Engineering

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PENN STATE

Fall/Winter 2019

Working together to achieve equity and inclusion

Inspiring Change.
Impacting Tomorrow.

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ALUMNI

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Look out for these icons to access bonus videos and photos as well as links to stories to learn more.

Video Photos Story

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"I often hear that Penn State engineers are more prepared to work on day one than any others, yet we are not standing still!"

the DEAN'S MESSAGE

Inspiring change. Impacting tomorrow.

Engineering has a multi-millennium history of solving our society's biggest problems.

Penn State Engineering is committed to addressing today's challenges, and moving humanity to a sustainable future. We are also committed to leadership within the engineering community, both technical and social.

As past is prologue, impact must be our story for the next millennium, too. Within this edition of *Engineering Penn State*, you will discover some examples of impact from the research performed by our amazing faculty and students.

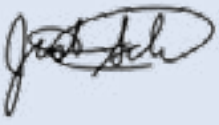
From personalizing treatment of infectious disease (page 18) and visualizing vitals through video (page 28), to creating a reverse filter (page 36) and robotic wheelchairs (page 39), Penn State engineers are using their skills and passion for humanity, progress, and innovation to improve the health and well-being for all humankind.

In addition to just educating our student engineers, we want to arm them with the hard and soft skills they need to be leaders in their fields and change agents in their organizations. We want them to have the tools and confidence they need to excel. We are committed to ensuring all of our students have well-rounded experiences beyond the classroom, through global programs, clubs, and professional society activities.

Getting the brightest student engineers to choose Penn State is going to be a combination of creating a welcoming academic home through new and expanded student success programs, attractive student aid packages, and modern academic curriculum that addresses the changing needs of our students. We aim to create a community where our students' voices are heard and their talents and innovation are appropriately rewarded. All of this work is being spearheaded by **Tonya Peeples**, our associate dean for equity and inclusion, who you will learn more about on page 12.

I often hear that Penn State engineers are more prepared to work on day one than any others, yet we are not standing still! We are proud of the many opportunities we provide to our students, and want to ensure that all of our programs are accessible, and that we prepare students to not only enter the workforce ready to be great engineers, but to also contribute positively to the climate and culture of their employer.

For the Glory,



Justin Schwartz
Harold and Inge Marcus Dean of Engineering
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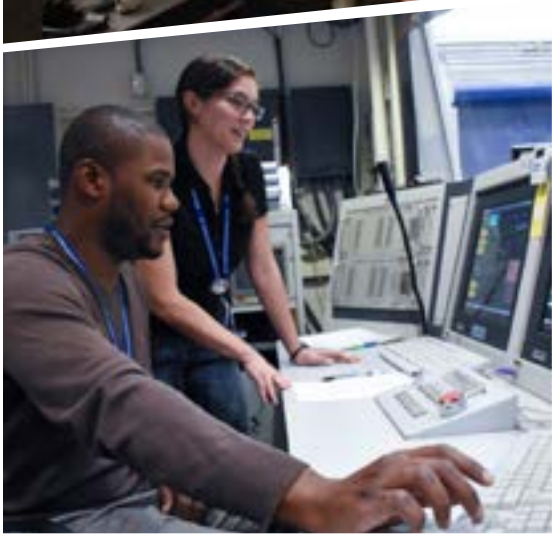

Mechanical, nuclear engineering programs to become independent departments

On the advisement of the Faculty Senate Council, Penn State Executive Vice President and Provost Nicolas P. Jones approved the separation of the Department of Mechanical and Nuclear Engineering into two independent departments: the Department of Mechanical Engineering and the Ken and Mary Alice Lindquist Department of Nuclear Engineering, effective July 1, 2019.

Justin Schwartz, the Harold and Inge Marcus Dean of Engineering, said separating the programs will allow each to grow, as well as focus on their individual strengths.

"Penn State's mechanical engineering program has had a very long and successful history. It's one the country's largest programs and is highly respected in national rankings. And when you look at nuclear engineering at Penn State, you have one of the few university programs remaining in the country that continues to operate a nuclear research reactor," Schwartz said. "Allowing these two proud and storied programs to become independent departments will give each the opportunity to chart its own course and flourish."

Mechanical engineering was introduced at Penn State in 1881 and nuclear engineering was formed in 1955. They operated as independent departments until they merged in 1997, due to declining enrollment in the nuclear engineering program and across the field.

"I want to thank Dr. Karen Thole, distinguished professor and head of mechanical and nuclear engineering, for her leadership over the past decade," Schwartz said. "It is by virtue of her efforts and remarkable success that the College of Engineering is now in a position to launch two successful departments."

Schwartz said Thole will continue to lead the new Department of Mechanical Engineering. A national search has begun for the department head in nuclear engineering.

