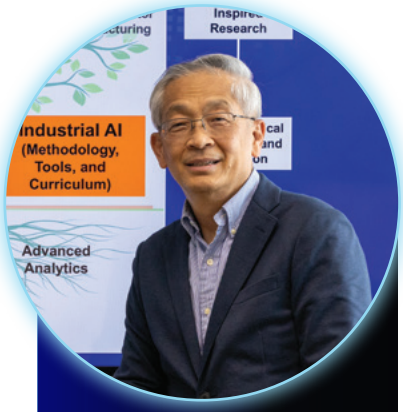
As industries integrate AI more pervasively into their workflows and supply chains, they will need research expertise to guide them, as well as skilled engineers with a background in the field. They'll find both at UMD. Lee's aim in the coming years is to build up the center into a research and education powerhouse, drawing potentially hundreds of graduate students and postdocs to conduct research, while creating opportunities for both undergraduate and graduate students to gain skills and knowhow.

Among other steps, he is introducing Industrial AI to undergraduate and graduate students through courses he teaches in the mechanical engineering department, thus updating the existing curriculum to take into account the growing interest in machine learning, AI, and data.

"AI should not belong just to advanced researchers," Lee said. "I want to bring it to the undergraduate level, starting in the sophomore year. Traditionally, we use a physics-based approach to engineering education, with every student taking physics, chemistry, and calculus. But our society today needs both a physics-based and a data-centric approach."

Students enrolled in Lee's Introduction to Industrial AI course will learn AI, machine learning, and data science fundamentals, and gain experiences using real data from industrial systems such as semiconductors, EVs, wind turbines, jet engines, and rotary machines. The course is designed to complement existing programs within the department, Lee said.

With Lee on the faculty, UMD's Clark School of Engineering now becomes one of the few engineering colleges in the nation where students can study and gain hands-on experience with Industrial AI, working under a mentor who pioneered the field. Lee's 2020 book *Industrial AI: Applications with Sustainable Performance* is considered a seminal work on the topic.



Clark Distinguished Chair Jay Lee

is a member of the World Economic Forum's Global Future Council on Advanced Manufacturing and Value Chains. He also co-founded the company Predictronics, with customers that include companies such as Canon, Coca-Cola, Epson, Hibachi, Nissan, and Toyota.

Prior to joining the mechanical engineering department at UMD, Lee was a faculty member for 17 years at the University of Cincinnati, where he was an Ohio Eminent Scholar and L.W. Scott Alter Chair, as well as a University Distinguished Professor. He was a founding director of the NSF/URCR on Intelligent Maintenance Systems, which partnered with more than 100 global companies from 2001-2019.

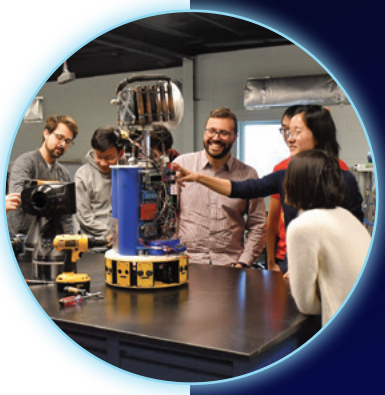
Spotlight: UMD Mechanical Engineering Research Centers

In addition to the newly-established Industrial AI Center, the department is home to five internationally known research hubs that specialize in areas ranging from heating and cooling systems to ventilation.

CALCE's director, UMD Distinguished Professor Michael Pecht, delivers a presentation.

Center for Advanced Life Cycle Engineering

Home to one of the world's largest electronics testing and failure analysis facilities, the Center for Advanced Life Cycle Engineering (CALCE) has been leading the research and practices that enhance the safety and reliability of products and systems for more than 35 years. CALCE has stayed current with the needs of the industry through its evolution and directs the research priorities and resources across the global supply chain. The focus of CALCE has evolved from electronic board and component reliability to supply chain management, the introduction of prognostics to electronic systems, energy systems deployment, and infrastructure sustainability. CALCE faculty and staff have published more than 2,000 highly cited articles, authored more than 30 references and textbooks, led the development of more than twenty international standards, offered hundreds of professional development courses, and served in national academies and other advisory bodies. Above all, CALCE has graduated more than 500 highly qualified engineers and scientists who are leading organizations around the globe. CALCE has created collaborations with domestic and international academic institutions and created centers and research partnerships in more than twenty countries. The symposia and conferences organized by CALCE are acclaimed for their independent dissemination of technological information. For more information, contact the founding director, Michael Pecht.



The Center for Environmental Energy Engineering (CEEE) brings together three consortia dedicated to fostering sustainable solutions in industries such as refrigeration and heating.

Center for Environmental Energy Engineering

Developing more efficient and environmentally friendlier heating and cooling systems is the overarching focus of research at the Center for Environmental Energy Engineering (CEEE), which is helping to pioneer air conditioning and refrigeration systems for both industry and consumer use. The center brings together three consortia: Energy Efficiency and Heat Pumps (EEHP), directed by Yunho Hwang; Advanced Heat Exchangers and Process Intensification (AHXPI), directed by Michael Ohadi; and Modeling and Optimization (MOC), directed by Vikrant Aute. One of CEEE's best-known projects, a robotic device known as the Roving Comforter (RoCo), follows users around as it delivers cool or warm air as needed. Developed with the help of an Advanced Research Projects Agency-Energy (ARPA-E) grant, RoCo can potentially reduce energy consumption in buildings by up to 30 percent, according to CEEE researchers.

Center for Risk and Reliability

Founded in 1985, the Center for Risk and Reliability is an umbrella organization within UMD's A. J. Clark School of Engineering, bringing together world-class experts to conduct research on methods and tools to perform risk and reliability assessment of complex engineering systems and processes for energy, transportation, defense, space, information systems, consumer products, and civil infrastructures. Recently, CRR has provided leadership in new frontiers that include developing risk and reliability models for hydrogen vehicles and fueling stations, risk analysis for natural hazards, and prognostics and health management for big machinery, consumer devices, and nuclear power plants. The center is also the research arm of the Reliability Engineering educational program, through which students are offered an M.S., Ph.D, and Graduate Certificate in Reliability Engineering.

The Center for Risk and Reliability is the research arm of UMD's reliability engineering program.

PHOTO: JOANNA AVERY.

Center for Engineering Concepts Development

Engineering doesn't happen in a vacuum. Whether it's designing a new laptop or building an electric vehicle, projects can and often do have weighty societal impacts. At the Center for Engineering Concepts Development (CECD), an interdisciplinary team of faculty, staff and students works to advance our understanding of these wider impacts, while also exploring future-oriented technologies, including autonomy, energetics, and machine learning. Since 2015, CECD has offered Engineering for Social Change (ENME 467), a course created by Professor Emeritus and CECD Director Davinder Anand and Assistant Director Dylan Hazelwood. Through this course, important social issues, such as unintended consequences, are examined at the intersection of engineering, philanthropy and social change. Topics include ethics and the impact of electronics on society, sustainability, humanitarian engineering, and artificial intelligence. Anand and Hazelwood, together with Michael Pecht and Mukes Kapilashrami, wrote the book *Engineering for Social Change: Engineering Is Not Just Engineering*, which is used in the course and provided for free to the students.

The Neilom Foundation provides critical support for CECD programs and initiatives, including the Engineering for Social Change course.

