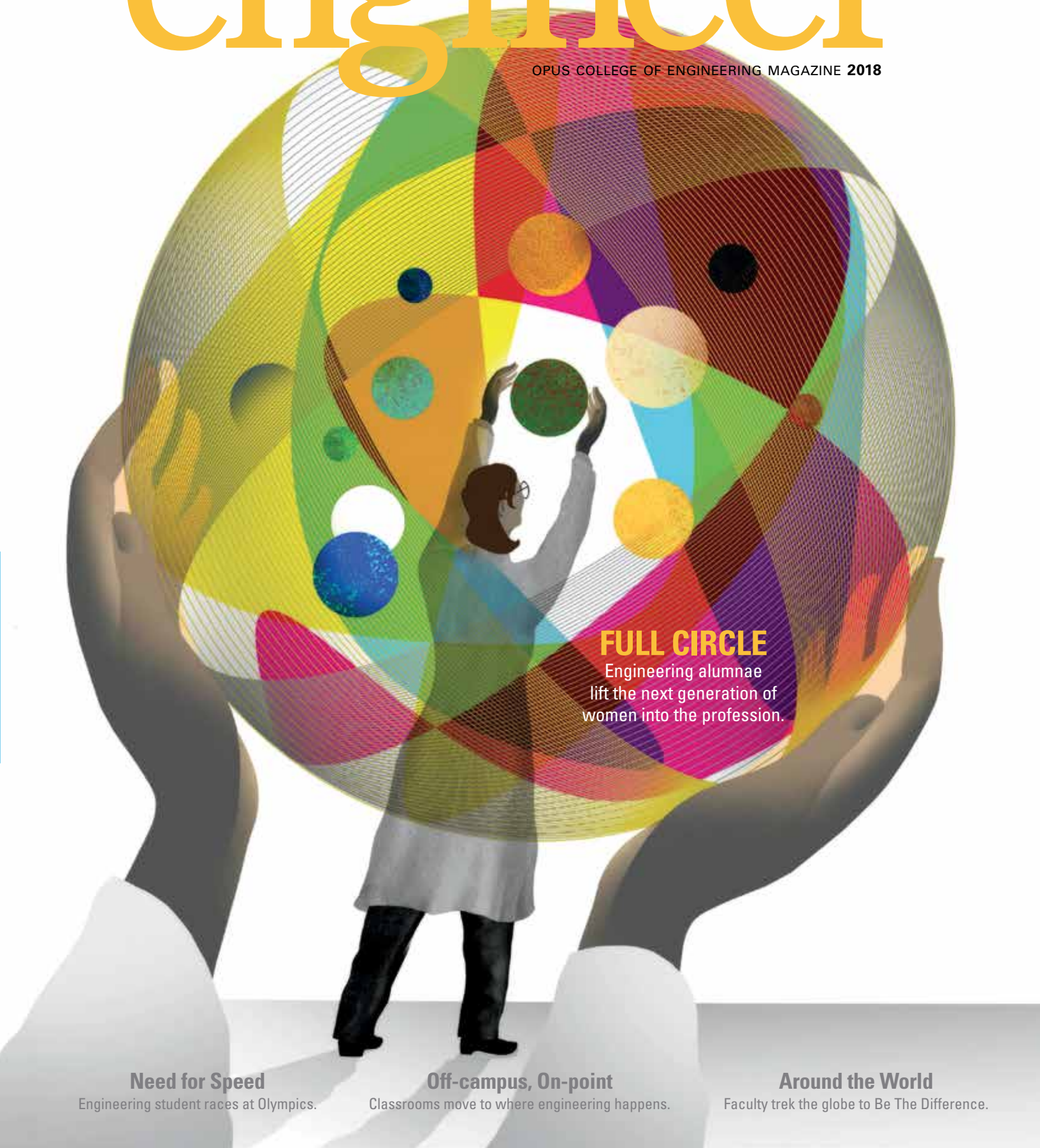
marquette engineer

OPUS COLLEGE OF ENGINEERING MAGAZINE **2018**



FULL CIRCLE

Engineering alumnae lift the next generation of women into the profession.

Need for Speed
Engineering student races at Olympics.

Off-campus, On-point
Classrooms move to where engineering happens.

Around the World
Faculty trek the globe to Be The Difference.

Paying it forward

Every day, I am reminded of the true blessing I have to serve as Opus Dean. I wear many hats that allow me to interact with different people — students, faculty, staff, alumni, industry partners and friends of the college. No matter which hat I am wearing, I work with people who share a common mission of providing the best opportunities for our students. It is wonderfully rewarding to be part of this mix of people who are so committed to serving others.

As I reflect on the opportunity I have to serve our college, I am reminded of the many people who have helped me to get where I am today. I have stood on the shoulders of giants who continually pushed me to be better. Countless women and men, engineers and non-engineers, paid it forward as teachers, mentors and leaders. They instilled in me that I, too, must do the same for others.

Now in my fourth year as Opus Dean, I have noticed this theme of "paying it forward" among our Opus College family. Take our alumnae and faculty members on pages 18–21 who are giving their time and talents to inspire more females to pursue engineering. Or, read about our Biomedical Engineering Society students on pages 12–15 who are going out into the Milwaukee community offering STEM activities to students from underrepresented populations.

As you read through our magazine, you will see many of these examples of paying it forward. While I wish we could share every story, know that as a college, we are proud of all our alumni who are out there making a difference in their organizations and communities each day.

I recently came across a quote from Gary Vaynerchuk, a social media entrepreneur and wine critic, that I'd like all of us to keep in our back pockets: "Please think about your legacy, because you are writing it every day." It does not matter whether we are young or old, just getting started or heading into the twilight of our careers. We can all make a difference, and the best way to do so is by empowering others to someday do the same.

It is all full circle. So, what will your legacy be?

Dr. Kristina Ropella
Opus Dean
Opus College of Engineering

Follow the dean on Twitter @DeanRopellaMU.

marquette engineer 2018

"BELIEVE IN YOURSELF, build up a peer group of support, and be driven to succeed."

p.18

—Dr. Brooke Mayer

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OPUS College of Engineering
MARQUETTE UNIVERSITY

MarquetteEngineering MUEngineering DeanRopellaMU marquette_opus_engineering

The need for

Marquette civil engineering student races his way onto the 2018 U.S. Olympic Team.

By Joe DiGiovanni, Jour '87

IN MANY WAYS, EMERY LEHMAN IS A TYPICAL STUDENT IN THE OPUS COLLEGE OF ENGINEERING — WITH ONE BIG EXCEPTION.

At the age of 22, the Marquette senior already has competed in two Olympiads as a member of Team USA's Long-track Speedskating Team.

"It's unbelievable," Lehman says. "The fact that I went was an experience in itself. You get treated like royalty, and on top of that, I met great athletes from all these different sports."

The youngest male U.S. athlete in Sochi, Russia, in 2014 at age 17 and the youngest member of the speedskating team in Pyeongchang, South Korea, this year, Lehman typically spends six days a week training at Milwaukee's Pettit National Ice Center while juggling a rigorous engineering curriculum.

He wouldn't have it any other way.

"It's the best-case scenario that allows me to train and go to class at the same time," he says.

Lehman took the 2017–18 school year off to train for the Olympics but has returned to campus this fall with his engineering classmates — many of whom he remains close to since residing in an engineering living learning community at Carpenter Tower his freshman year.

He gives credit to Marquette for helping him mature to handle the pressure of competing on the world stage.

"When I went to Sochi I was kind of getting babied, being the youngest kid on the team," he says. "I just showed up. Once I got to Marquette, I was on my own and got thrown into a new place with new people. It was a big change, but it prepared me for competing at this level."

Those are not the only skills he's refined at Marquette. Lehman is majoring in civil engineering and spent the past summer working at a large firm in Chicago in the company's façade engineering section.

While Lehman hasn't earned a medal yet in the Olympics, he says he's hoping to make Team USA for the 2022 Olympics in Beijing.

speed

At the (New) Core

The new Marquette Core Curriculum has launched this fall for incoming freshmen. The restructured core calls for an integrated approach to learning, and uses a three-tier organization: Foundational Courses, taken in the first two years, emphasize the foundations of a Jesuit education while allowing students to address 21st-century questions; Discovery Courses, taken in the second through fourth years, involve multidisciplinary course work interconnected by a key question or theme; Culminating Experiences, taken in the third or fourth year, provide students with an experiential learning opportunity that connects core learning with disciplinary contexts.

"We're making good on our promise to be intentional about our Jesuit nature," says Dr. Lars Olson, associate professor of biomedical engineering and a member of the Core Curriculum Implementation Committee. "Engineering students at Marquette will get a more cohesive and integrated understanding about how theology, philosophy and all areas of scholarship lead us to the truth. Different courses will be connected through our learning objectives and in specific discovery themes."

Graduate Education Evolution

Thanks to a $5 million grant from the GHR Foundation, the Opus College of Engineering has embarked on an ambitious five-year program to fully reimagine its graduate engineering degrees for the first time in decades. This bold new program — Master's Across Boundaries — will incorporate multiple subjects beyond engineering, such as law, business and humanities, to provide students with a well-rounded degree that reflects the challenges and complexities of the modern world.

The grant will allow the college to hire an accomplished team of experts and academics to execute the transformative program, including an executive director, seasoned professors and industry professionals. It will be designed to meet the needs of today's working student, with online course work, "stackable" certificates that can culminate in a master's degree, and innovative research initiatives that address concrete problems.