Major gift to transform nuclear engineering, support areas across University

Nuclear engineering alumnus **Kenneth Lindquist** and his wife and fellow Penn State graduate, Mary Alice Lindquist, have made a transformative estate commitment to support Penn State's nuclear engineering program.

"This extraordinary gift from Ken and Mary Alice Lindquist will expand and accelerate the exciting work Penn Staters are already doing in the area of nuclear energy," said Penn State President Eric Barron. "This, in turn, will advance our vision of making Penn State the preeminent destination for research and teaching that advances the world's need for safe, abundant, and affordable energy."

The gift will establish the Ken and Mary Alice Lindquist Excellence Fund in Nuclear Engineering, which will support a range of programming within the new department, and the Ken and Mary Alice Lindquist Professorship in Nuclear Engineering, which will enhance the department's ability to recruit, retain, and reward high-achieving faculty. In recognition of the couple's generosity, the University will name the department in their honor: the Ken and Mary Alice Lindquist Department of Nuclear Engineering.

"This commitment reflects our profound belief that nuclear represents the future of clean energy in the United States," said Ken Lindquist. "It also reflects our deep gratitude to Penn State for providing the foundation for our careers and lives. Mary Alice and I believe there is no better investment than Penn State students and faculty, whom we know will do extraordinary things with our support."

Penn State SWE wins highest collegiate recognition five years in a row at WE18

For the fifth consecutive year, Penn State Society of Women Engineers (SWE) received the highest possible collegiate recognition within the Society of Women Engineers – the Outstanding Collegiate Section Gold Mission Award – at the WE18 National Conference in Minneapolis, Minnesota, held October 18-20. The conference is the largest gathering of women engineers across all major engineering disciplines.

The award is earned through the submission of an extensive application that outlines every Penn State SWE event that emulates SWE's strategic goals centered on professional excellence, globalization, advocacy, and diversity and inclusion.

Penn State SWE was also recognized as a "Best Practice" for other collegiate sections to follow in two categories:

- **Outreach**, for their SWE Stayover, where 80-90 prospective Penn State engineering female students visit and engage with current members, and
- **Global**, for STEP UP, a collaborative three-day transition program for students from Penn State Commonwealth campuses; **Diversity Round Table**, where organizations including National Society of Black Engineers, Association for Women in Computing, Society of Hispanic Professional Engineers, and more discuss ways to support inclusion in engineering at Penn State; **Hurricane Relief Donation Drive**, where they donated and packaged hurricane relief kits for storm victims in the southern states; and **blood drives**, where members donated blood to help others in medical need.

In addition, Penn State Department of Architectural Engineering alumna **Natalie Miller** received the SWE Distinguished New Engineer Award at WE18 for setting a high bar for success in architectural engineering; for long-standing service to SWE; and for commitment to educating and inspiring current and future women engineers. Miller graduated in 2009 with an integrated bachelor and master of architectural engineering degree, and is currently a senior project manager at Davis Construction.

Penn State SWE was founded in 1975 and has grown to become the largest and most active engineering organization on campus, with more than 250 members.

Choi wins Giuseppe Pellizzi Prize in Bologna, Italy

Department of Agricultural and Biological Engineering Assistant Professor **Daeun "Dana" Choi** was the sole winner of the prestigious Giuseppe Pellizzi Prize in Bologna, Italy on November 10. The award was given to Choi for the best Ph.D. dissertation worldwide during 2016 and 2017 related to agricultural machinery or mechanization. Her dissertation on "Development of intelligent vision systems to support precision agriculture practices in Florida citrus production" was written at the University of Florida. Choi has been a Penn State faculty member since receiving her Ph.D. in 2017.

Paul Heinemann receives Leadership Award from ASABE

Paul Heinemann, head of the Department of Agricultural and Biological Engineering, received the James R. and Karen A. Gilley Academic Leadership Award from the American Society of Agricultural and Biological Engineers (ASABE) at the 2018 Annual International Meeting of ASABE in July. The award "honors and recognizes annually an ASABE member who is currently providing outstanding academic leadership while serving as the department head/chair of a biological and/or agricultural engineering department (or similarly named department) in the United States that presently has an ABET accredited agricultural/biological engineering program."

Don't miss a thing...

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Spencer receives International Astronautical Federation Frank J. Malina Astronautics Medal

David B. Spencer, professor of aerospace engineering, has been named the recipient of the 2018 International Astronautical Federation (IAF) Frank J. Malina Astronautics Medal.

The Malina Medal is presented annually to an educator who has demonstrated excellence in taking the fullest advantage of the resources available to them to promote the study of astronautics and related space sciences.

Spencer was presented with the Malina Medal during the closing ceremony of IAF's 69th International Astronautical Congress on October 5, 2018, in Bremen, Germany. As part of the honor, he gave the keynote presentation at the beginning of the Congress's E1 Space Education and Outreach Symposium.