Center for Sustainability in the Built Environment

With urban populations on the rise while the environmental costs of urbanization continue to mount, avoiding a dystopian future hinges on making cities more sustainable. At UMD's Center for Sustainability in the Built Environment (City@UMD), directed by Margaret G. and Frederick H. Kohloss Chair Jelena Srebric, researchers use a blend of modeling, simulation, and experimentation to map out distributed systems capable of ensuring healthy and comfortable environments, utilizing energy more efficiently, and providing a clean water supply. With funding from agencies such as the Center for Disease Control, the National Institutes of Health (NIH) and the National Science Foundation (NSF), this unique center has tackled projects ranging from personalized air cleaning devices to ventilation in public transit. Small, distributed devices such as these could prove crucial to the protection of urban populations amid perturbed weather and climate patterns.

Researchers at City@UMD developed a comfortable alternative to masks worn during the COVID-19 pandemic.

ILLUSTRATION BY DAVID PLUNKERT.

MEET OUR INCOMING UMD ME CHAIR: Harry Dankowicz

Harry Dankowicz is an engineer with an expansive vision of the field, one informed by his own varied background. His research career spans areas as diverse as corrective surgery of spinal deformity, dust particle dynamics near asteroids, yield mapping techniques for harvest combines, and information transmission in honeybee colonies.

Recently named to succeed Balakumar Balachandran as chair of UMD's mechanical engineering department, Dankowicz is an expert in design, modeling, analysis, and control of nonlinear dynamical systems, such as networked robotic manipulators, micromechanical sensors, and atomic force microscopes. He has authored textbooks, patent applications, and open-source research and educational software.

Mechanical engineering is broadening its scope, Dankowicz said. "Today's mechanical engineers include people who work with biological systems, people who do chemistry and physics, and people with an interest in computational methods. There's a very broad range of subject fields that now come under mechanical engineering, and I think that's a strength."

Even fields as seemingly remote as public policy and communications increasingly find a place under the ME umbrella—after all, engineers must be able to explain what they do to general audiences, engender confidence in the solutions they offer, and understand the societal context in which they operate. Notes Dankowicz: "Making that happen requires emphasizing the humanity in what we do and who we are"—a goal also of a podcast about engineering science researchers, which he

Wise and Visionary Leadership in a Time of Growth

BALAKUMAR BALACHANDRAN LEAVES A LASTING IMPACT AS CHAIR

When Balakumar Balachandran steps down in December as chair of the University of Maryland's Department of Mechanical Engineering, he'll be leaving a legacy that any leader would be proud of. The department has not only grown during his ten-year stint as chair, but has risen steadily in the *U.S. News & World Report* rankings, while also attracting top notch faculty, including not only established luminaries but emerging researchers who are quickly making their mark.

UMD Distinguished University Professor, Minta Martin Professor, and ME Chair Balakumar Balachandran and UMD President Darryll J. Pines, then the dean of the A. James Clark School of Engineering, attend Maryland Day on the UMD campus.

And while he's kept a steady hand on the wheel, he's captained the department in a way that strikes many as unusually modest for someone of such influence. "He seems to have no ego," said Don DeVoe, associate chair of research and administration, who has worked closely with Balachandran over the years.

Kenneth Kiger, Keystone Professor in the department and Associate Dean for Undergraduate Programs at the A. James Clark School of Engineering, appraises Balachandran's leadership style similarly. "He approaches the position as a service to everyone else in the department," Kiger said. Likewise, Nuclear Energy Institute president Maria Korsnick, a UMD alum who serves on the ME visiting committee, describes his style as "collaborative."

"That's very encouraging for a research-oriented, educational atmosphere," she said. "People want to know their ideas are being considered. He's really put the department first as he's worked to expand. It's not about him. Leaders want to be successful, but oftentimes they also want people to know that 'I did it.' That's not Bala's style."

It's an approach that has yielded success. Besides its steady rise in rankings, impressive citation metrics bear testament to its reputation for quality research. And this progress has happened during a time of explosive enrollment growth during which undergraduate enrollments have doubled. "He's been able to maintain this growth without any decline in the quality of teaching," says inventor and entrepreneur Alex Severinsky, a member of the Visiting Committee and an Innovation Hall of Fame (IHOF) inductee. "Indeed, the quality of teaching continues to improve."

"Dr. Balachandran gave us the freedom to explore the avenues we were interested in, but if we got stuck he was always ready to provide ideas and guidance. He's incredibly knowledgeable."

PREETHI RAVULA (PH.D. '21), *DATA SCIENTIST*

produced between 2014 and 2019.

As ME chair at UMD, Dankowicz will lead a department that has seen explosive growth over the past decade, with undergraduate enrollments having doubled since the late 2000s. And he'll be doing so at a time when engineers are being called upon to help address a wide range of societal and global concerns, from sustainability to health.

UMD mechanical engineering is facing the challenges head on, Dankowicz said, pointing to pioneering work being done in areas ranging from refrigeration and ventilation systems to fostering advances in clean energy, including hydrogen and nuclear.

"The field is moving rapidly, society is moving rapidly, and the challenges are quite immense," Dankowicz said. "It's very important for engineers to take a leadership role in discovery and innovation."

With a career spanning nearly three decades, Harry Dankowicz brings expertise in scientific research, engineering education, technical publication, program administration, public service, and academic diplomacy.

In the Grainger College of Engineering at the University of Illinois Urbana-Champaign, he served as Associate Dean for Graduate, Professional and Online Programs. Since 2021, he has been Program Director in the Division of Civil, Mechanical and Manufacturing Innovation at the National Science Foundation (NSF). In this role, as Embassy Science Fellow with the US Embassy in Mexico City, he contributed to workforce development initiatives in support of the local semiconductor industry.

Dankowicz is a recipient of a Presidential Early Career Award for Scientists and Engineers from NSF, as well as the Fred Merryfield Design Award and Archie Higdon Distinguished Educator Award from the American Society For Engineering Education. He was elected Fellow of the American Society of Mechanical Engineers in 2012. He earned his Ph.D. in Theoretical and Applied Mechanics from Cornell University in 1995.

DeVoe notes that Balachandran has been exceptionally effective at recruiting top-notch faculty. While that can sometimes mean attracting the field's rock stars to Maryland, it can also mean keeping a keen eye out for newcomers with the zeal and ingenuity to become tomorrow's leaders. Beyond the impact on cutting-edge research, recruiting top talent also has an important reputational benefit for the department.

"Universities are judged by who's there, especially at the level of advanced degrees," Korsnick said. "They don't just want to go to a university. They want to go for that particular faculty member at that university."

Those top-drawer faculty include Balachandran himself. An expert on applied mathematics, nonlinear phenomena, dynamics and vibrations, and control, he has published not only journal articles but multiple textbooks. Despite the demands of a department that is larger than some universities, he has managed to keep up the pace—and the accolades have kept coming. In 2022, he became one of only two UMD faculty members to receive the coveted Den Hartog Award from the American Society of Mechanical Engineers; the organization also conferred upon him the Lyupanov Award. A year later, the American Society of Civil Engineers awarded him the Robert H. Scanlan Medal.

"It's rare to have a chair who is at the top of their game with their research, who is also very good with the nuts and bolts of the job, and who really cares about doing the right things for the department at every turn," DeVoe said. "Those will be hard shoes to fill."