"We have long understood the importance of moving beyond the ivory tower to connect academia with the real world of industry and business," says Opus Dean Kristina Ropella. "This new program will prepare our graduates to meet global needs across multiple industries. It will provide a richer, more individualized experience for students that will endow them with essential skills as well as specialized knowledge tailored to their interests and career goals."

The Master's Across Boundaries program "will prepare our graduates to meet global needs across multiple industries."

The Master's Across Boundaries program will also be distinguished by its focus on developing the students' Ignatian mindset, integrating ethical studies to convey how the engineering profession can effectively serve others and work on behalf of the greater societal good. Strengthening the college's offerings to meet a diverse student body by incorporating teachings based on authentic experience and from cross-disciplinary experts is also expected to be a key component of the new program.

The grant reflects the college's long-held partnership with the GHR Foundation, which has been a generous supporter of many important Marquette initiatives in the past and an advocate for enlightened engineering education. The evolution of the college's graduate offerings owes much to the foundation's dedication to meaningful change and Jesuit values.

The five-year timeline for the development of the program begins with the hiring of an executive director this fall and the development of online classes, targeted to begin in fall 2019. It will continue with expanding the curriculum, engaging instructors, renovating classrooms to allow for online course delivery and marketing the program. — JENNIFER ANDERSON

Co-ops Get Entrepreneurial

Mechanical engineering senior Karlie Hornberger wants to become an engineer to creatively solve problems in the field of reusable energy. That's what excites her. And that's what she likes best about the entrepreneurial mindset that's being infused into the Opus College of Engineering's curriculum and co-op program — "where the emphasis is on thinking of new, innovative ways to solve problems, as opposed to what's the easiest or most efficient," she says.

In 2014 the college received a $549,000 KEEN grant to develop and implement entrepreneurially minded learning into courses. Then in May 2017, the college received a three-year $745,000 KEEN grant to "support a culture of entrepreneurship in our college's co-op program," according to Dr. Jay Goldberg, clinical professor of biomedical engineering.

Marquette's co-op and internship program is 100 years old, founded in 1919, and one of the first programs in the country. Traditionally, students complete a co-op by working full time for a company over the course of three terms. Last year, this concept of the entrepreneurial mindset was added with a goal to help both students and employers develop a new way of thinking as they work together and learn from one another, says Katherine Atkinson, Marquette's entrepreneurial minded co-op project manager.

"Engineers with an entrepreneurial mindset can demonstrate curiosity about the changing world, integrate knowledge from the classroom into the context of their co-op company, and identify unexpected opportunities to create new, extraordinary value for the company," says Atkinson.

Co-ops and internships give students their first opportunity to apply the entrepreneurial mindset outside the classroom in real-world applications. "Students want to make a difference, and having an entrepreneurial mindset allows them to make that difference earlier," adds Atkinson. "Employers seek students with this mindset because they are able to meet the ever-changing needs of their customers." Atkinson works with companies to develop and strengthen co-op and internship programs to include key indicators for entrepreneurially minded learning.

Of the 1,350 engineering students at Marquette, 75 percent participate in co-ops or internships, with some students completing both. The Opus College has partnered with 15 companies — including Husco, GE Healthcare and Milwaukee Tool — to form an Entrepreneurial Mindset Industry Advisory Board.

KEEN, funded with grants by the Kern Family Foundation, is a national partnership of colleges and universities, including Marquette, with the shared mission to graduate engineers with an entrepreneurial mindset so they can create personal, economic and societal value through a lifetime of meaningful work. — GEORGIA PABST

100
YEARS OLD
MARQUETTE'S CO-OP PROGRAM

1,350
ENGINEERING STUDENTS
75%
participate in co-ops or internships

KEEN is a network of colleges and universities
that shares ideas on developing the entrepreneurial mindset in engineering students.

First Place

Organizers were "blown away" by the quality of photography entered into the 2017 Engineers Without Borders photo contest. And among the treasure was Opus College senior Jess Thayer's photo (above), which took first place. Taken in Joyabaj, Guatemala, during a Marquette EWB chapter trip to build a pedestrian bridge that helped 65 children travel to school through the rainy season, Thayer captured translator Emily Rafalik, Arts '18, talking to some of the younger locals, who had been watching the bridge construction.

E-WEEK
A NATIONAL CELEBRATION OF ENGINEERING

Engineers Week Revived

Thanks to the hard work of the Engineering Student Council and several other student organizations, the Opus College revived Engineers Week at Marquette this past February. The celebrations included industry-sponsored lunches, panel discussions, faculty-student events, an Engineers Ball and even a flash mob dance with cameos from Opus Dean Kristina Ropella and Rick Smith, Eng '73, Grad '87, 2018 member of the Marquette University President's Society.

E-Week is a national celebration of engineering and the difference engineers can make through their work. Visit our E-Week 2018 photo album on our Facebook page at facebook.com/MarquetteEngineering.

Ignatian Innovation

Answering Marquette President Michael R. Lovell's call to achieve *Beyond Boundaries* and double research efforts by 2020, Opus Dean Kristina Ropella and university leadership continue work on campus planning and programming for Innovation Alley, a space for industry, students and faculty to work together to solve the world's grand challenges.

While the proposed space will be located immediately south of Engineering Hall on North 16th Street, the success of engineering projects going on within the walls of Innovation Alley will encourage — and require — collaboration with students and faculty from other colleges across campus.

"From ideation and research to product development, to manufacturing and supply chain management, Innovation Alley will be the go-to place for students and faculty from across campus to learn about, and put into practice, what it takes to conceptualize and transform an idea into a real product or solution," says Lora Strigens, vice president for planning and facilities management.

As Innovation Alley itself transforms from ideation to development, Ropella hopes to see industry co-located in small shops, incubator spaces and maker spaces within the building. For Ropella, it's all about rethinking what the classroom looks like.

"We're teaching our students to develop an entrepreneurial mindset, which means getting out beyond the walls of our traditional classrooms and challenging them to find new and interdisciplinary ways to solve the world's problems," says Ropella.

It's just that task — solving the world's problems — that will make Innovation Alley a differentiator among other innovation campuses across the country.

"The programming and space will not just support innovation, but rather Ignatian Innovation. Students will be challenged to think about the consequences of their work and how they're impacting the greater good of our world," Ropella adds.

So what's next?

The planning team is dedicated to engaging the design process, which will allow for input from key stakeholders and determine the physical space by first defining the activities and programs that will go on within. Up next are benchmarking trips to other university innovation campuses as well as industry panels to gather feedback on the development of programming and space.

"The programming and space will not just support innovation, but rather Ignatian Innovation."

—Opus Dean Kristina Ropella

If your organization is interested in potential involvement with Innovation Alley, contact Karlyn Agnew, Arts '08, director of development, at karlyn.agnew@marquette.edu or 414.288.6958. —ALEXIS SCHLINDWEIN, COMM '13

/ NEWS /

New Chairs

Dr. Frank A. Pintar

Dr. Daniel Zitomer

Dr. Majeed Hayat

The Opus College welcomes three new department chairs this fall. Dr. Frank A. Pintar, a national leader in biomedical engineering and neuroscience research, has been appointed founding chair of the Marquette University and Medical College of Wisconsin Department of Biomedical Engineering. Pintar, Eng '82, Grad '86, has held dual faculty positions with both Marquette and MCW since 1987, and is the director of the Neuroscience and Biomechanics Research Laboratories at the Clement J. Zablocki VA Medical Center. He has published more than 430 refereed journal publications and original papers, and more than 260 books, chapters and reviews.

The Civil, Construction and Environmental Engineering Department chair is also a familiar face: Dr. Daniel Zitomer, PE, who has served in the department as a faculty member and researcher since 1995. Zitomer is the university's site director of the National Science Foundation Industry/University Cooperative Research Center on Water Equipment and Policy, and director of Marquette's Water Quality Center.

Dr. Majeed Hayat has been named chair of the Electrical and Computer Engineering Department. Hayat comes from the University of New Mexico where he was a professor of electrical and computer engineering and co-chair of the Optical Science and Engineering Graduate Program. He has authored or co-authored over 100 peer-reviewed journal articles and 125 conference papers, and has 13 issued patents, six of which have been licensed.

Practiced Professional

Dr. Dragomir Marinkovich, Grad '06, was hired last fall as the Opus College's first assistant professor of practice. With more than 30 years of industry experience, including product design positions with Milwaukee Tool and United States Surgical Corp., and military leadership within the U.S. Army Reserve, Marinkovich offers an array of relevant practice expertise to his students. He teaches courses in the area of engineering mechanics — statics, dynamics and mechanics of materials.

"Professors of practice are critical to meeting the teaching needs of the college while at the same time providing our students with a wealth of industry experience in the classroom," says Dr. Mark Federle, PE, associate dean for academic affairs.

Dean Kristina Ropella and partner Oleksandr (Alex) Kozhukhar, Fred Astaire Studio, Milwaukee

Dancing Dean

Opus Dean Kristina Ropella was named Ballroom Champion at Cristo Rey Jesuit High School's first Milwaukee's Stars Merengue fundraising event this past November. Eight community leaders partnered with dance professionals to choreograph and perform live original routines for those in attendance. Stars couples showcased their preferred style of dance as they competed for fan votes. Together, the group raised more than $400,000 for the school, which uses an innovative work-study program to provide a comprehensive, affordable Catholic education to students who come from families with limited financial means. Marquette University partners with Cristo Rey on several initiatives.