Trustees committee recommends design build team for West Campus parking garage

In an effort to prepare for and support future College of Engineering construction, Clayco, Inc., of St. Louis, Missouri, has been appointed as the design build team for the West Campus Parking Garage and roadway connections project at University Park.

With a master plan for the College of Engineering currently underway and the intention to eventually relocate a substantial portion of the college to new buildings on West Campus, it was determined the first step is a consolidation of existing surface parking lots into a new parking deck that can accommodate about 1,670 parking spots. The parking deck is expected to make up for the loss of surface parking in advance of future building projects. The project includes improvements to White Course Drive and an evaluation of a secondary access point to the future garage from the west, with considerations for the CATA bus stop. In addition, an existing storm water detention basin will be expanded.

Through a qualifications-based selection process, Clayco, Inc., was one of 10 firms to submit letters of interest and one of three teams to be selected for a final interview. The firm has extensive experience on similar projects, including the Centene Parking Garage in Clayton, Missouri, and the University of Chicago Medical Center West Campus Center for Care and Discovery Parking Garage in Chicago, Illinois. The siting and capacity of the facility will be verified by Clayco, Inc., in conjunction with the facilities master plan and traffic and parking study data, respectively.

New study abroad opportunity for engineering students in Italy and Switzerland

The Office of Global Engineering Engagement is offering a new study abroad program open to all engineering students in Italy and Switzerland beginning in summer 2019. As the first of its kind in the College of Engineering, participants in the Cross-cultural Engagement and Technical Presentation Program learn how to deliver effective technical presentations in a European setting as they are introduced to Italian language and local culture.

All participants will earn a total of six credits through the program, which runs from May 5 to May 25, 2019:

ENGR 197: Cross-cultural Engagement and Technical Presentation for Engineers, taught by **Lori Miraldi**, director of the Engineering Ambassadors Program and Student Engagement Initiatives, College of Engineering, and Peter Miraldi, teaching professor, communication arts and sciences, College of the Liberal Arts, is designed to help students research, develop, and deliver effective technical presentations to cross-cultural audiences. Students will gain and employ language skills to collaborate and present with students from other countries, gain insights into cultural differences among presentation styles, and develop their competencies in cross-cultural communication.

ENGR 197: Cross-cultural Engagement for Engineers in a European Context, taught by **Patrick Tunno**, director of Global Engineering Engagement, consists of two components: a required pre-departure web-based orientation course to equip participants with the tools and knowledge to successfully embark on a productive experience abroad, and an in-country portion to allow students to build upon meaningful connections between the program's technical content and critical issues in the global context, including local language, culture, behaviors, and society.

Students will be provided the opportunity to enjoy academic and cultural engagement with local university students and will visit CERN, the United Nations, the World Health Organization, and other excursions that explore local economies, products, customs, and traditions.

College of Engineering introduces graduate nuclear security option

To ensure the continued security and safety of our nation's nuclear enterprises, the College of Engineering is formally introducing a nuclear security option in its nuclear engineering master's program.

As the first of its kind in the world, this curriculum will prepare students to become the next generation of technical experts in nuclear and radiological security around the world. The nuclear security program is the brainchild of **Kenan Ünlü**, professor of nuclear engineering and director of the Penn State Radiation Science and Engineering Center.

Ünlü created the program and laboratories with a grant from the United States Department of Energy and the National Nuclear Security Administration (NNSA), which were designated to develop a comprehensive curriculum in nuclear security, primarily for graduate students studying nuclear engineering.

"The nuclear security program at Penn State is unique and combines the technical, societal, and policy aspects of nuclear security and safety," said Ünlü. Students in the program will gain experience with state-of-the technologies and be trained in nuclear threat assessment and analysis, global nuclear security policies, and nuclear security system designs.

By successfully completing the following five courses, students will receive the designation M.S. or M.Eng. with a nuclear security option and significantly expand their expertise on these critical issues.

- Nuclear security threat analysis and assessment
- Nuclear security system design
- Source and detector technologies for nuclear security
- Nuclear security education laboratory
- Global nuclear security policies