From left; Natalie Grandison, Director of External Relations for the Department of Mechanical Engineering, 2014-2018; UMD Distinguished University Professor, Minta Martin Professor, and ME Chair Balakumar Balachandran; Heidi Sweely, Director of External Relations for the Department of Mechanical Engineering, 2019-2023.

UMD Distinguished University Professor, Minta Martin Professor, and ME Chair Balakumar Balachandran was formally presented with the 2022 Robert Scanlan Medal at the EMI 2022 conference at The Johns Hopkins University in June 2022. From left: Balachandran, ASCE Engineering Mechanics Institute (EMI) President and Vanderbilt University Professor Sankaran Mahadevan, and ASCE EMI Treasurer and UC Davis Professor Michele Barbato.

"Bala took a risk in hiring me to perform a job I had never done. He saw something in me that I didn't see in myself, and that became a theme during our tenure together. He gave me latitude to try new programs, brainstormed along with me when we needed to solve problems, and served as the perfect blend of role model, mentor, leader, and friend. Looking back, I realize now how much I grew as a person and fundraiser under Bala, and I am forever grateful to him for making my time in ME a high point in my career."

HEIDI SWEELY, *CHIEF DEVELOPMENT OFFICER & ASSISTANT DEAN SCHOOL OF PUBLIC HEALTH; FORMERLY DIRECTOR OF EXTERNAL RELATIONS, DEPARTMENT OF MECHANICAL ENGINEERING.*

YU RECEIVES NSF FUNDING TO DEVELOP SENSORS FOR ENVIRONMENTAL MONITORING

UMD Wilson H. Elkins Professor Miao Yu is bringing her expertise with sensing technologies to bear on two new projects funded by the National Science Foundation (NSF) Ideas Lab on Engineering Technologies to Advance Underwater Science, with the aim of improving underwater and under ice monitoring.

In one, the NSF awarded $1.5 million to a four-institution team, with Yu as the UMD PI. She and her research group received $689,000 to support their efforts to develop technologies capable of delivering more precise measurements of ice accretion and melt on frozen bodies of water, particularly at the boundary point where the ice and water meet. Novel metamaterials—that is, engineered materials whose structure is manipulated in order to yield particular properties—will be used to develop a new technology to track ice thickness and image the internal structure of the ice.

Miao Yu

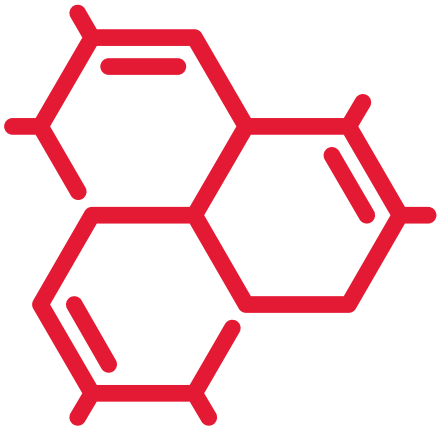
This new tool, envisaged by Yu and colleagues at Rutgers, NSF Bigelow Laboratories, and UC Davis is intended to help overcome the limitations presented by current methods and achieve higher-resolution imagery and better quality data for predicting climate-related ice layer loss from lake ice to ice shelves in Antarctica.

Meanwhile, the NSF has also announced funding for another $1.5 million five-institution collaborative Ideas Lab project, "Light in the Dark: Fiber Optic Sensing of Climate-Critical Carbon Cycle Components at Water/Ice-Air Interfaces." Yu is the UMD PI. Supported by $499,000 in NSF funding, her team will work to develop a sensor that can aid in monitoring water quality in freshwater lakes throughout the year—even during the iciest months of winter, when monitoring costs until now have often been prohibitive.

LEARN MORE go.umd.edu/miaoyu

PHOTO: SHUTTERSTOCK

New Research Could Spur Broader Use of 2D Materials



They're considered some of the strongest materials on the planet, but tapping that strength has proved to be a challenge.

2D materials, thinner than the most delicate onionskin paper, have attracted intense interest because of their incredible mechanical properties. Those properties, however, dissipate when the materials are stacked in multiple layers, thus limiting their usefulness.

"Think of a graphite pencil," says Teng Li, Keystone Professor at UMD's Department of Mechanical Engineering. "Its core is made of graphite, and graphite is composed of many layers of graphene, which has been found to be the world's strongest material. Yet a graphite pencil isn't strong at all—in fact, graphite is even used as a lubricant."

Now, Li and collaborators at Rice University and the University of Houston have found a way to overcome this barrier, by carefully tweaking the molecular structure of 2D polymers known as covalent organic frameworks (COFs). Using molecular-level simulations, the researchers studied different functional groups—that is, arrangements of molecular elements—and then designed two COFs with minute differences in structure. They then studied how the COFs behaved when stacked into layers. It turned out that the tiny structural differences led to significantly different results, with the second COF retaining strong interlayer interaction and robust mechanical properties even as multiple layers were added. The findings are detailed in a study published in Proceedings of the National Academy of Sciences.

UMD Keystone Professor Teng Li

LEARN MORE go.umd.edu/graphene

DeVoe Pioneers New Approach to Liposome Production

Small artificial vesicles known as liposomes are used widely as nanoscale drug carriers in treatment of cancer and immune system diseases, as well as in vaccine delivery and other applications, in large part because of their ability to protect medication from being degraded as it courses through a patient's body.

As Don DeVoe, Wilson H. Elkins Professor and associate chair of mechanical engineering at the University of Maryland (UMD) explains, "lipid-based nanoparticles are the leading nanomedicine delivery vehicles. The most successful nanomedicines to date, and the vast majority of nanomedicines that are currently in clinical trials, are based on the use of lipid nanoparticles." Among the best-known examples: the mRNA vaccines used to protect against COVID-19.

But the current microfluidic-based methods used to prepare lipid nanomedicines run into problems when scaled up to meet high levels of demand, as with the COVID vaccines. In particular, control over the size of the lipid particles deteriorates—and that's a major drawback, as particle size has a direct impact on drug delivery, affecting the way medication enters the bloodstream and is taken into individual cells.

DeVoe and his research team at the Maryland MEMs and Microfluidics Lab have come up with a solution, however. In a paper published recently by *Nature Communications*, DeVoe and co-authors Jung Yeon Han and Joseph LaFiandra detail a process that utilizes an entirely new technique known as "microfluidic vortex focusing".

The technique works by creating a rapidly rotating flow in a microfluidic chamber. Lipid molecules injected into the center of the vortical flow are focused into a narrow stream while simultaneously mixing with the surrounding fluid. Through this process, diffusion and solubility of the lipids—and, as a result, particle size—can be controlled precisely.

"The vortex focusing method provides exquisite control over lipid assembly kinetics, allowing the sizes of liposomes and other lipid nanoparticles to be defined by the user," DeVoe said. "While rapid microfluidic mixing has been broadly used for lipid nanomedicine preparation, such as in the production of mRNA vaccines for Covid-19, the vortex focusing process provides a level of control over nanoparticle size that cannot be achieved by rapid mixing alone."