Engineering Student Success Center

Student Center Supports Success

With its backlit whiteboards, collection of wide-open tables and constant thrum of students hard at work on tough problems, the new Engineering Student Success Center in Haggerty Hall is a haven for students in the Opus College of Engineering. In addition to excellent work spaces, the center has provided tutoring and academic support to hundreds of students since its opening on February 5, 2018.

The center was made possible through a generous gift from 2018 Marquette University President's Society members Jim, Eng '68, and Kelly, Arts '68, McShane that included the renovation of the space in Haggerty, staff salaries, programming and other expenses. According to Brigid Lagerman, Eng '83, director of academic advising, the gift and the center are helping the college better support student needs. "The students in the college really needed a welcoming place that could provide tutoring for tough classes as well as programming, and so far, it has been incredibly successful," she says.

Bioelectronics senior Madison Hertel is one of the 200 students who benefited from the Engineering Student Success Center's tutoring services this past spring semester and is also one of its 20 tutors. Per Hertel, in providing drop-in, peer-led tutoring for 16 courses in the college, the center fosters an environment where students can work collaboratively and independently.

"Over the course of spring semester, I built strong relationships with many students, and they felt comfortable coming to my sessions to work with friends and only asked questions if they truly needed help," Hertel says.

Tutors like Hertel are required to have achieved a B+ in the class, garner a recommendation from a professor, and undergo extensive training in metacognitive learning strategies. Jenna Lassila, Grad '16, assistant director of academic advising, leads these training sessions. Lassila also provides support for the Engineering Scholars program.

"It is key that the college has this center," Lassila says. "The center gives the students a much needed hub and, in my position, gives me the ability to seek out gaps in student needs. Because of its success so far, we'll continue to expand the center's programming." — ANNA MILLER, ARTS '17

TUTORING FOR 16 COURSES

200 STUDENTS SERVED IN ONE SEMESTER, through tutoring

CELEBRATING OUR DISTINGUISHED ALUMNI

Distinguished Alumna of the Year

Teresa Ferry Mogensen, Eng '89, Grad '03

2018 member of the Marquette University President's Society

As a child, Teresa Ferry Mogensen wanted to grow up to do something meaningful, challenging and engaging. Today, as senior vice president of transmission and president of Xcel Energy Transco, Mogensen plays a significant role in keeping the North American power grid reliable, safe, economical and secure. "I love being part of something that is so impactful to so many, and that really makes a difference in both the short and long term," she says of her role with Minneapolis-based Xcel Energy. "Decisions made now can have repercussions decades into the future." (See related story on p.18.)

Professional Achievement Award

William A. Feess, Eng '51

2018 member of the Marquette University President's Society

Next time you arrive at a destination with help from global positioning system navigation, one person you can thank is Bill Feess. The pioneer in GPS development is recognized for critical early developments and continuing contributions to the art and science of navigation. Feess' body of work developing and refining GPS navigation was recognized in 2010 with The Institute of Navigation Captain P.V.H. Weems Award. Upon his retirement from Aerospace Corp., Feess continued to serve as its distinguished engineer, working part time into his mid-80s. In this capacity, he especially enjoyed mentoring young engineers. Feess passed away this May.

Entrepreneurial Award

Robert J. Platt, Eng '74

Bob Platt and his Marquette roommate were barely two years out of college when they started an eponymous environmental consulting business in a Chicago garage. Today, Mostardi Platt has grown to a full-service firm with clients throughout the United States and the world. Platt remains president and CEO of Mostardi Platt, which in 2001 sold two of its five divisions to General Electric. With six locations, including its state-of-the-art headquarters in Elmhurst, Ill., the company employs approximately 110 engineers, scientists and technicians and owns a fleet of vehicles specially equipped to facilitate air emissions and other environmental testing services.

Friends of the College Award

Janet L. Shibilski and Frank R. Shibilski, PE

2018 members of the Marquette University President's Society

Janet and Frank Shibilski had no connection to Marquette before they approached the university in 2009 to discuss establishing an endowed scholarship for students in the Opus College of Engineering. The Shibilski Family Endowed Engineering Scholarship was one of the largest gifts to the university that year. Frank says they believe the contribution "will make an incremental change for the world by helping students in need complete their engineering education and develop new products and health aids for the world population."

Nominate a deserving alumna/us for the 2019 Marquette University Alumni National Awards at marquette.edu/alumni/awards/nominate.php.

Day of Undergrad Research

The Opus College of Engineering hosted its first Undergraduate Research Day in October 2017, featuring 33 undergraduate engineering students' research. Participating students received financial support from faculty research grants and the Opus College's Undergraduate Research Fellowship Program. As part of the event, the college also welcomed nearly 90 local high school students to learn more about research and engineering at Marquette.

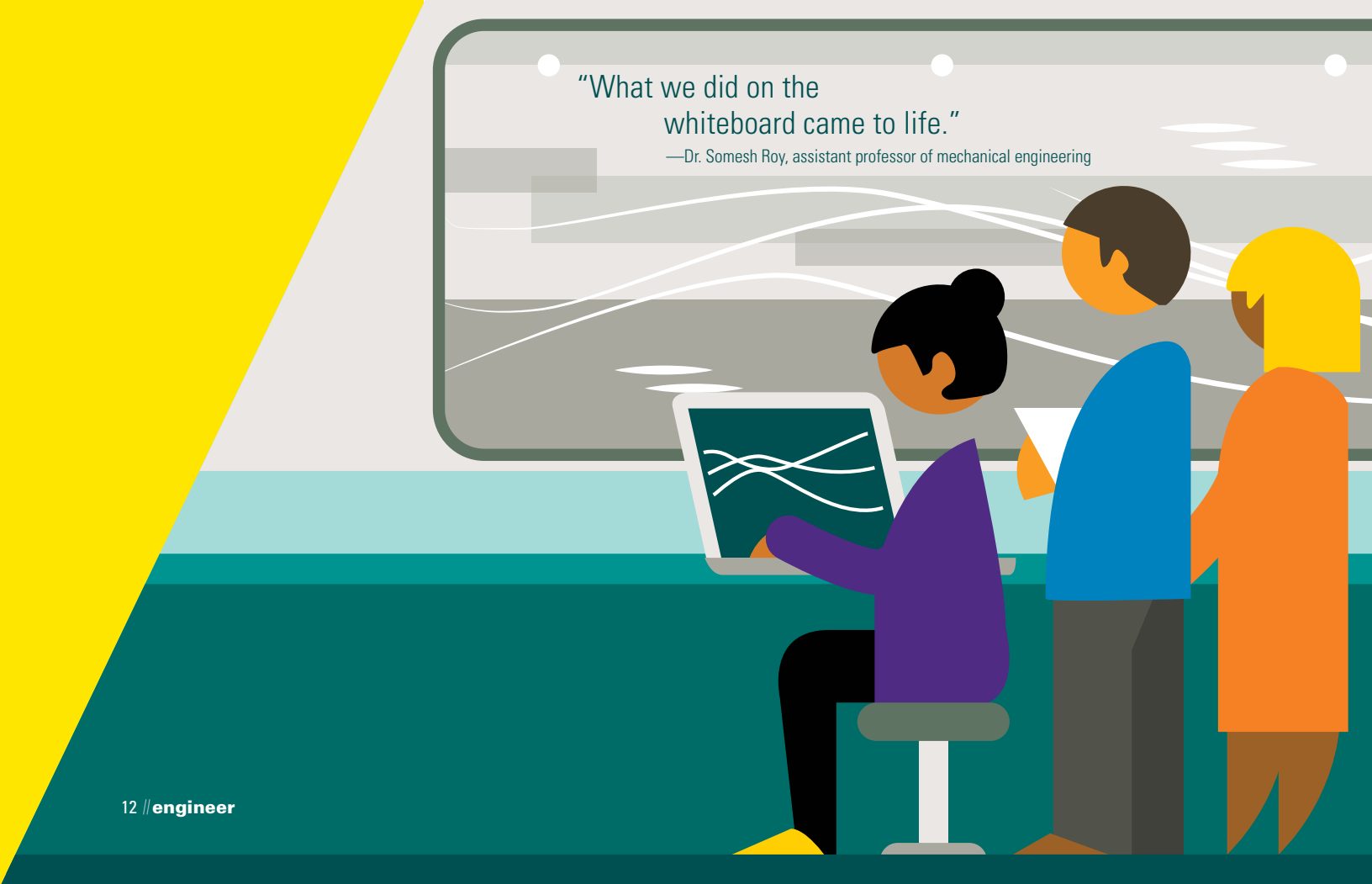
Student research represented all four departments and included projects such as: the impact of metals from aging drinking water infrastructure on antibiotic resistance; tracking passengers and their luggage at airport checkpoints; and analysis of amputee gait during indoor and outdoor mobility tasks.

The college has scheduled its next Undergraduate Research Day on October 26, 2018, and aims to earn industry support for some of the student research projects.