Family honors late Penn State professor's legacy through graduate scholarship

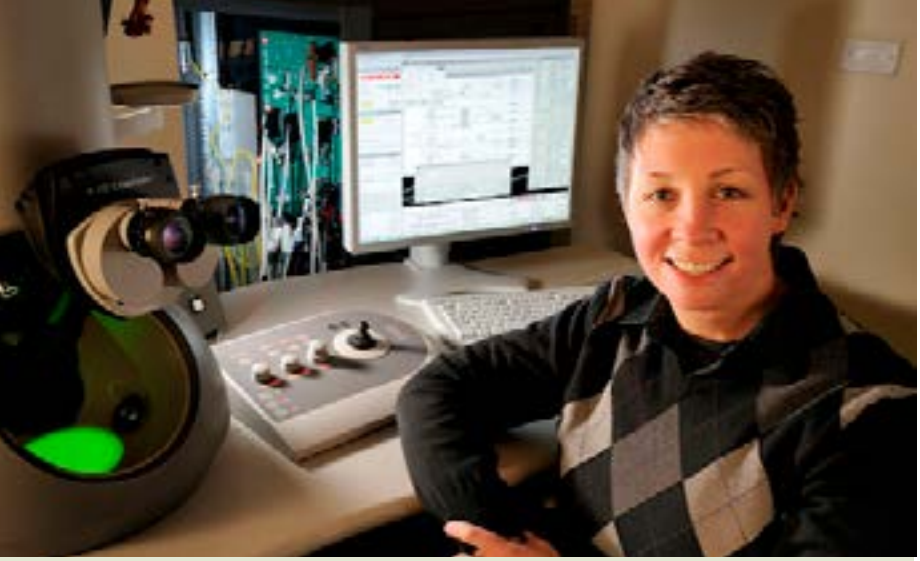
Arthur Henry Waynick, who served as head of the Department of Electrical Engineering and director of the Ionosphere Research Laboratory until his retirement in 1971, profoundly influenced the course of radio science and atmospheric research both in the United States and abroad.

Today, his legacy lives on not only through the groundbreaking research that continues to take place within the Communications and Space Sciences Laboratory, but also in the memories of his grandchildren and great-grandchildren. And a recent major gift from one of Waynick's three granddaughters, Gillian Carey, and her family, will enable the next generation of Penn State scientists and innovators to follow in his footsteps.

Gillian, Kevin, and Art's son, Jon Waynick, have created the Arthur H. Waynick Graduate Scholarship to support outstanding graduate students in the Department of Electrical Engineering. The fund was created with a gift of $125,000, which the University matched 1:1 through its recently concluded Graduate Scholarships Matching Program.

Gillian, Kevin, and their extended family look forward to meeting future recipients of the scholarship at the annual Arthur H. Waynick Memorial Lecture, a tradition which was begun by Art's friends and colleagues following Waynick's death in 1982, and which continues today.

This gift to endow the Arthur H. Waynick Graduate Scholarship will advance "A Greater Penn State for 21st Century Excellence," a focused campaign that seeks to elevate Penn State's position as a leading public university in a world defined by rapid change and global connections. With the support of alumni, parents, and friends, "A Greater Penn State" seeks to fulfill the three key imperatives of a 21st-century public university: keeping the doors to higher education open to hardworking students regardless of financial well-being; creating transformative experiences that go beyond the classroom; and impacting the world by fueling discovery, innovation, and entrepreneurship. To learn more about "A Greater Penn State for 21st Century Excellence," visit greaterpennstate.psu.edu.



Biomedical engineering welcomes pioneering cancer, cryo-electron microscopy researcher

Deborah Kelly, a ground-breaking researcher who developed the new field of structural oncology, has joined the Department of Biomedical Engineering as full professor and Lloyd and Dottie Foehr Huck Chair in Molecular Biophysics. Kelly also holds a joint appointment with the Huck Institutes of the Life Sciences and serves as the director of the new Center for Structural Oncology (CSO) at Penn State.

Kelly's background is in cryo-electron microscopy (cryo-EM), molecular biophysics, chemistry, and biotechnology. Her research focuses on innovative approaches to studying biological systems from human viruses to cancer, including the creation of new high-resolution molecular imaging technologies.

Kelly's team was the first to visualize the complete 3D architecture of the breast cancer susceptibility protein, BRCA1, using structural biology tools they invented for that purpose. The team has also determined how cancer-associated mutations in BRCA1 affect its physical properties and performance in human cells, giving rise to aggressive forms of breast cancer.

In doing so, Kelly's team pioneered a new area of research named "structural oncology." This exciting new initiative focuses on unraveling the underpinnings of cancer-causing processes by studying their protein players at the atomic scale. Utilizing the state-of-the-art cryo-EM resources found only at Penn State, Kelly and her team will elevate their efforts to new heights in the fight against human cancer.

With the new CSO, Kelly will work with researchers from a variety of groups such as biomedical engineering, the Huck Institutes, Materials Research Institute, and the Penn State Cancer Institute to develop advanced tools to provide strategic insight in the detection and prevention of breast cancer. In addition, Kelly will continue to explore potential uses for the tools and processes she developed in the detection and prevention of other cancers such as brain tumors and pancreatic cancer. She also expects to work with colleagues researching viruses, including the viruses that cause some forms of cancer.