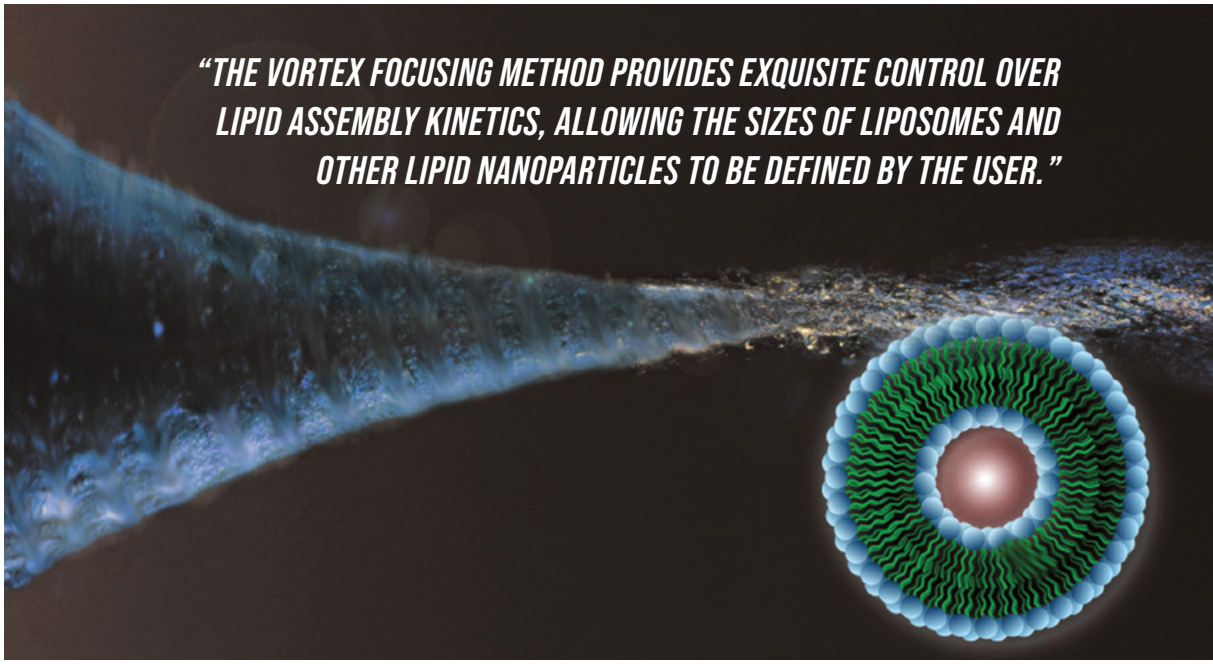
Because the microfluidic system can be operated at high flow rates with Reynolds numbers approaching the laminar limit, throughput of the technology is orders of magnitude higher than that of previous liposome synthesis techniques based solely on flow focusing, he said.

Moreover, the entire process can be scaled to very high levels of throughput without losing size control.

"A single device the size of a matchbox can produce lipid nanoparticles at a rate consistent with pilot-scale manufacturing, and multiple devices can be easily operated in parallel," DeVoe said.

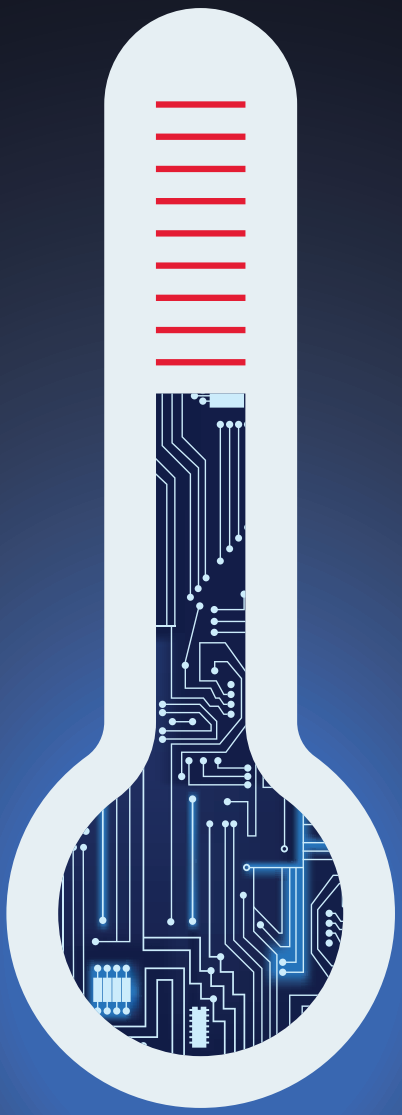
"Since the platform requires very little infrastructure to run—just a pair of small pumps and a refrigerator to store reagents—we envision that it may also play a role in rapidly scaling production capacity when needed, for example in response to future pandemic threats."

LEARN MORE go.umd.edu/liposome



A focused microfluidic vortex enabling tunable self-assembly of size-optimized lipid nanoparticles.

Wilson H. Elkins Professor and Associate ME Chair Don DeVoe



Maryland Engineering Tapped for $3.5 Million ARPA-E COOLERCHIPS Award

UMD has been selected to receive approximately $3.5 million in federal funds to help improve the efficiency of cooling systems used in data centers around the country. The award is part of a major DOE Advanced Research Projects Agency-Energy (ARPA-E) endeavor aimed at reducing the environmental impact of data centers, which include the network servers and associated equipment at many organizations, as well as massive server systems that house the off-site storage system popularly known as the Cloud.

As part of the program, a UMD team led by mechanical engineering faculty members Patrick McCluskey (PI), Damena Agonafer, Michael Ohadi, and Peter Sandborn will develop an integrated decision support software tool for the design of next-generation data centers that includes reliability, thermal, and cost modeling.

As McCluskey explains, "we're setting out to achieve cross-optimization in a way that has never been done before. It will give you a cost estimate, a reliability estimate, a carbon footprint estimate, and an energy estimate, and then engineers can take that information and design a system that will meet the desired goals."

Team members will bring specific areas of expertise to the effort, with Agonafer and Ohadi focusing on thermal modeling, McCluskey on reliability modeling, and Sandborn on cost modeling. The team will be partnering with the National Renewable Energy Laboratory in Golden, Colorado and Lawrence Berkeley National Laboratory to conduct energy and climate footprint modeling. University of Arkansas and Trane Corporation will also be collaborating on the modeling and optimization efforts.

In addition to the UMD-led project, several faculty members are also contributing to COOLERCHIPS projects led by other institutions. These include Agonafer, who is part of a University of Texas at Arlington-led team that is developing a hybrid cooling system for data centers and server farms, and McCluskey, who is assisting a University of Florida-led endeavor aimed at developing the technology needed for hyper-efficient, deeply decarbonized data centers. Ohadi is a subcontractor on a Flexnode-led project that will develop prefab, modular, liquid-cooled data centers, with Sandborn also conducting research as part of the same project.

LEARN MORE go.umd.edu/coolerchips

UMD Mechanical Engineering Professor Patrick McCluskey is leading the development of a support software tool for the design of next-generation data centers that includes reliability, thermal, and cost modeling.

IMAGE: SHUTTERSTOCK

Tubaldi Wins NSF CAREER Award to Support Metamaterials Research

Metamaterials, whose structures can be manipulated in order to produce a particular set of properties, have long been of interest to engineers, but until now little attention has been paid to how they interact with fluids.

Eleonora Tubaldi, assistant professor of mechanical engineering at UMD, aims to close this research gap with support from a National Science Foundation CAREER award announced in April. She will receive $702,211 over five years to support this endeavor, which could lead to more effective heart stents, robots that can shape-shift in response to their environments, and numerous other applications.