33
UNDERGRADUATE RESEARCH PROJECTS SHOWCASED

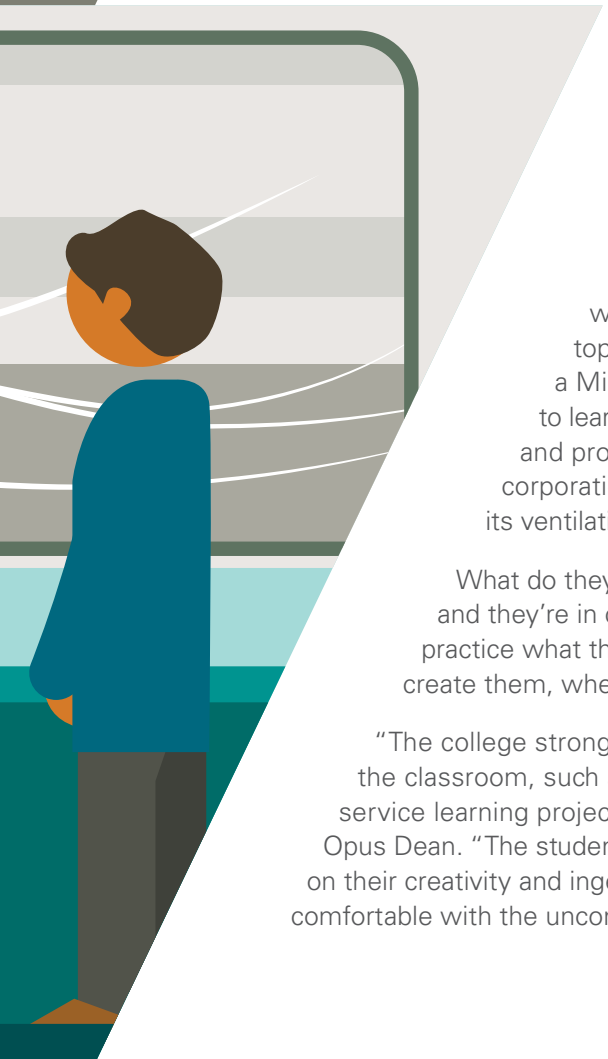
90
HIGH SCHOOL STUDENTS WELCOMED


"They understand the reality of construction engineering and management."
—Dr. Yong Bai, McShane Chair in Construction Engineering


"What we did on the whiteboard came to life."
—Dr. Somesh Roy, assistant professor of mechanical engineering

OFF-CAMPUS, ON-POINT

BY DAN SIMMONS



Opus College classrooms move to where real-world engineering happens and students can translate theory into reality.

Eleven students in hard hats, safety glasses and vests ride a work-site elevator, disembarking high above Chicago near the top of an under-construction high-rise. A different group walks into a Milwaukee central-city high school classroom full of students eager to learn coding but anxious to be around high-powered college students and professors. A third group makes regular trips to a Racine, Wis., corporation to work with its engineers on improving a key piece of its ventilation operations.

What do they have in common? They're Marquette engineering students, and they're in class. When opportunities exist to get out into the world and practice what they learn, they go there. When opportunities don't exist, they create them, whether it involves teaching, learning or doing.

"The college strongly encourages student participation in experiences outside the classroom, such as industry internships and co-op experiences, research, and service learning projects in local and global communities," says Dr. Kristina Ropella, Opus Dean. "The students must reach beyond theory and textbook solutions and draw on their creativity and ingenuity. These outside experiences prepare our students to be comfortable with the uncomfortable. The same is true for our faculty."

Efrain Torres, a senior biomedical engineering major from Chicago, agrees. In his role with the Biomedical Engineering Society, he arranged a mini boot camp of sorts in 2016 at his junior high alma mater, St. Agnes of Bohemia.

He and other students, assisted by a professor, engaged the youngsters with a class about heart physiology, electronics and computer programming. Each middle schooler was then paired with a Marquette student, and each built an electrocardiogram simulator. Students oohed and ahhed watching their heartbeat projected on a laptop in front of them, in the process learning important lessons about coding and getting early exposure to the "wow" factor that engineering can provide.

"This outreach event was truly amazing," Torres says. "I had such a good time meeting the students and inspiring them to pursue engineering. It was one of the most wonderful experiences I have ever had."

It led to bigger ambitions close to home, which culminated in BMES running its first Biomed Boot Camp in November 2017. The Marquette students walked into a classroom at Milwaukee Academy of Sciences, a charter high school not far from campus created to bolster STEM education for central-city students.

"They're very smart, but they're still tentative," says Hasan Barakat, BMES' student president. "They're not exactly forthcoming at first."

By the time the celebratory pizza party happened four days later, and the students had experienced lightbulb moment after lightbulb moment about biomedical engineering concepts simple and complex, the timidity had vanished.

"That half hour or so where we talk to them about their experiences and what they want to do in the future really sticks with me," says Barakat, a senior.

"You get to them step-by-step. And they're like, 'Wait a second, I get that now!' By the end they're talking about future career aspirations."

The epiphanies happen both ways.

"My motto is: You don't know something unless you can teach it to someone else," he says.

Francis Weiss, project manager for Related Midwest, the Chicago office of Related Companies, lives out that motto, too. A 2016 Opus College graduate in construction engineering and management, he invited Marquette students in Dr. Yong Bai's Cost Analysis and Estimating class down to Chicago for a one-day work-site immersion at One Bennett Park. The high-rise development in downtown Chicago will be 69 stories, making it the 12th-highest in the city. Related Midwest serves as the construction management company for the project.

When Bai and his 11 students visited in March, they visited an active construction site, with concrete mixers, forklifts and scaffolding. Weiss accompanied them on the elevator, stopping along the way to conduct impromptu lectures on construction cost analysis, estimating, as well as planning and development.

"We were able to see building construction at different stages," Bai says. Although One Bennett will likely be done by the time the next class trip opportunity arises, Bai, McShane Chair in Construction Engineering, says he'll keep putting students on a bus to see projects up close.

"These kinds of trips put the theories in perspective and put their knowledge and skills to use," he says. "How do things work? What are the challenges? Basically, they understand the reality of construction engineering and management. That's why it's so important to have this kind of field experience."

"My motto is: You don't know something unless you can teach it . . . ."

—Hasan Barakat, BMES' student president

> "The reality is that the world is changing, engineering is changing, and design is changing."
>
> —John Caruso, MIAD professor

Dr. Somesh Roy, assistant professor of mechanical engineering, takes the concept to another level. Four of his students in a heat transfer class partnered with Modine Manufacturing Co. in Racine for their senior design project, a graduation requirement overseen by faculty adviser Dr. Simcha Singer, assistant professor of mechanical engineering.

Student Timothy Fair, who works part time at Modine, came up with the project in August 2017, along with a Modine colleague. Fellow Opus College students Sam Goulet, Shaun Plunkett and Luke Klusmeyer, Eng '18, joined the project. Under Roy's and Singer's guidance, they took over one of the company's wind tunnels with an aim to improve efficiency of a heating and cooling unit.

They met every couple weeks with Rob Bedard, a principal engineer at Modine who developed the project with Fair.

"I could feel the excitement (among the students), and it's a very satisfying thing to see," Roy says. "What we did on the whiteboard came to life."

Modine has agreed to host more Marquette students in coming years.

"The students can really see how important it is to collaborate with industry," says Roy. "It's a valuable part of students' learning."

For Bradford Eagan, landing the job he wanted in industry got a massive boost from taking a first-of-its-kind class offered in fall 2017 by both Marquette and the nearby Milwaukee Institute of Art and Design. The DaVinci class brought together professors and students from each school — industrial designers from MIAD, mechanical engineers from Marquette — to create a blended curriculum, with classes on each campus, built to share knowledge and strengths in these increasingly interconnected fields.

"The reality is that the world is changing, engineering is changing, and design is changing," says John Caruso, the MIAD professor who taught the class, along with Marquette professors Drs. Richard Marklin and Mark Nagurka. "The new students coming in have aptitudes and proficiencies that former students didn't have, and they have an open mind." That open-mindedness makes collaborations such as this welcome and sought-after. The initial class enrolled 17 MIAD students and nine Marquette students.

It didn't take long for Eagan, a mechanical engineering senior, to reap professional benefits. While interviewing for a design engineering co-op position at Husco, he went through five different rounds of meetings. They had a common theme: Everyone wanted to talk about the collaborative course with MIAD.

"The majority of the time was spent discussing this course and the projects being completed. In addition we covered the challenges I faced working with industrial designers, as well as the skills I had acquired as a result of working side-by-side with the designers, and likewise what the designers learned from me," he says. "Two days after the completion of my on-site interview, I was offered the position."

His success came because he had a good answer, as many Opus College grads do, to a basic interview inquiry: Tell me about your learning outside the classroom.

AROUND THE WORLD

By Ann Christenson, CJPA '90

A hydrologist and civil engineer whose primary area of study is water's role in ecosystems, **DR. ANTHONY PAROLARI** is actively engaging in the research partnership Marquette has honed with Universidad Centroamerica in El Salvador. In 2018, he traveled to El Salvador to work with UCA researchers who've built and calibrated field instruments used to monitor a crater lake (caldera) that rural communities use for irrigation and recreation. Parolari's April visit focused on testing instruments in the lab, deploying instruments in the field and collaborating with peers to collect and analyze data.