Kelly received a bachelor of science in biochemistry from Old Dominion University, a master of science in chemistry from Old Dominion University, and a doctor of philosophy in molecular biophysics from Florida State University. She also served as a postdoctoral fellow in the Department of Cell Biology at Harvard Medical School.

New graduate certificate in additive manufacturing offered at Penn State

Penn State is offering a new graduate certificate in Additive Manufacturing and Design (AMD) through Penn State World Campus. Joining the University's quickly expanding graduate program in AMD, the new 12-credit certificate provides a springboard for engineers to build a strong foundation in the thriving field.

Ideal for engineers working full time, the certificate can be completed in one or one-and-a-half years and equips students with the knowledge and skills to work effectively across AMD disciplines.

To capitalize on the field's interdisciplinary emphasis, the AMD program combines the strengths of six departments and one school across two colleges, the Colleges of Engineering and Earth and Mineral Sciences.

The admission requirements are based on a combination of academic records, GRE scores, resume and applicable work experience, a personal statement of interest, and three letters of recommendation from a professor or supervisor. GRE scores will be waived for applicants who have five or more years of work experience or who have previously completed a master's degree.

To receive the graduate certificate, students will complete three of the four offered 4-credit core courses in the existing AMD master's program. The credits earned in pursuit of the certificate can also be applied toward a master's degree in AMD if the student chooses to continue their education.

Applicants will be expected to have a bachelor of science or four-year associate's degree in engineering, engineering technology, manufacturing, materials science, or a related field.

The program launched in the spring of 2019. For more information, visit bit.ly/2zUzWhR.

Atamturktur appointed head of architectural engineering

Sez Atamturktur has been named the Harry and Arlene Schell Professor and Head of the Department of Architectural Engineering at Penn State.

Previously, Atamturktur was a provost's distinguished professor and professor of environmental engineering and earth sciences, mechanical engineering, industrial engineering, and civil engineering at Clemson University. In addition, Atamturktur served as the associate vice president for research and was the founding director of Clemson's office of research development.

Atamturktur's research, focused on uncertainty quantification in scientific computing, has been documented in more than 100 peer-reviewed publications in some of the finest engineering science journals and proceedings. Her research has been funded by federal agencies including the National Science Foundation, the U.S. Department of Energy, the Department of the Interior, Department of Transportation, the Department of Education, as well as industry organizations and corporations.

During her time at Clemson, Atamturktur has been honored with the McQueen Quattlebaum Faculty Achievement Award, Outstanding Woman Faculty Award from Clemson University President's Commission on Women, the Murray Stokely Award for Excellence in Teaching in the College of Engineering and Science, and two Outstanding Teacher Awards from the Clemson's Chapter of Chi Epsilon Honors Society. She has also been nominated for and has received numerous best paper awards.

In addition to her administrative and academic roles, Atamturktur is currently a member of the American Society of Mechanical Engineers, the American Concrete Institute, the American Institute of Aeronautics and Astronautics, the Masonry Society, the American Society of Civil Engineers, and the Society of Experimental Mechanics.

Prior to her current roles, Atamturktur served as a distinguished professor of intelligent infrastructure and in associate and assistant professor roles in Clemson's Glenn Department of Civil Engineering. Before joining Clemson, she was a technical staff member and researcher in the Applied Physics Division of the Los Alamos National Laboratory and a doctoral student and researcher at Penn State.

Atamturktur earned her Ph.D. in civil engineering from Penn State, her master of science in architectural engineering from Penn State, and her bachelor of science in architecture and civil engineering from Orta Dogu Teknik Universitesi in Ankara, Turkey.

Electrical Engineering's Pasko elected Fellow of the American Geophysical Union

Victor Pasko, professor of electrical engineering, has been elected a Fellow of the American Geophysical Union (AGU) for developing new understanding of lightning driven electrical gas discharges in the upper regions of Earth's atmosphere.

According to the AGU, "AGU Fellows are recognized for their scientific eminence in the Earth and space sciences. Their breadth of interests and the scope of their contributions are remarkable and often groundbreaking. Only 0.1% of AGU membership receives this recognition in any given year."

Through several National Science Foundation programs, such as Coupling, Energetics, and Dynamics of Atmospheric Regions; Frontiers in Earth-System Dynamics; Aeronomy; Physical and Dynamic Meteorology; Division of Engineering Education and Centers; and the Defense Advanced Research Projects Agency, Pasko has made major research contributions in the Earth and space sciences.

His vast research contributions include the development of a new understanding of electrodynamic coupling of thunderstorms and upper regions of Earth's atmosphere; experimental discovery of a new electrical discharge phenomenon in Earth's atmosphere that is manifested in formation of a path of electrical contact between thundercloud tops and the lower ionosphere; development of first principle models of non-thermal and thermal filamentary gas discharges in air, leading to a new understanding of similarity relations and scaling of these discharges with gas pressure; development of mechanisms of bursts of high energy photons in Earth's atmosphere; and successful model interpretation of infrasonic and gravity waves generated by thunderstorms and aurora.