"We're setting out to create materials that have properties that we not only can predict, but harness for specific purposes," Tubaldi said. "We do this not by altering the chemical composition of the materials, but by manipulating their structure."

"We then put these metamaterials into contact with flowing fluids in order to explore how they interact."

On a typical day in her lab, Tubaldi and her students create building blocks—often arches and domes—out of rubber or metal, then combine them into lattices and other configurations. The inspiration, she says, comes in part from her native Italy, home to ancient aqueducts and Rome's Colosseum.

Such marvels of engineering are similar to metamaterials in that they utilize discrete units, such as arches, in order to distribute energy and loads in a particular way. But while these structures are static—the Colosseum, after all, was built to stay still—Tubaldi's metamaterials are intended to be dynamic, reconfiguring themselves in response to external stimuli.

"Engineering has traditionally sought to keep things stable," Tubaldi said, "Instability can lead, for instance, to disasters such as the Tacoma Bridge collapse, or to unwanted flutter in an airplane's wings. But in my work, we're actually trying to harness instability and direct it to our purposes. And we're doing this specifically within the context of fluids."

In the case of cardiovascular implants, for instance, the goal is to better mimic the properties of the human aorta, which responds flexibly to blood flow, expanding and contracting. Current stents are too stiff and thus incapable of such a dynamic response. Tubaldi's research could help change that.

"With a stent made out of a metamaterial, the flow would act on it, and then it would respond to it in a way that we can predict," Tubaldi said.

Combining metamaterials and fluid dynamics could also yield new approaches to underwater robotics. Unlike the stereotypical, C3PO-like robot with its gleaming, rigid shell, a robot made of metamaterials could shape-shift in response to the flow that surrounds it.

"We're hoping to integrate our work with current advances in soft robotics," Tubaldi said.

Eleonora Tubaldi, Assistant Professor, University of Maryland.

Tubaldi is among several current faculty members in the department to have received NSF CAREER awards, including Damena Agonafer, Michel Cukier, Don DeVoe, Hosam Fathy, Mark Fuge, Samuel Graham, Jr. (Dean, A. James Clark School of Engineering), Katrina Groth, Jin-Oh Hahn, Ken Kiger, Johan Larsson, Elisabeth Smela, Ryan Sochol, Jelena Srebric, and Miao Yu.

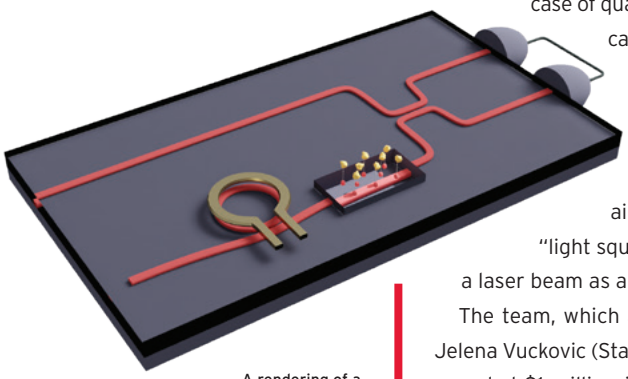
IMAGE: SHUTTERSTOCK

Assistant Professor Avik Dutt

Dutt is PI on NSF-Funded Quantum Research Grant

Nearly a century after quantum mechanics enabled the development of transistors and lasers, the "second quantum revolution" is in full swing, as researchers manipulate phenomena such as quantum entanglement for purposes that include computing, sensing, and measurement. Barriers to progress exist, however. In the case of quantum sensors, for instance, exponential increases in complexity can cancel out the gains in sensing capability.

Avik Dutt, assistant professor at UMD (mechanical engineering/Institute for Physical Science and Technology) and director of the FearLess Optics, Quantum Engineering and Technology (FloQuET) Laboratory, is leading a multi-institutional effort aimed at overcoming these hurdles through techniques such as "light squeezing," which involves compression of the noise produced by a laser beam as a result of the Heisenberg Uncertainty Principle.



A rendering of a proposed chip-scale quantum sensing platform includes a representation of the generation and detection of quantum light.

RENDERING BY CHAD SMITH

The team, which also includes Paul Lett (Joint Quantum Institute–NIST/UMD), Jelena Vuckovic (Stanford University), and Peter Maurer (University of Chicago) was awarded $1 million in August by the National Science Foundation as part of its Quantum Sensing Challenges for Transformational Advances in Quantum Systems program. Dutt and his students will conduct their work at UMD's FabLab, a micro and nano fabrication facility housed at the Maryland NanoCenter.

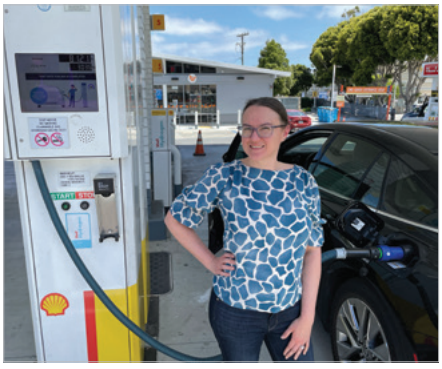
LEARN MORE: go.umd.edu/squeezedlight

GROTH ESTABLISHING UMD AS HYDROGEN RESEARCH HUB

When people think about clean energy and reduced emissions, they often think of electric vehicles. But a large share of the global carbon footprint is generated by trucking and heavy industry—sectors that are not easy to decarbonize. As Katrina Groth, associate professor of mechanical engineering at UMD, puts it, "you can't just plug in a blast furnace."

That's one of the reasons government and the private sector alike are interested in hydrogen energy, which can support industrial needs as well as other heavy-duty applications, such as long-haul trucking, forklifts, backup power and aviation. The DOE, in fact, is pumping $10 billion into hydrogen energy research and development, and analysts predict the field could create around 100,000 jobs by 2030 alone.

But the success of hydrogen depends on understanding and addressing the safety challenges: after all, it only takes a handful of high-visibility safety incidents to halt the trend in its tracks. Groth, who is associate director of the Center for Risk and Reliability, a research hub that spans the Clark School, has become one of the leading researchers involved in examining hydrogen reliability, risk, and safety. Currently, her team has taken on no fewer than seven active projects, with more in the works. These include development of a safety and reliability database for hydrogen fueling stations; examination of Quantitative Risk Assessment techniques for novel hydrogen systems; determining how to conduct risk assessments for electrolyzers, pipelines, fueling stations, and industrial vehicles; building models that can support real-time system fault diagnosis; and studying the risks and benefits of incorporating hydrogen energy generation at nuclear power plants by means of electrolysis.



Associate Professor Katrina Groth is leading multiple research projects aimed at ensuring the safety and reliability of hydrogen energy systems, enabling fueling stations like this one in California.

Over the longer term, Groth plans to establish a hydrogen teaching, and engineering research program at UMD, to be dubbed HyTERPS. "Hydrogen is a growing part of our energy system. If we build all these important technologies, we're going to need engineers who know how to do the safety and reliability analysis so that we can get it right the first time, and quickly recover if we don't. We want UMD to be instrumental in educating the future hydrogen energy workforce and driving hydrogen safety innovation," Groth said.

Sochol Named "Rising Star" in Advanced Materials Technologies

Mechanical Engineering Associate Professor Ryan D. Sochol has been honored as an inaugural "Rising Star" in the latest issue of *Advanced Materials Technologies*. An article by his research group—highlighted on the issue's inside front cover—introduces a three-dimensional (3D) printing approach for building new classes of microneedle arrays that are beneficial for delivering therapies into the brain.