Both Marquette and UCA are Jesuit institutions with a "strong interest in water and the environment," says Parolari. "My work will help strengthen the collaboration between these institutions and provide a learning environment for students." For him, studying hydrology in this environment and culture is invaluable: "We've learned a lot about how locals view and manage their water resources and how research can impact rural communities whose livelihood depends on this water source." And necessity, as always, is the mother of invention. One of the most memorable moments of Parolari's trip was a day spent with several graduate students in a boat on the lake, with the purpose of taking water-quality measurements. As they faced the challenge of building a structure to keep their instruments in a permanent location, Parolari was struck by both the lake's beauty and its enigmatic nature. Marshy conditions make the lake unstable for storing long-term equipment so, relying on ingenuity, the students crafted a system of PVC pipes that "allowed us to route instrument cables to more stable ground. A great example of on-the-ground learning."

Dr. Anthony Parolari is an assistant professor of civil, construction and environmental engineering. (Pictured above in sunglasses.)

DR. STEPHEN M. HEINRICH completed a one-month visiting research professorship at the Université de Bordeaux this past June, his fourth such position, hosted by collaborator Dr. Isabelle Dufour in Bordeaux, France. Heinrich's research focuses on the analytical modeling of micro structures, which includes theoretical investigations on "higher-order" discrete-mass detection.

The advantages of these visiting posts, Heinrich says, are incalculable. "It opens doors for me to not only work with talented individuals but to also meet other visiting professors from around the world," he says, adding that the most recent opportunity allowed him to connect with Dr. Enrico Mastropaolo, a visiting professor from the University of Edinburgh, who is preparing a proposal for a "very powerful" piece of equipment that is "ideally suited to perform the studies needed to verify" the theoretical models Heinrich recently developed with Dufour. Their work, he explains, shows the potential of using small-scale resonators (or vibrating devices) to probe the characteristics of cells, molecules and other tiny entities. An example of a big-picture application is "tracking cancer cells when subjected to different treatment protocols."

The acquisition of the equipment by UE could serve as a springboard for furthering the research of Heinrich and Dufour and their students. The prospect of future collaboration between Marquette and UE, he says, wouldn't have been possible without the support provided by the visiting professor program at Université de Bordeaux. Another "significant joy" associated with this program, he adds, is the enriching personal experiences — the long-term friendships and relationships fostered in the process.

Dr. Stephen M. Heinrich is a professor and director of graduate studies in the Department of Civil, Construction and Environmental Engineering.

This summer, Marquette faculty trekked the globe to pursue Marquette's mission of being the difference.

DRS. MARK FEDERLE AND LARS OLSON joined forces to attend the three-day inaugural meeting in July of the International Association of Jesuit Engineering Schools at University of Deusto in Bilbao, Spain. The goal of this trip and the purpose of the conference, says Federle, is to create a "hardworking network of scholars and students to set the world on fire. If we can combine forces and create groups that get things done, we can transform the lives of people from Bogota to Bangladesh."

The scholars' engineering expertise differs — Federle's is in strategic planning and organizational behavior in construction companies, and in 2004, Olson founded the human-powered nebulizer project to help those who suffer from respiratory diseases in developing countries with limited electricity access. But these professors share a commitment to the core Jesuit tenet of service. They're also united by an "incredible enthusiasm" for this founding meeting, which cements Marquette's leadership role working with international Jesuit engineering schools — among them, Brazil, Lebanon and Indonesia. Of that network, Olson says: "Our goal is to make connections with Jesuit engineering schools around the world to help our researchers find new projects and help our students understand the world better and be prepared global citizens. We also want to reach out and help our partners around the world to help address needs for our most vulnerable neighbors in low-income regions."

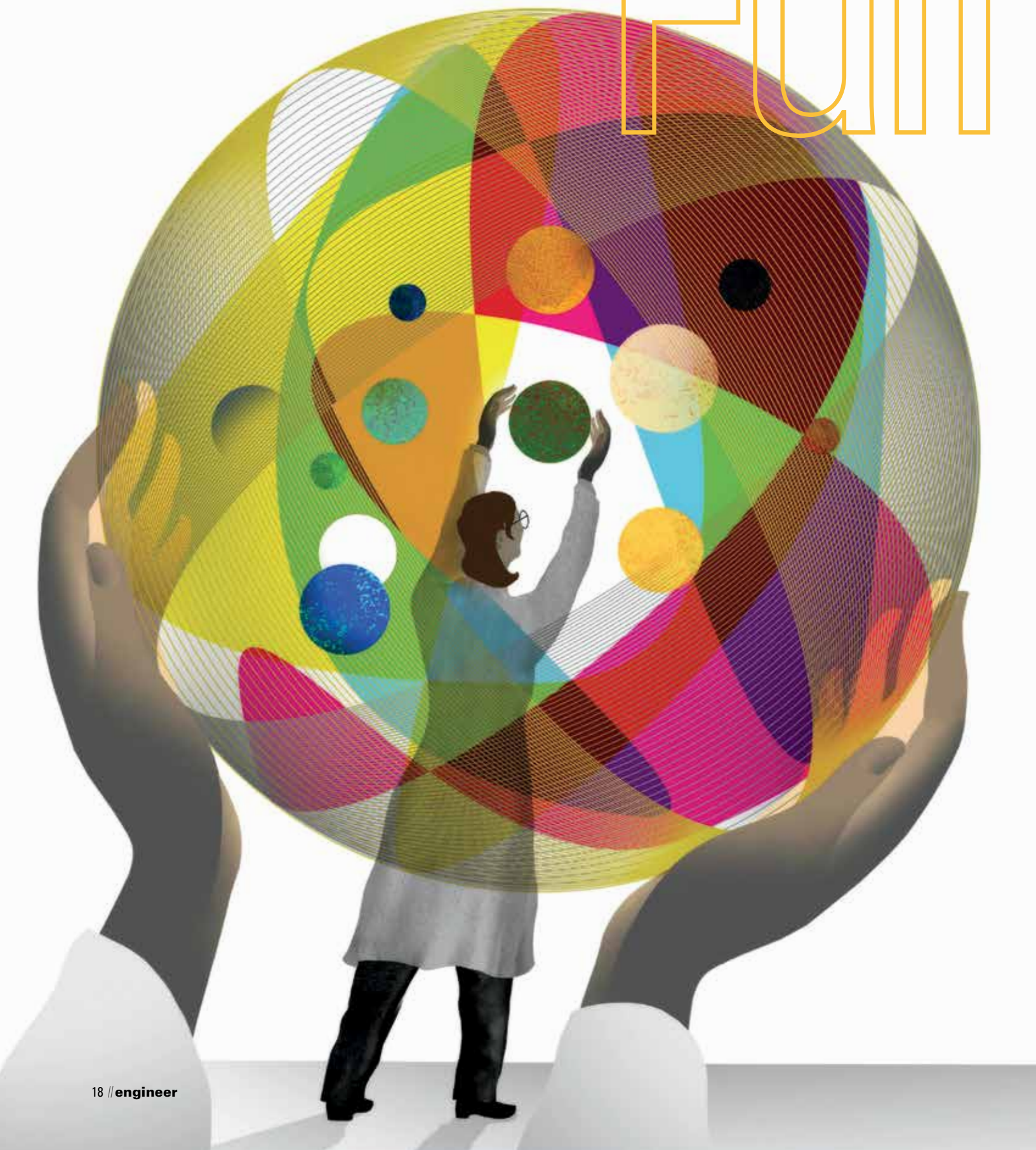
Dr. Mark Federle is associate dean for academic affairs; Dr. Lars Olson is an associate professor of biomedical engineering.

It makes sense that, building on her expertise in nutrient removal and recovery in water and wastewater streams, **DR. BROOKE MAYER** would travel to Joyabaj, Guatemala, with the Marquette chapter of Engineers Without Borders to dive into projects. This journey for the associate professor of civil, construction and environmental engineering piggybacks a research trip she took to the same impoverished country in 2017 — an "enriching experience" that enabled Mayer to get firsthand perspectives of people in the area, work with local project leaders and soak up the unique culture. Mayer accompanied the student team to concentrate on project assessment, including site evaluation, materials availability, water quality and surveys of the needs and wishes of the community's residents.

With that 2017 research as a guide and Mayer working closely with the student team, the professor's two-week trip in 2018 focused on system implementation to work "with the community to construct storage tanks and water treatment processes," she explains. The mission is a crucial one: The system will transport treated spring water to 300 homes in the Joyabaj community where the water quality is consistently low quality. "One of the biggest challenges, which is critical to design, is system acceptance and maintenance." For the system to be a success, it has to meet the needs of the community. For Mayer, this hands-on work is "a quintessential example of engineering design, wherein engineers must consider not only the technical details but the economics of design and social aspects."

Dr. Brooke Mayer is an associate professor of civil, construction and environmental engineering.

Full



Circle

By Paula Wheeler

Engineering alumnae lift the next generation of women into the profession.

This fall, the Opus College of Engineering welcomes a freshman cohort with the highest percentage of women to date for an incoming class: Nearly one-third of the fresh faces congregating in Engineering Hall will be female.

The increase represents progress toward Opus Dean Kristina Ropella's stated priority to "change the face of engineering" so the industry can better represent the world it serves. Recruiting more women is an important aspect of Ropella's initiative, as the most current reports from the National Science Foundation show engineering as the STEM field with the lowest percentage of women — just 15 percent in 2015.

"For me, changing the face of engineering has three facets: changing the face of our people, changing the face of our graduates and changing the face of our college. Each of these components plays an important part in helping us to achieve a profession that is more representative of the world we serve, which includes equal representation of women and men," Ropella says.