Tom and Mary Ellen Litzinger establish Open Doors Scholarship in the College of Engineering

The College of Engineering's **Tom Litzinger** and his wife, Mary Ellen, have contributed $30,000 to fund and endow the Thomas A. and Mary Ellen Litzinger Open Doors Scholarship in the College of Engineering.

Their gift will be matched 2:1 by Penn State – making it a total of $90,000 – and will support undergraduate students in the College of Engineering who meet financial need requirements through the Student Transitional Experiences Program (STEP), a summer transition program for students who are making the junior year transition to University Park after starting at another Penn State campus. Through coursework, mentoring, and a six-week workshop series, students become familiar with University Park people, opportunities, and resources.

After receiving a bachelor's degree in nuclear engineering from Penn State, Tom Litzinger joined General Electric (GE) and completed a master's degree in mechanical engineering from Rensselaer Polytechnic Institute through GE's Edison Engineering Program. He left GE to do doctoral studies at Princeton and joined Penn State in 1985 as a College of Engineering faculty member. He is currently assistant dean of educational innovation, accreditation, and digital learning, director of the Leonhard Center for the Enhancement of Engineering Education, and professor of mechanical engineering.

Mary Ellen Litzinger received a B.A. in English from Ithaca College, a M.S. in library science from the University of North Carolina – Chapel Hill, and a Ph.D. in instruction systems from Penn State. She was employed at Penn State from 1981 to 2011 as a reference librarian at University Libraries (1981-1997); a strategic planning facilitator in the Office of the Provost (1997-1999); an instructor in Kinesiology (1999-2007); and as an instructor in the College of Engineering's Women in Engineering Program from 2003 until her retirement in 2011. Mary Ellen is also an active Penn State volunteer. She is a past member and chair of the WPSU Board of Representatives, and she also chaired the Fundraising Committee for Shaver's Creek Environmental Center during the For the Future and Building the Future Campaigns. She currently chairs the Community Advisory Council for the Center for the Performing Arts.

National experts collaborate at Penn State to ensure election security

On December 3, dozens of experts from across the country met at the Penn Stater for the first Penn State Symposium on Election Security. The event was cohosted by the College of Engineering, the Law School, and the School of International Affairs, as well as the Penn State Institute for Networking and Security Research, and the Institute for CyberScience.

The Symposium allowed for experts from disciplines as diverse as public policy and cybersecurity to collaborate on solutions to election security threats.

"This event brought together some of the thought leaders in elections security from around the nation, and highlighted the problems and importance of vigilance in protecting our democracy," said **Patrick McDaniel**, director, Institute for Network and Security Research, and one of the event's organizers. "It also led to concrete plans for taking action in the future, in which Penn State will play a central role."

The December timing of the Symposium allowed for the speakers and panelists to take a retrospective look at the November mid-term elections while making suggestions for the 2020 election.

Working together to achieve equity and inclusion

by Megan Lakatos

Engineering Penn State sat down with Dr. Tonya Peeples, who joined the College of Engineering on August 15, 2018, as its inaugural associate dean for equity and inclusion and professor of chemical engineering. We are pleased to share that conversation with you.

Engineering Penn State (EPS): What drew you to Penn State?

Tonya Peeples (TP): I was really drawn to Penn State for the opportunity to become the College of Engineering's inaugural associate dean for equity and inclusion. I remember applying for the position and thinking, "Wow, I might be the perfect person for this job; I've done all these things in my career that are aligned with what this role is."

I was coming from another big institution but with a smaller engineering college, and the opportunity to have an impact on a large number of students and to work in a different culture was something that was appealing to me. The scale of the engineering community here is one that can really have impact across campus and beyond.

Justin Schwartz, who is the Harold and Inge Marcus Dean of Engineering, is a major champion for equity in the College. We had some conversations in the recruitment stage and all along the way, he has been a great support and ally helping me establish the initiatives that we have in the College. I was really encouraged that I was going to be doing this in the right place with the right kind of support in the work environment to make some progress.

EPS: What do you find most exciting about this position?

TP: The ability to build something and to design a structure to advance equity goals is really exciting. It was very important to me that the position is equity and inclusion, so that we provide opportunity and access to people who want to pursue engineering, but also to develop the capacity to really create a welcoming environment for education and scholarship.