The breakthrough represents an especially interdisciplinary effort, involving not only Sochol's Bioinspired Advanced Manufacturing (BAM) Lab as well as the groups of Mechanical Engineering Assistant Professor Eleonora Tubaldi and Chemical & Biomolecular Engineering Professor Peter Kofinas within the A. James Clark School of Engineering, but also neurosurgeons and medical researchers at the University of Maryland School of Medicine (UMSOM) including Dr. Piotr Walczak, Dr. Miroslaw Janowski, and Dr. Yajie Liang.

To demonstrate the technology, the team used their 3D-printed microneedle arrays to inject fluidic payloads directly into mouse brains. The results revealed significant improvements for the injection distributions and coverage areas in the brains compared to current clinical needles, providing a new route to potential treatments of neurological conditions ranging from stroke and traumatic brain injury to Alzheimer's Disease, Parkinson's Disease, and Amyotrophic Lateral Sclerosis (ALS).

Dr. Sunandita Sarker—a Maryland Robotics Center (MRC) Postdoctoral Fellow in Sochol's and Tubaldi's groups—is lead author of the article, which builds on the team's earlier work that led to them receiving the "Springer Nature Best Paper Award – Runner-Up" in 2022.

AZARM WINS ASME MACHINE DESIGN AWARD

Professor Shapour Azarm has won the American Society of Mechanical Engineers' (ASME) Machine Design Award. He was selected for the honor in recognition of his "outstanding contributions to research and applications in design optimization of engineered systems with multiple objectives, subsystems, and uncertainties, and in design for market systems," ASME said.

A member of the UMD faculty since 1984, Azarm directs the Design Decision Support Lab, which is part of the UMD Department of Mechanical Engineering. The lab has conducted research in a broad area of design optimization, including multi-objective robust optimization, decision support systems, optimization-based path planning and predictive maintenance of unmanned systems, co-design (design and control), data assimilation, V&V of spatio-temporal systems, task planning of multi-agent systems, and design for market systems.

Azarm is an ASME Fellow and Life Member, and currently serves as Vice Chair of the organization's Technical Committee on Publications and Communication.

Modarres Becomes IEEE Life Fellow

Professor Mohammad Modarres, director of the Center for Risk and Reliability, was elevated to the rank of Life Fellow by the Institute of Electrical and Electronics Engineers (IEEE) for his contributions to probabilistic risk assessment in nuclear safety. IEEE Fellow is a distinction reserved for select IEEE members with extraordinary accomplishments in any of the IEEE fields of interest.

Modarres, the Nicole Y. Kim Eminent Professor at UMD's A. James Clark School of Engineering, is the recipient of numerous awards and honors. He co-founded the world's first degree-granting graduate curriculum in reliability engineering at the University of Maryland. As the University of Maryland Center for Risk and Reliability Director, Dr. Modarres serves as an international expert on reliability and risk analysis.

AWARDS, HONORS AND PROMOTIONS

UMD's Board of Regents has selected

MICHEL CUKIER, professor of reliability engineering, to receive a 2023 USM Regents Faculty Award for Excellence in Mentoring. The Regents awards are the highest honors that the Board bestows to recognize exemplary faculty achievement.

Associate Professor **SIDDHARTHA DAS** was named

an Emerging Investigator by the journal *Soft Matter*, and also recently joined the editorial advisory board of *Physics of Fluids*.

The distinctions are the latest in a succession of accolades for Das, who has been conducting novel research into the behavior of liquids inside nanochannels by means of molecular simulations and fluidics and ionics of polymer-functionalized systems.

Professor **DON DEVOE** has been named a

Distinguished Scholar-Teacher by the University of Maryland. The Distinguished Scholar-Teacher Program, established in 1978, honors a small number of senior faculty who have demonstrated outstanding success in both scholarly accomplishment and excellence in teaching.

Associate Professor **JIN-OH HAHN** and Associate Professor **JOHANN LARSSON** have been promoted to the rank of full professor.

Research Professor **YUNHO HWANG** is the

2023 recipient of the Gustav Lorentzen Medal from the International Institute of Refrigeration (IIR). The IIR awards the medal every four years to an individual who has made outstanding and original achievements in academic or industrial research, innovation or development, in all fields of refrigeration, thus promoting creativity and renewal in the fields of expertise of the IIR.

Professor of Practice **JEONG H. KIM** received the

National Medal of Technology and Innovation from President Joe Biden at a White House ceremony on Oct. 23. It is the nation's highest award for technological achievement.

Professor **MIAO YU** was selected to receive a

two-year University System of Maryland Wilson H. Elkins Professorship for FY24–25. She is the third Clark School and Mechanical Engineering faculty member to receive the prestigious professorship, following in the footsteps of Jim Duncan and Don DeVoe, and the first female Clark School faculty member to be so honored.

Samantha Wismer Wins DOE NEUP Fellowship

UMD DOCTORAL STUDENT HELPS ASSESS THE SAFETY OF COMBINING HYDROGEN AND NUCLEAR SYSTEMS.

University of Maryland (UMD) doctoral student Samantha Wismer has been awarded a fellowship under the Department of Energy's Nuclear Energy University Program (NEUP), becoming the second student in UMD's reliability engineering program to receive the prestigious award.

The NEUP University Nuclear Leadership Program, designed to support future leaders in the nuclear energy field, will fund Wismer's studies fully for the next three years as she assesses the risks involved in combining a hydrogen electrolyzer facility—that is, a facility that uses electrical power to split water into hydrogen and oxygen gas—with a nuclear power plant.

The combination could provide a novel clean energy solution, but engineers must first be able to understand and mitigate any potential hazards to meet the rigorous regulatory requirements applied to anything on site at a nuclear power plant. To that end, Wismer will be conducting a quantitative risk assessment under the supervision of her advisor, Associate Professor Katrina Groth.

"I'll be evaluating an electrolyzer design, identifying failure modes of each component in the electrolyzer, and creating logic models to identify which sequences of events matter from a safety perspective—and which ones don't," said Wismer, who earned her bachelor's degree in mechanical engineering from the University of Pittsburgh before embarking on her doctoral degree at Maryland.

"We want to get out in front of any potential safety issues involved in coupling hydrogen and nuclear systems—or find out there are no concerns—so that our findings and recommendations can be incorporated in the initial design phases," she said.

In addition, Dr. Groth said, "it's important to avoid overreacting and wasting resources on changes that won't actually make the system safer."

Wismer is conducting her work at the Systems Risk and Reliability Analysis (SyRRA) Lab, which is directed by Groth. The lab's 15-strong research team studies emerging safety, risk, reliability, and security issues associated with advanced energy systems.

In 2022, SyRRA Lab researcher and doctoral student Camille Levine was awarded an NEUP UNLP fellowship, becoming the first UMD student to receive the award, followed by Wismer a year later.

"I'm both proud and grateful to have been selected," Wismer said.

Groth, who is also associate director for research at UMD's Center for Risk and Reliability, said Wismer exemplifies the high caliber of students who are coming to UMD to build their careers in reliability engineering.

"Developing innovative energy systems and ensuring their reliability is a front-burner issue both in the U.S. and globally," Groth said. "The field—and the planet—stands to benefit as talented young engineers like Samantha contribute their creativity, drive, and passion for excellence."