Targeted scholarships and popular pre-college enrollment programs on campus — including a thriving chapter of Girls Who Code and a girls-only summer engineering leadership academy — have helped attract more female students, as have the Opus College's female student ambassadors who are passionate about sharing their journeys and experiences with prospective students. Another powerful factor that helps move the needle, Ropella points out, is simply the presence and visibility of women who are succeeding in engineering professions.

"If an aspiring (female) engineer can look at a woman in different phases of her career — student, young professional, C-suite executive — she is more likely to feel encouraged that she, too, can succeed as an engineer," says Ropella, who herself is a visible leader as a female engineering dean in the United States. (According to the Society of Women Engineers, just 17 percent of U.S. engineering schools had female deans as of January 2018.) "I am humbled to be just one example of a female engineer. We have countless alumnae across the country and across all disciplines who serve as wonderful examples for the next generation. They have progressed not only in their professional lives, but also in their personal lives, leading boldly in their professions, their families and their communities, opening doors for others to walk through."

"BELIEVE IN YOU

build up a peer group of support, and be driven

Leading by Example

After earning engineering degrees in classrooms full of men, working their way to the pinnacles of their fields alongside mostly male colleagues and now mentoring Marquette engineering students, alumnae from the '80s and '90s are energized by the uptick in female enrollment.

Billie Jean Smith, ENG '89

"It's a really exciting time for women to be in engineering school," says Billie Jean Smith, Eng '89, an intellectual property attorney at Michael Best & Friedrich, a Milwaukee law firm. "The jobs they are going to have don't even exist today. They will see needs for products and services in the industry and in life, and they will be those entrepreneurs."

Smith, who was encouraged to pursue a math or science-related field by a female algebra teacher at her high school in suburban Milwaukee, went directly to law school after earning her biomedical engineering degree and became the first female patent lawyer at Michael Best, where she has practiced since 1992. "I use my engineering degree almost every day in what I do," says Smith, who was inspired to pursue patent law when she worked with a female patent lawyer during her co-op semesters at 3M. "I very much enjoy the combination of using my technical background and then adding that layer of legal strategy."

Dr. Kelly Piacsek, ENG '96, GRAD '00

Like Smith, Dr. Kelly Piacsek, Eng '96, Grad '00, is excited by the idea of more women contributing their perspectives to the problem-solving that's at the heart of an engineer's work.

"There's no question that men and women think differently and approach problems differently," says Piacsek, vice president of patient-centered research at the Aurora Research Institute in Milwaukee, where she oversees a team of 175, serving 1,000-plus investigators across the organization. "Bringing people to the table who think differently and approach the world through a different lens is what leads to innovation."

Piacsek grew up in a family with a service station business, "around cars and mechanics and technology and gadgets everywhere," she says. "I was never intimidated by it and always curious. I enjoyed fixing things and understood how things worked." After earning her degree in biomedical engineering, she was one of the first students to complete Marquette and the Medical College of Wisconsin's functional imaging doctoral program, then spent more than 15 years at GE Healthcare, where she held a variety of research leadership roles before joining Advocate Aurora Health in 2017.

Teresa Ferry Mogensen, ENG '89, GRAD '03

Teresa Ferry Mogensen, Eng '89, Grad '03, senior vice president–energy supply at Xcel Energy in Minneapolis, agrees that simply being visible as a female leader in the industry can provide up-and-comers with powerful inspiration.

"I think visibility is important for a woman in a traditionally male-dominated field and also in a technical area, because people will say, 'I didn't know a woman could do that,'" says Mogensen, who is the first woman to head the power generation business at Xcel — that's about 2,400 employees and approximately 85 plants — and currently the only woman heading an operational business unit.

The 2018 recipient of the Opus College's Distinguished Alumna of the Year award, Mogensen says she thought electrical engineering seemed like the "coolest" engineering major and knew it would lead to a challenging and rewarding career. "I love being a leader and creating an environment where other people have the opportunity to work together to accomplish something so important to society," she says.

Staying Connected

All three women make it a priority to remain connected to Marquette by mentoring engineering students, both formally and informally, and contributing in advisory

RSELF,
to succeed." —Dr. Brooke Mayer

roles at the Opus College — all efforts to support the goal to change the face of engineering.

Mogensen has served as the Engineering Alumni Association director, a Marquette Alumni Association mentor and a willing resource for Marquette students seeking opportunities in the Twin Cities. Along with Smith and Piacsek, she serves on the college's Engineering Thought Leaders Council, a group of alumni and supporters that meets annually to discuss strategy for the college.

Piacsek and Smith are members of the industrial advisory board for the E-Lead program, a three-year leadership development program for undergraduates that attracts many female students. Piacsek also led senior design projects while at GE.

Smith, who for many years hosted "summer send-off" gatherings for incoming Marquette engineering students and speaks in classes and seminars about intellectual property law and her career path, says, "I will absolutely do anything (the dean) asks of me. The Marquette mission is service to others, and service back to the engineering school is really important to me. They helped shape who I am."

Having had strong mentors while at Marquette, Piacsek also wants to pay it forward. "I know what it feels like to have role models and people you can watch and follow and lean on," she says. "I never felt like there were boundaries to what I was able to accomplish."

Faculty Forerunners

Women who chose to study engineering when far fewer females were among their classmates are now working on some of the Opus College's most compelling projects while mentoring the next generation of women.

At least two engineering research labs with women at the helm count a significant number of female student researchers, something the college may continue to see if this year's uptick in freshman females indicates an ongoing trend.

Dr. Taly Gilat-Schmidt's lab, which designs and optimizes medical imaging systems and reconstruction algorithms to improve image quality while reducing patient radiation exposure, comprises several women researchers this fall. They are working on a nearly $2.5 million National Institutes of Health grant Gilat-Schmidt was awarded to develop and validate a software tool to estimate radiation doses delivered to specific organs during CT scans as well as other projects to improve CT image quality.

Dr. Taly Gilat-Schmidt

Gilat-Schmidt, associate professor of biomedical engineering, is glad to see more women in the career pipeline. Her field's gender discrepancy is less apparent to her on campus, more so at professional meetings or in corporate settings, where, she says, "Sometimes I will notice I'm one of two women in a room of 50." She sets an example of what women can accomplish in her field: "I think being here as a role model is important, that (female students) see a woman doing this work and teaching these classes."

Dr. Brooke Mayer

Dr. Brooke Mayer, associate professor of civil, construction and environmental engineering, is the only female among the chief researchers at Marquette's Water Quality Center, which brings together multidisciplinary researchers, government, private foundations, industry and others to solve problems related to lake, river and groundwater quality. Her own lab group designs and evaluates sustainable water and wastewater treatment technologies. Its current makeup skews female, and Mayer says she's always interested in involving underrepresented students.

She, too, believes in the power of role models for women entering the field and appreciates the college's commitment to assisting students to connect with faculty mentors with similar backgrounds. "The more they can feel connected to the faculty and see women's involvement, including our dean, who is a woman and very successful, they might say, 'They are like me, and they've succeeded,'" she says, adding that female students may feel more at ease seeking out women in the field for advice.

What does Mayer tell them? The same thing she would tell young men. "Believe in yourself, build up a peer group of support, and be driven to succeed." — PAULA WHEELER

OPUS COLLEGE RESEARCH & INNOVATION

HEALTH & HUMAN PERFORMANCE

DR. JOHN LADISA
BIOMEDICAL ENGINEERING

CHANGE OF HEARTS

Dr. John LaDisa, associate professor of biomedical engineering, has received a four-year $1.5 million grant from the National Institutes of Health for "Mechanisms of Morbidity After Correcting Aortic Coarctations of Varying Severity." LaDisa and his collaborators, from Marquette and the Medical College of Wisconsin, will define the types and extent of vascular changes that occur in patients with coarctation of the aorta — a narrowing of the aorta, the large blood vessel that branches off your heart and delivers oxygen-rich blood to your body. When this occurs, the heart must pump harder to force blood through the narrowed part of the aorta.

Using novel experimental approaches and new molecular mechanisms will allow LaDisa and his co-investigators to study this heart defect without the complications that often exist with aortic coarctation clinically. Results from these approaches will be used to propose new criteria for surgeries and long-term treatment of these cardiac patients.

This January, LaDisa, Eng '00, Grad '01, '04, was named the Lafferty Professor in the Opus College. The professorship is designed to support engineering education and pedagogy initiatives, such as faculty workshops on teaching strategies, and conferences and expert lectures on engineering education.

2,300,000

The estimated number of people living with multiple sclerosis worldwide, many of whom struggle with balance and gait difficulties. With a two-year $120,000 grant from the Greater Milwaukee Foundation, Dr. Brian Schmit, Eng '88, along with Marquette and Medical College of Wisconsin colleagues, is studying a new technique for improving balance during walking for people with MS. With a state-of-the-art motion-based treadmill system that creates a challenging walking environment, researchers are able to simulate uneven terrain by moving the walking surface while still maintaining a safe walking environment.

"The premise is that a rehabilitation therapy aimed at challenging balance during walking will be more effective than stable gait training approaches," says Schmit, professor of biomedical engineering and associate dean for research, who was inducted into the American Institute for Medical and Biological Engineering College of Fellows this year for his exemplary leadership in spinal cord injury and stroke rehabilitation research.