What I've been really excited and encouraged about lately is that we can't achieve equity and inclusion if the whole community isn't involved. A lot of times when you hear equity and inclusion, you have people who check out and say, "That doesn't represent me," but it absolutely does represent everybody. We all are working to create this welcoming environment where anybody who comes in feels an ease of wellbeing while they're reaching their educational goals. I'm really excited to work on an allies program across groups and disciplines to talk about how we create the kind of environment we want to have in college and in engineering specifically. I think there's a lot of energy in terms of how we all make the environment better for women, for first-generation students, for minorities, whatever piece of the pie you represent, how do we make it better, how do we have our white male students go out and feel like they can be really effective at advancing equity from their position. I want everybody to see themselves as a partner.

Along those lines, I've been encouraging people to think about who made a difference in their life. An ally could be a U.S. citizen making a difference for an international student, or it could be a low-income student that made a difference for somebody who is a person of color. There are so many different aspects of who we are that we bring here to Penn State. Who made a difference for you? I've had a lot of mentors who didn't look like me – a lot of white men, including my Ph.D. adviser who made a difference for me. And that's really what I feel like I'm here for, to make a difference for people.

EPS: How has your professional experience prepared you to be the associate dean for equity and inclusion?

TP: I started my career as a chemical engineering faculty member, and my entry into the area of equity and inclusion work happened when I was an assistant professor at the University of Iowa and I was writing a National Science Foundation (NSF) CAREER grant. In the CAREER program, the NSF supports junior faculty who are "teacher-scholars." I got feedback from the NSF that I should really think about pursuing an education program and where I can make an impact. And for me, being an underrepresented student, being a woman in engineering, I thought I could really do some things to help women and underrepresented students. That part of my work really grew.

All throughout my career as a faculty member, I was working with students, whether it was outreach to K-12 students or working with students in professional organizations. I was engaged in that way which led me into doing more in that area. Once I got tenure and I could devote a bit more time to the service part of it, I developed more leadership in equity and inclusion work.

EPS: Can you explain your experience as a woman and minority in engineering, and how the experience has aided you in your role in equity and inclusion?

TP: There were times when I would be the only African American in the STEM space. The numbers were low when I was in undergraduate school, but there were people like me around. It wasn't until graduate school that I was one of very few African American students, particularly Ph.D. students in my program. I was at Johns Hopkins in Baltimore, and it's sort of ironic because Baltimore is a very diverse city, but in graduate school you didn't see that diversity in the lab. In fact, in 1997, I was the only woman faculty member in the University of Iowa College of Engineering.

My experience has helped me think about others and what their struggles might be being the only female or minority in a

Peeples participated in a panel discussion at the 2018 Multicultural Engineering Program Orientation.

"An important piece of equity is engaging our whole community, thinking about how we can get more people who want to be engineers to be able to do so. That's really what it's about."

classroom, lab group, or in a meeting, thinking about how to build community, how to work with people who maybe don't look like you or have the same background as you in terms of mentoring. Whether it was teachers or lab mates, I grew in my ability to work with different people, whether they were international students or U.S. students from different parts of the country, and I really just got a lot of empathy from it in terms of being able to understand what somebody else might be going through, and to help figure out how do we do things to improve the sense of community for people.

EPS: Can you talk about the Dean's Engineering Equity Initiative?

TP: Penn State is a large institution that is graduating so many engineers. If we really look at advancing equity at the University, it could actually have a national impact because we graduate so many people. And as we think about equity, what we want to do is think about how we can graduate men and women who are advancing equity in the workplace, because if we have more participation from different groups at the undergraduate level, they go into the professional world. And the professional world includes the next generation of professors as well as those who are working at companies, so a lot of companies around the country have been talking about getting more women and underrepresented minorities into high tech fields. It also impacts those who come from economically disadvantage backgrounds or first-generation students whose parents never went to college. We're thinking about what the experience is like for these people, and we are asking, "How do we develop more opportunity and more access to the things that help them be successful in engineering?"

We are successful in inspiring students if they have role models. For instance, it's so important for women to see other women in engineering to prove that women can do this work.

It is crucial to share the stories of successful women, to have successful women as faculty, as graduate students, as college students, also sharing stories with women that are in the K-12 space so that there's this idea that this is something that women can do. They can go into engineering in a variety of fields and be successful and make a difference in the world. I think another aspect is the inspiration of helping people. The idea that engineering is a discipline that solves problems and designs solutions to make the world better is a part of the draw to become an engineer.

In the faculty equity space in the College of Engineering, I'm launching an equity advising program to help improve the faculty search process to think about things like how do we improve the applicant pool, and how do we look at every piece of the hiring process to identity areas where we can think about equity and inclusion, and do a better job of attracting diverse faculty into the College.

EPS: When talking about equity, there is a perception that underrepresented students who aren't as academically successful as their counterparts will be accepted just to "meet the quota." Can you explain this misconception?