> ***"I'll be evaluating an electrolyzer design, identifying failure modes of each component in the electrolyzer, and creating logic models to identify which sequences of events matter from a safety perspective—and which ones don't."***
>
> SAMANTHA WISMER, *UMD DOCTORAL STUDENT*

GRADUATE STUDENT AWARDS

ASME DSCD Rising Star 2022
LASITHA WEERAKOON

Best Student Poster at the APS Division of Fluid Dynamics Conference
VEDANT KUMAR

Best Thesis Award from IAFSS for the Americas
PARHAM DEHGHANI

Clark Fellowships
ARKO CHATTERJEE, KIERAN BARVENIK, KATHRYN PACHECO, MICHAEL XU

Dean's Fellowship
SINA MASOUMI SHAHRBABAK

Distinguished Graduate Endowed Fellowship for Energy Innovation in Mechanical Engineering
PO-CHING HSU

Engie Chuck Edwards Memorial Fellowship
ZHENYUAN MEI, JANGHO YANG

George R. Irwin Centennial Research Award
CHANGSU KIM, SUKRUT PRASHANT PHANSALKAR

Grace Hopper Celebration Student Scholarship
SARA HONARVAR

Graduate School Summer Research Fellowship
COLLEEN MURRAY, QIONGYU CHEN

C. Raymond Knight Endowed Scholarship in Reliability Engineering
COLIN SCHELL

Alex Mehr Distinguished Graduate Fellowship
NATHAN BOYD

Outstanding Graduate Research Assistant
L3 Communications Fellowship
HIRBOD AKHAVANTAHERI

Society of Tribologists and Lubrication Engineers Scholarship
BHARGAV SAI CHAVA, VISHAL SANKAR SIVASANKAR

Top 5 Abstract of 2022 American Burn Association Annual Meeting
Yi-MING KAO

USNC/IIR Outstanding Young Researcher Paper Award
NEHEMIAH EMAIKWU

Vertical Flight Foundation Scholarship
COLLEEN MURRAY

Ann G. Wylie Dissertation Fellowship
WEIDI YIN

Zolve Scholarship Award
ARJUN ARAVIND PALAT MEETHALE

MICHAEL BONTHRON LANDS NDSEG FELLOWSHIP

TUBALDI LAB RESEARCHER LANDS PRESTIGIOUS DOD AWARD.

University of Maryland (UMD) doctoral student Michael Bonthron, a research assistant at the mechanical engineering department's Tubaldi Lab, has been selected for a National Defense Science & Engineering Graduate (NDSEG) Fellowship. Awarded by the Department of Defense (DoD), the fellowship is part of a program aimed at building a broader pool of high-achieving U.S. scientists and engineers.

Bonthron, now in his second year of the doctoral program, works with assistant professor Eleonora Tubaldi, who recently won a NSF CAREER award to support her lab's exploration of pioneering technologies.

"Our work focuses on mechanical metamaterials, which are engineered structures that can have unique mechanical properties," he said. "We design structures that have properties that don't occur in a traditional material, or that respond in unique ways." Applications include designing aircraft wings, hi-tech ship components, or creating smart materials that can adjust their properties in response to stimuli.

A native of the Chicago suburbs, Bolthron majored in mechanical engineering at the Illinois Institute of Technology and went on to earn a master's degree in applied math from DePaul University. In researching doctoral programs, he says, his aim was to join a research group with a focus on the analytical and computational side of engineering. Given these interests, he said, the Tubaldi Lab is a perfect match.

"WE DESIGN STRUCTURES THAT HAVE PROPERTIES THAT DON'T OCCUR IN A TRADITIONAL MATERIAL, OR THAT RESPOND IN UNIQUE WAYS."

MICHAEL BONTHRON, *DOCTORAL STUDENT, UMD DEPARTMENT OF MECHANICAL ENGINEERING*

With support from the NDSEG Fellowship, Bonthron will be able to dive deep into the analytical approaches that have come to fascinate him. His specific areas of focus at the lab, and in his doctoral research, will be on developing analytical models that can predict how a given set of metamaterials will behave, as well as on computational tools that allow these predictions to be scaled up to cover larger structures. In addition, he will be carrying out experimentation designed to validate the models.

NDSEG Fellowships, which include full tuition coverage plus a stipend, are highly competitive, portable awards granted to U.S. citizens and nationals. Awardees are given the opportunity to work with a mentor who can share expertise and provide career-building guidance. "The stipend is fantastic, and the mentorship opportunity is equally valuable," Bonthron said.

The Department of Defense (DoD) has awarded nearly 3,400 NDSEG fellowships since the program began in 1989.

ALUMNI NOTES

TYLER DENK '16 was named to Forbes 30 under 30 List for 2023.

SEAN DURBIN '93 and **WILLIAM MAJETTE '01** have joined the Board of Visitors of the A. James Clark School of Engineering. Durbin is Executive Vice President at Linde, and Majette is Chief Engineer, Intel and Cyber, at L3Harris.

JOSHUA GOLDMAN '00 was named VP of Mobility at Xendee.

VAHID MOTEVALLI (B.S. '83, M.SC. '85, PH.D. '89) was named interim vice chancellor for academic affairs at Penn State Harrisburg.

RAJA SUNDARAJAN (M.SC. '98) was named Executive Vice President, Strategy and Customer Solutions at Alliant Energy.

CAREER PATHS SPEAKERS

LES BUKOFF '94
Co-Founder, Bookoff McAndrews

DAVID BIGIO '90
Professor, University of Maryland
CEO. R.O.M.E. Energy

DONYA DOUGLAS-BRADSHAW '94
Deputy Director for Planning and Business Management, ETD
NASA-Goddard Space Flight Center

SEAN DURBIN '93
Executive Vice President
Linde

CHRISTINE GILBERT B.S. '06, M.S. '11, PH.D. '12
Associate Professor, Virginia Polytechnic University

KATIE HARKLESS '01
Assistant Director, Industrial Demonstrations, DOE Office of Clean Energy Demonstrations

DAVID HATWELL '97
Founder and CEO, Aegis Project Controls

SARAH MCCOMB '94
Senior Technical Advisor, Office of Research and Engineering
National Transportation Safety Board (NTSB)

ANIL TAILOR '92
Senior Vice President, Leidos

MONICA WATKINS '94
Executive Vice President/Chief Operating Officer, Housing Authority of Baltimore City

DESIGN DAY JUDGES

HAKAN BEYGO B.S. '88, M.B.A '90
Senior Director, Bulk Loan Acquisitions and Servicing Released Executions, Freddie Mac

MEGAN COONEY
Manager, Additive Manufacturing
Northrop Grumman

DONYA DOUGLAS-BRADSHAW '94
Deputy Director for Planning and Business Management, ETD
NASA-Goddard Space Flight Center

SUSAN EDWARDS '00
Director of Operations
Phoenix Operations Group

TOPAZ ELLIOTT '03 (nuclear and mechanical engineering)
Primary Patent Examiner
U.S. Patent & Trademark Office

ELLIOTT FLICK '89
(nuclear engineering)
Vice President of Commercial Projects, Constellation Energy

ALEX FOLK '96
Senior Operations Advisor, National Institute of Standards and Technology

JEFF GAIR M.S. '16, PH.D. '17
Founder and CEO, Scinetics, Inc.