1 in 323

The estimated number of children identified with cerebral palsy. According to the CDC, the most common foot deformity among children with cerebral palsy is pes planovalgus or flatfoot. If the deformity is severe and the foot is not stable, surgical correction is often performed on such patients.

The Opus College's Orthopaedic and Rehabilitation Engineering Center is researching two orthopaedic surgery techniques used for severe flatfoot to identify which is most effective long-term. This study compares healthy controls to adults with cerebral palsy who have pes planovalgus and have been treated with either of the two techniques. The effectiveness of the surgical interventions is studied using clinical measures of mobility, radiographic assessment, quantitative 3D gait analysis, 3D fluoroscopic analysis of the foot and ankle, as well as outcomes assessment of activity levels and health-related quality of life. Working on the study are postdoctoral fellows Drs. Karen Kruger and Ben McHenry, Grad '13, and Dr. Gerald Harris, Grad '78, '81, OREC director and professor of biomedical engineering.

The Opus College of Engineering is transforming engineering education by preparing today's engineers to be creative problem solvers. We invite you to read how our professors and programs are seeking **THE NEXT SOLUTIONS TO OUR WORLD'S GREATEST CONCERNS,** all the while leading the way for the next generation of Marquette engineers.

DR. ROBERT SCHEIDT
BIOMEDICAL ENGINEERING

GOOD VIBRATIONS

Four million Americans who have survived a stroke are living with impairments, according to the CDC. Led by founder and co-director Dr. Robert Scheidt, Marquette's NeuroMotor Control Laboratory is hard at work developing novel technologies, training strategies and therapeutic interventions to promote rehabilitation in patients with neuromotor injuries caused by stroke.

Body-machine interfaces or BMIs — machines designed to help improve human performance or replace lost bodily function — enable users to control intelligent machines through bidirectional communication channels that include control signals originating from the user's body and feedback signals originating from the machine. The lab's research looks to improve human perception and action by using BMI feedback in the form of vibrational touches or light brushing of the skin. This research supports the development of assistive devices for survivors of stroke that will improve arm and hand control, subsequently enhancing a patient's daily activities.

"Our research shows that with just 30 minutes of training, healthy people can improve arm control using vibrotactile feedback," Scheidt says.

Scheidt, Eng '89, professor of biomedical engineering, and Dr. Leigh Ann Mrotek, director of the NeuroMotor Control Laboratory and research professor, were awarded a National Institutes of Health research grant of $438,182 to explore the use of sensory augmentation to improve motor control. This work will identify the best ways to program information within vibrotactile stimuli and methods to deliver those stimuli to locations on the body best suited for sensory reinforcement/augmentation.

"Stroke impacts all the economies of the world," Scheidt says. "Novel BMI technologies such as those we are developing may enable more survivors of stroke to live independently, thereby reducing health care costs worldwide."

In addition, Scheidt has committed to a three-year term as program director for the National Science Foundation's Mind, Machine and Motor Nexus program. "This is a new core program at the NSF, and I am charged with mobilizing a community of researchers to develop theories and physical manifestations of those theories that advance understanding of how machine intelligence can physically interact with human intelligence to enhance the physical and cognitive capabilities of individuals, groups and society," Scheidt says.

76 million

The estimated number of CT scans performed annually in the United States, which account for half the radiation delivered to patients through medical procedures. Dr. Taly Gilat-Schmidt, associate professor of biomedical engineering, received a nearly $2.5 million grant from the National Institutes of Health to develop and validate a software tool that can estimate the radiation dose delivered to a patient's organs during a CT exam. Existing automated tools that measure doses do not model a patient's anatomy and can be off by 40 percent or more in some cases. Gilat-Schmidt is collaborating on the four-year grant with Variant Medical Systems, the Medical College of Wisconsin and Children's Hospital of Wisconsin.

16 WATER

The number of inorganic chemical contaminants — including arsenic, lead and mercury — whose levels in public water systems are tested and enforced by the EPA's National Primary Drinking Water Regulations.

While there are many sensors on the market to detect such contaminants, none can detect changes in water quality in real time without touching the water or using mechanical movements. With a two-year $125,000 grant from the Water Equipment and Policy Research Center, Drs. Chung Hoon Lee and James Richie, both associate professors of electrical and computer engineering, are developing a water contaminant detection system using magnetic resonance spectroscopy that will fill that need. This technology will lead to accurate and instant contaminant detection as well as sensor longevity and maintenance reduction.

$1 Billion

ANNUAL HEALTH CARE COSTS ASSOCIATED WITH ANTIBIOTIC-RESISTANT INFECTIONS IN THE UNITED STATES

Assistant Professor of Civil, Construction and Environmental Engineering Patrick McNamara investigates how micropollutants in our nation's waterways are affecting bacterial resistance to antibiotics. As a 2018 Way Klingler Young Scholar awardee, McNamara, Eng '06, will spend a semester sabbatical researching microbial communities in drinking water pipes, including those constructed of iron, lead, copper and PVC. His latest research is studying how the aging drinking-water systems across the country are impacting the type of bacteria present in our water.

DR. WALTER MCDONALD
CIVIL, CONSTRUCTION AND ENVIRONMENTAL ENGINEERING

ADVANCING GREEN INFRASTRUCTURE

According to the EPA, storm-water runoff is a major cause of water pollution in urban areas. When rain falls on city and suburban roofs, streets and parking lots, the water can't soak into the ground as it normally would. Green infrastructure created to mitigate water pollution problems uses vegetation, soils and other practices to restore some of the natural processes needed to manage water and create healthier urban environments. Boosted by nearly $300,000 in grant funding from the Milwaukee Metropolitan Sewerage District, Dr. Walter McDonald's recent research focuses on monitoring such green storm-water infrastructure and developing advanced green-infrastructure technologies and controls to improve its effectiveness.

One MMSD grant will allow McDonald, assistant professor of civil, construction and environmental engineering, to monitor flow and water quality in two green storm-water infrastructure practices — bioretention and pervious pavements — to evaluate their performance over time. "This research will provide MMSD with actionable data that can improve models used to design future green storm-water infrastructure and can guide strategic investments within the district," notes McDonald.

With the second grant, he will aim to improve existing green infrastructure performance through the design and implementation of a low-cost active control system, which will improve volume and peak flow mitigation when excessive runoff mandates it. "Ultimately, both these projects will help MMSD meet its goals of zero basement backups, zero combined sewer overflows and improved storm-water management," McDonald says.

TRANSPORTATION & INFRASTRUCTURE

DR. CASEY ALLEN
MECHANICAL ENGINEERING

In high-voltage battery controls for electric vehicles, two of the key parameters that must be estimated are the state of charge (SOC) and the capacity of each cell. Accurately determining those two characteristics will improve battery utilization. Presently, SOC and capacity cannot be directly measured, according to Dr. Fabien Josse, professor of electrical and computer engineering. "They must be estimated based on the battery's voltage, current and temperature inputs during use," he says.

Josse received a two-year $150,000 research grant from the Ford Motor Company to address the feasibility of directly monitoring battery cell behavior over time, and to develop a sensor system for monitoring the internal state of high-voltage batteries in real time that will allow for improved battery management and reduce sensing costs. As fuel economy targets become tighter, more accurate sensors or new control strategies will be required. Degree of lithiation, which is a measure of the concentration of lithium in active material, is an internal characteristic of battery cell behavior over life and is related to SOC and cell capacity. The ability to measure lithiation through a sensor system presents the opportunity to develop new accurate control strategies to improve battery operation and monitor battery degradation.

OPTIMIZING FUEL RATING

The core technology for measuring octane number and cetane number — the standard measures of fuel behavior in an engine — has not changed for nearly a century. Armed with a four-year $465,000 grant from Wisconsin-based CFR Engines, a fuel-rating equipment manufacturer, Dr. Casey Allen is hoping to rev up this testing to modern day speeds. The assistant professor of mechanical engineering is exploring novel approaches for measuring the ignition quality of diesel and gasoline fuels, and hopes insights gained will enable the development of more efficient octane/cetane rating tools. Octane numbers are what appear for the different grades of gasoline when you go to the gas pump, and they measure a fuel's resistance to autoigniting, according to Allen. "Having a sufficiently high octane number in gasoline engines is important to avoid abnormal combustion like engine knock, which can damage an engine," he adds.

"Having a sufficiently high octane number in gasoline engines is important to avoid abnormal combustion like engine knock, which can damage an engine."

The 1920's fuel-rating technology is based on a large, single-cylinder engine, and the tests are expensive and time-consuming to run. There is significant interest in developing a benchtop-type apparatus that could be used to measure the parameters of octane number and cetane number. In this funded project, Allen and his team will be exploring the optimal conditions for all fuel types in determining diesel cetane number in a constant volume spray bomb, and then investigating new strategies for determining octane number for gasoline fuels. This may involve use of the spray bomb or using novel spectroscopic techniques. "The results of the project will have a large impact on how refineries operate to control fuel specifications and will aid in the rapid development of optimized fuel blends for advanced engines," Allen says.

TECHNOLOGY & SYSTEMS

100%

The percentage of passengers tracked by a detection technology system being developed by multiple universities, including Marquette, with grant support from the Department of Homeland Security. The project — known as CLASP (Correlating Luggage and Specific Passengers)* — is a system using multiple cameras and automated tracking algorithms (ATA) to track passengers, bins and baggage at airport security checkpoints to detect incidents such as theft or abandoned items.

Research teams from Marquette, Boston University, Northeastern University, Purdue University and Rensselaer Polytechnic Institute analyzed hours of video data collected during testing exercises of passengers moving through a mock airport security checkpoint that simulates simplified real-world conditions and learned that passenger tracking with the new system was very accurate. The next steps of the research include extending the ATAs to more complex scenarios, particularly for accurately detecting and tracking baggage and items passengers put into bins. "Mechanisms based on machine-learning techniques are a promising approach to address this issue. Further investigation in that area is needed," according to Marquette's contributing researcher, Dr. Henry Medeiros, assistant professor of electrical and computer engineering.

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DR. NATHAN WEISE
ELECTRICAL AND COMPUTER ENGINEERING

POWER UP

Marquette's Power Conversion and Renewable Energy Lab conducts research at the forefront of power electronics and renewable energy technologies. Dr. Nathan Weise, assistant professor of electrical and computer engineering and lab director, has received $632,437 from the U.S. Department of Energy to develop a small, compact, lightweight and efficient one-megawatt battery charger for electric vehicles. His team aims to use state-of-the-art MOSFET switches based on silicon carbide to ensure the charger runs efficiently while handling very large amounts of power in a small package. This project seeks to triple the power density and double the specific power of the charging technology available today. If successful, such a device could help to dramatically reduce charging times for large electric vehicle batteries to a matter of minutes.

"At best, current charging takes 30 minutes to several hours. Our goal is to develop a device that can cut that down to two minutes, which could significantly impact the electric vehicle industry," Weise says.

A CLEAN ROOM

Once operational this fall, **Marquette's Class 1,000 clean room,** under construction in Engineering Hall, will contain no more than 1,000 half-micron-diameter particles per cubic foot of space. A human hair is about 100 microns in diameter, so a half-micron diameter is invisible to the naked eye. But even at that seemingly insignificant size, such a particle in the wrong place can destroy the microelectronic and micro-electromechanical systems — or MEMS devices — that will be eventually fabricated here in this very specialized lab. When it is opened for student use in the spring of 2019, it initially will be for faculty and graduate student research. Later that year, Dr. Ronald Coutu, Jr., V. Clayton Lafferty Endowed Chair in Electrical Engineering, plans to conduct device fabrication courses in the lab.

DR. SOMESH ROY
MECHANICAL ENGINEERING

COMPUTING CLEANER COMBUSTION

Combustion has been an important source of energy since fire was discovered, explains Dr. Somesh Roy. And its predicted demise due to alternative, cleaner energy sources is premature, he adds.

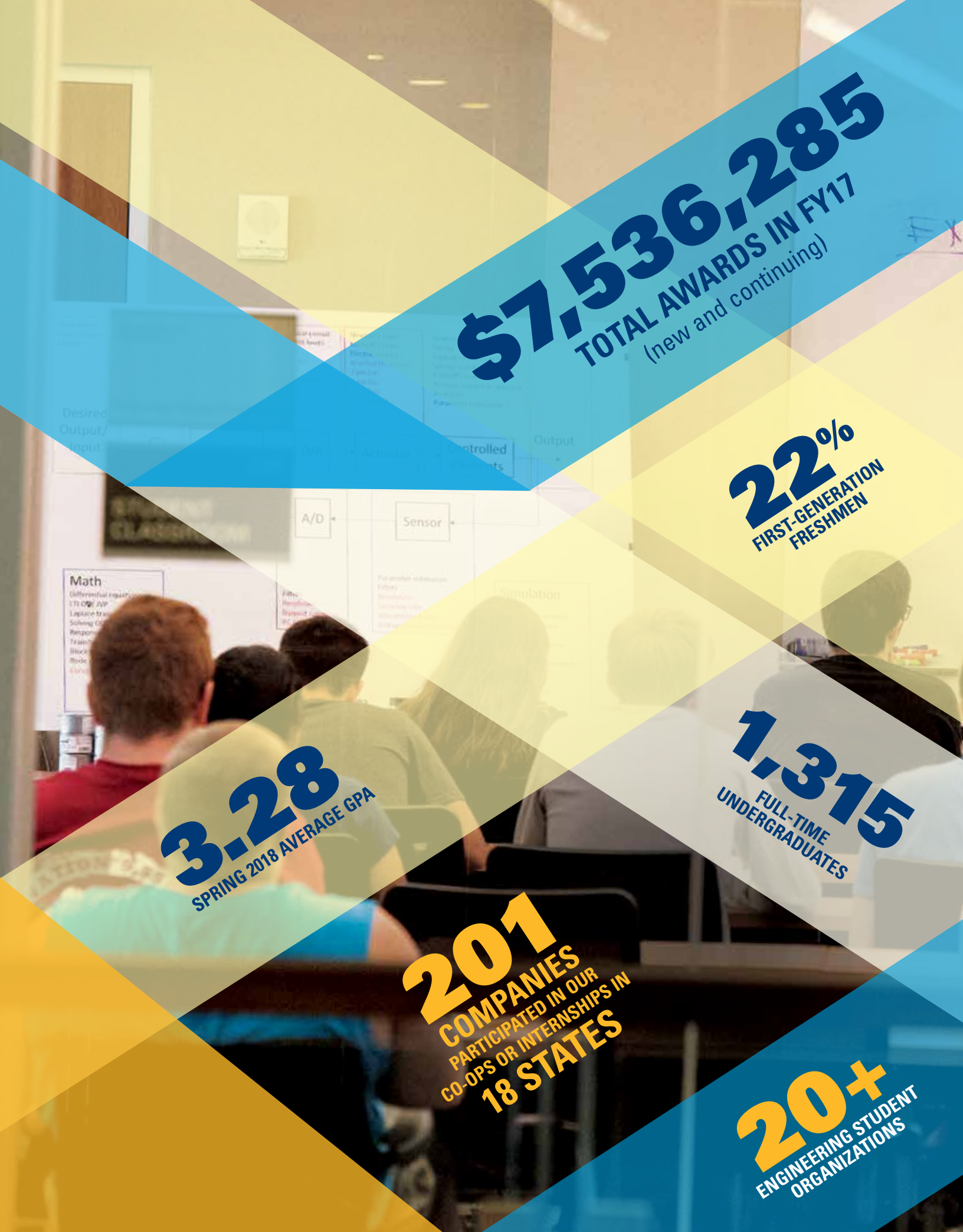
Considering its ubiquitous presence in our energy and transportation industries, Roy says it's important to further our understanding of the fundamental physics behind combustion with particular focus on developing more efficient and cleaner combustion devices. However, many of the actual physical and chemical processes taking place during combustion are still not well understood.

The assistant professor of mechanical engineering has been awarded a two-year $174,951 grant from the National Science Foundation to explore several novel ideas to increase the efficiency and robustness of a computational tool required for high-fidelity, high-performance computing simulations of combustion, leading to the possibility of performing predictive and accurate simulations of practical combustion systems such as furnaces, gas turbines and internal combustion engines.

With the help of supercomputers, combustion simulations have tremendous potential to emerge as a cost-effective and reliable tool for designing and assessing these types of combustion systems. Predictive computer modeling of combustion systems requires, among other things, detailed and accurate tools for modeling of thermal radiation. However, thermal radiation models used in combustion simulations are usually over-simplified and have poor accuracy. Roy says the main bottlenecks in using accurate and detailed radiation modeling tools are their high computational cost and poor efficiency.

Utilizing novel statistical methods and ideas from computer science, Roy's research proposes innovative ways to overcome these bottlenecks of a specific, detailed radiation modeling tool. The improved and efficient computational tool expected to come out of the research will be an integral part of a state-of-the-art modeling framework to capture combustion-related processes spanning multiple scales — from molecular to atmospheric levels.

"Such a modeling framework can be used to design more efficient and sustainable combustion devices not only just by predicting the immediate pollutant emissions, but also by directly considering the long-term atmospheric effects of such emissions," Roy says.


$7,536,285
TOTAL AWARDS IN FY17
(new and continuing)
22%
FIRST-GENERATION FRESHMEN
1,315
FULL-TIME UNDERGRADUATES
3.28
SPRING 2018 AVERAGE GPA
201
COMPANIES PARTICIPATED IN OUR CO-OPS OR INTERNSHIPS IN
18 STATES
20+
ENGINEERING STUDENT ORGANIZATIONS

SNAPSHOT

2017–18 ACADEMIC YEAR BY THE NUMBERS

75%
OF STUDENTS COMPLETE A CO-OP OR INTERNSHIP

800
TOTAL STUDENT VISITS TO THE ENGINEERING STUDENT SUCCESS CENTER

DISCOVERY LEARNING LABORATORY
847 work orders
33 different pieces of equipment
242 items printed with the 3D printer

157
FULL-TIME GRADUATE STUDENTS

Marquette University, P.O. Box 1881, Milwaukee, Wisconsin 53201-1881 USA

BE CREATIVE.
SOLVE PROBLEMS.
CHANGE THE WORLD.

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College of Engineering
MARQUETTE UNIVERSITY

The majority of the world's engineers serve but a minority of the world. In the Opus College of Engineering, we believe that engineering is bigger than that. We immerse our students in rich experiences and demand that they think critically. We prepare them to become adept problem solvers who are creative, innovative, technically proficient and ready to lead. Ready to be Marquette engineers who solve problems for the majority. Ready to Be The Difference.

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