SHEILA GLESMANN '87
Engineer/Business Owner
Sinc Energy

CHARLES GRODY '20
CEO, Hydraze, Inc.

BEN LAYLESS '85
Program Manager, Pond & Company

WILLIAM LEASURE '66
Retired

BARRY MCQUAY '83
Senior Manager, Whiting-Turner

SARAH PRZYBOCKI
UR&R Talent Acquisition Business Partner, Northrop Grumman

LARRY RAMSEY '69 (Chemical)
Retired, Contamination Engineer
NASA - Goddard Space Flight Center

SEBASTIAN SILVANI B.S. '95, M.S. '98
Research Engineer, Autonomous Vehicles, National Highway Traffic Safety Administration

RUSSELL WERNETH B.S. '64, M.S. '68
Aerospace Engineer
NASA - Goddard Space Flight Center

DOROTHY ZUKOR M.S. '77, PH.D. '82 (nuclear engineering)
Retired, Associate Director for Earth Sciences, NASA - Goddard Space Flight Center

ALUMNI SPOTLIGHT

Davinder K. Anand:
A Shaping Force at UMD ME

A PROFESSOR, PHILANTHROPIST, AND DIRECTOR OF THE CENTER FOR ENGINEERING CONCEPTS DEVELOPMENT, DR. ANAND CONTINUES TO BE A GUIDING INFLUENCE.

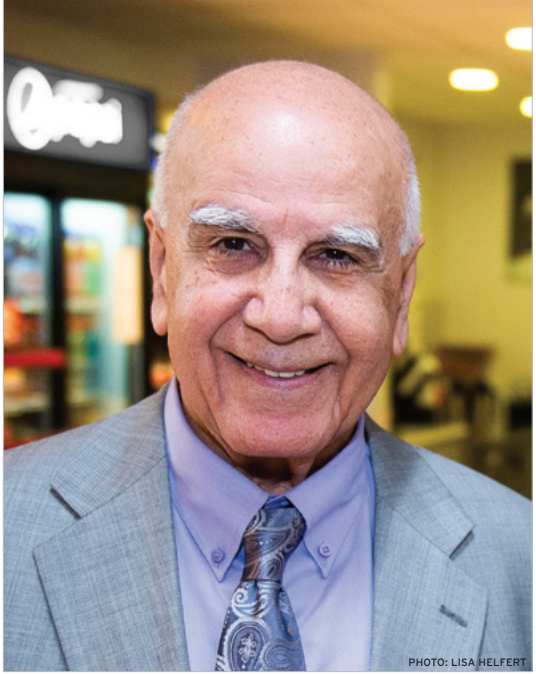


PHOTO: LISA HELFERT

Davinder K. Anand, professor emeritus of mechanical engineering at UMD, has been a central figure in the department since first joining the faculty in the mid-1960s. It was an appointment that occurred practically on the spot: when his UMD contact, Professor William Shreve, brought him to meet the dean, the interview lasted only a few minutes. "He's good," the dean said. "Hire him."

The dean's instincts were sound. The young professor, who had recently completed his Ph.D. at George Washington University, would ultimately go on to be chair, while making a name for himself in research areas that include space dynamics, satellite heat transfer, solar energy, and magnetic bearings.

He would also become a major donor whose support has backed faculty research as well as educational programs. Today, he is continuing that support through a Maryland Promise Scholarship earmarked for mechanical engineering students who are in need. His $250,000 gift will be matched by UMD.

Anand inherited William Shreve's desk when the latter retired, and he still works at it today. Though retired from teaching and research, he remains active in the department as director of the Center for Engineering Concepts Development, which he has led for nearly two decades.

The Center began as an energetics research hub—indeed, at the time of its founding, it was known as the Center for Energetics Concepts Development. Its scope has broadened, however, to cover a wider array of technologies, including autonomy and machine learning, as well as the broader social impacts of engineering. Supporting faculty research, education, and outreach, CECD has been at the forefront of departmental efforts to bring a big-picture perspective to engineering.

One of its most successful initiatives has been the Engineering for Social Change course, created by Anand and CECD Assistant Director Dylan Hazelwood. It features student competitions as well as a project in which students select a nonprofit to receive donations from a pro-bono foundation established by Anand, the Neilom Foundation.

The story of the Foundation is one of transforming tragedy into positive action.

Anand's son, Dilip, died of a sudden heart attack in 2012 at the age of 48. An avid basketball player and the co-owner of an accounting firm in Bethesda, the younger Anand—who went by the nickname Neil—had no apparent health issues. Yet now he was gone. In 2014, Davinder Anand set up the Neilom Foundation not only to honor him, but to continue his legacy: Neil had been passionate about technology and about helping young people. The foundation "is very much an extension of Neil's personality," said Hazelwood, the CECD assistant director. "He would help anyone."

Run on a volunteer basis by Anand and a close-knit team of associates, the Foundation has raised significant funds in the past decade, encompassing initiatives not only at UMD but also Johns Hopkins and George Washington University, and supported nonprofits such as the African Women's Cancer Awareness Association, Bread and Water for Africa, the Chesapeake Bay Foundation, and Students Helping Honduras through the Engineering for Social Change class.

Through the Foundation and now through the Maryland Promise scholarship, Anand continues to make good on his commitment to positive social impact. It's a perspective that reflects not only his life experiences but his cultural and religious roots.

"I'm a Hindu," he said. "You can't take it with you—you came into the world with nothing and you'll leave with nothing. The more you give, the more you get."

VISITING COMMITTEE MEMBERS

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Kathy Eberwein (B.S. '88)
Brian Gearing (B.S. '96)
Howard Harary
Steve Hogan (B.S. '85)
Roberto Horowitz
Asif Hussain (B.S. '94)
Bob Kaplan (B.S. '82)
Maria Korsnick (B.S. '86, nuclear engineering)
Dunstan Macauley (B.S. '95)
Nancy Margolis (M.S. '81)
Michael Miller (B.S. '79, M.S. '84)
Jim Moreland (B.S. '88)
José Reyes (M.S. '84, Ph.D. '86, nuclear engineering)
Alex Severinsky (M.S. '67 Ph.D. '75, electrical engineering)
ToniAnn Thomas (B.S. '82)
Kon-Well Wang
David Wilson

EMERITUS MEMBERS

Aris Cleanthous (B.S. '96)
George Dieter*
Charley Kilmain (B.S. '85)
G. Lee Lushbaugh, Jr. (B.S. '74)
T.G. Marsden (B.S. '87)
John Miller (M.S. '70)
Sheila Mortazavi (B.S. '95)
Hratch Semerjian
Sheldon Shapiro*
Susan Skemp
Tom Stricker (B.S. '89, electrical engineering)
Ward Winer Manolo Zúñiga (B.S. '83)

* DECEASED

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Support from L3Harris has enabled UMD's renowned racing team—which designs and builds three cars each year for a series of competitions—to acquire a new trailer.

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Save these dates

NOVEMBER 30
Distinguished Scholar Teacher Lecture: Don DeVoe
"Drips, Drops, and Drama: From Nanomedicines to Bioanalytics Through Microfluidic Discretization"

NOVEMBER 28-29
Industrial AI Center Launch

DECEMBER 5
Fall Design Day

MAY 7
Spring Design Day

MAY 20
A. James Clark School Commencement

MAY 20
Main UMD Commencement
SECU Stadium