TP: It really is misinformation. There are very talented people on paper who are just as strong, if not stronger, than the current students that are being admitted. We're not talking about changing admission standards, but actually changing the "why" or the reason people would want to come to Penn State or enter into engineering. We are really making the case for how engineering helps people. There are people who don't necessarily see themselves in engineering because engineering has never been communicated to them as an option and because they have so few role models. These individuals have the talent and the passion and the ability to really be engineers. An important piece of equity is engaging our whole community, thinking about how we can get more people who want to be engineers to be able to do so. That's really what it's about.

EPS: Along those lines, what is the Dean's Equity Partners Program, and how can alumni and corporate partners get involved?

TP: One of the things that we've been able to identify is that the yield or the number of women students who meet or exceed our admissions criteria that can actually come to Penn State is lower as a percentage because of finances. It is either too expensive or they don't have enough scholarship money. We realize that is an important lever to get these really talented people into engineering. Our corporate partners are very much interested in having great employees, so we're engaging with them to think about how we can create this opportunity for students and lower the cost of their education through scholarships.

EPS: How do you plan to create an inclusive academic community at Penn State?

TP: We need to communicate that Penn State has everything that a person needs to be successful and to be supported. Whether it's a special living option, scholarship opportunities, or undergraduate research, or whether they're coming from a Commonwealth Campus into Penn State University Park, we want to make sure that they're connected with a network that enables them to be successful. And a lot of times we think about it in terms of mentoring – we have this idea that there's one person who's going to know everything that we need, when actually it's more of a matrix or a community. There are other people around that are "human landmarks" that help you along the way. ■

Engineering Equity
INITIATIVE

The Penn State College of Engineering is committed to equity and we have a very big goal that is supportive of all students in an integrated way. We want to create a more welcoming engineering community where all students demonstrate the capacity to support others as allies. This community will invite more women, as well as more people from groups historically underrepresented, to engineering. This environment will inspire all learners, researchers, and partners to develop solutions to problems for an increasingly connected, diverse, and global landscape.

Inspiring Change.
Impacting Tomorrow.

TONYA PEEPLES APPOINTED INAUGURAL ASSOCIATE DEAN FOR EQUITY AND INCLUSION to ensure inclusive excellence among all engineering students, postdoctoral scholars, and faculty.

OUR WOMEN IN ENGINEERING PROGRAM IMPROVES STUDENT SUCCESS:

70%
GRAD RATE

10 points higher than the rest of the student population and **17 points higher** than the national average.

#9

National rank for number of degrees awarded to women engineers – Source: ASEE

23%

Female undergraduate students currently at the Penn State College of Engineering – Fall 2018

"In the future, there will be no female leaders. There will just be leaders."

– Sheryl Sandberg, COO Facebook

We provide support programs to thousands of students each year through our Center for Engineering Outreach and Inclusion.

inclusion.engr.psu.edu

ADVANCING EQUITY

Tomer Eldor receives Bechtel Engineering Equity Initiative Scholarship

by Megan Lakatos

Tomer Eldor was exposed to the subjects of chemistry, physics, and calculus when she moved to the United States from Israel four years ago. At that very moment, she knew she had found her passion, and wanted to attend a university to study either chemical or biomedical engineering.

"Science provides me with a comfortable venue, full of intellectual stimulation, and the moment I set foot into my science classes, I was amazed and knew then and there that nothing would stop me from attempting to quench my great scientific thirst," Eldor said.

She knew she would want, above all, to attend a university that would simultaneously slake her academic thirst and satisfy her determination to turn theory into meaningful practice. She applied to Penn State and was accepted into its Schreyer Honors College and the College of Engineering, but unfortunately, the cost of attending the University was a hindrance that could not be overcome without financial assistance.

Her situation is not unique. According to the Penn State Office of Undergraduate Admissions, cost and lack of scholarships are the main reasons for women not accepting their offer to study at Penn State College of Engineering.

Fortunately, Eldor was able to attend Penn State, thanks to the Bechtel Engineering Equity Initiative Scholarship in the College of Engineering. Bechtel, a leading global engineering, procurement and construction company and long-time supporter of the College of Engineering, values diversity and inclusion in the workplace, and knows that a diverse work environment cannot be attained without having a diverse undergraduate population.

"It's important to create and maintain a work culture and environment where each individual – regardless of their distinguishing physical characteristics, such as race or gender, or their personal backgrounds – believes their thoughts and contributions are considered and valued, and integral to the organization. Such a workplace fosters collaboration and inclusion that enables us to leverage the talents and diversity of our people in order to surface innovative ideas," Dan Williams, project director, Bechtel, said. "At Bechtel, our primary asset is our diverse global workforce. We deliver for our customers by smartly leveraging the intelligence and experiences of our workforce; it's a business imperative to foster such an environment."

Prior to beginning her journey at Penn State, Eldor attended the College of Engineering's Women in Engineering Program Orientation (WEPO), designed to introduce first-year women to the Penn State College of Engineering and to the engineering career path.

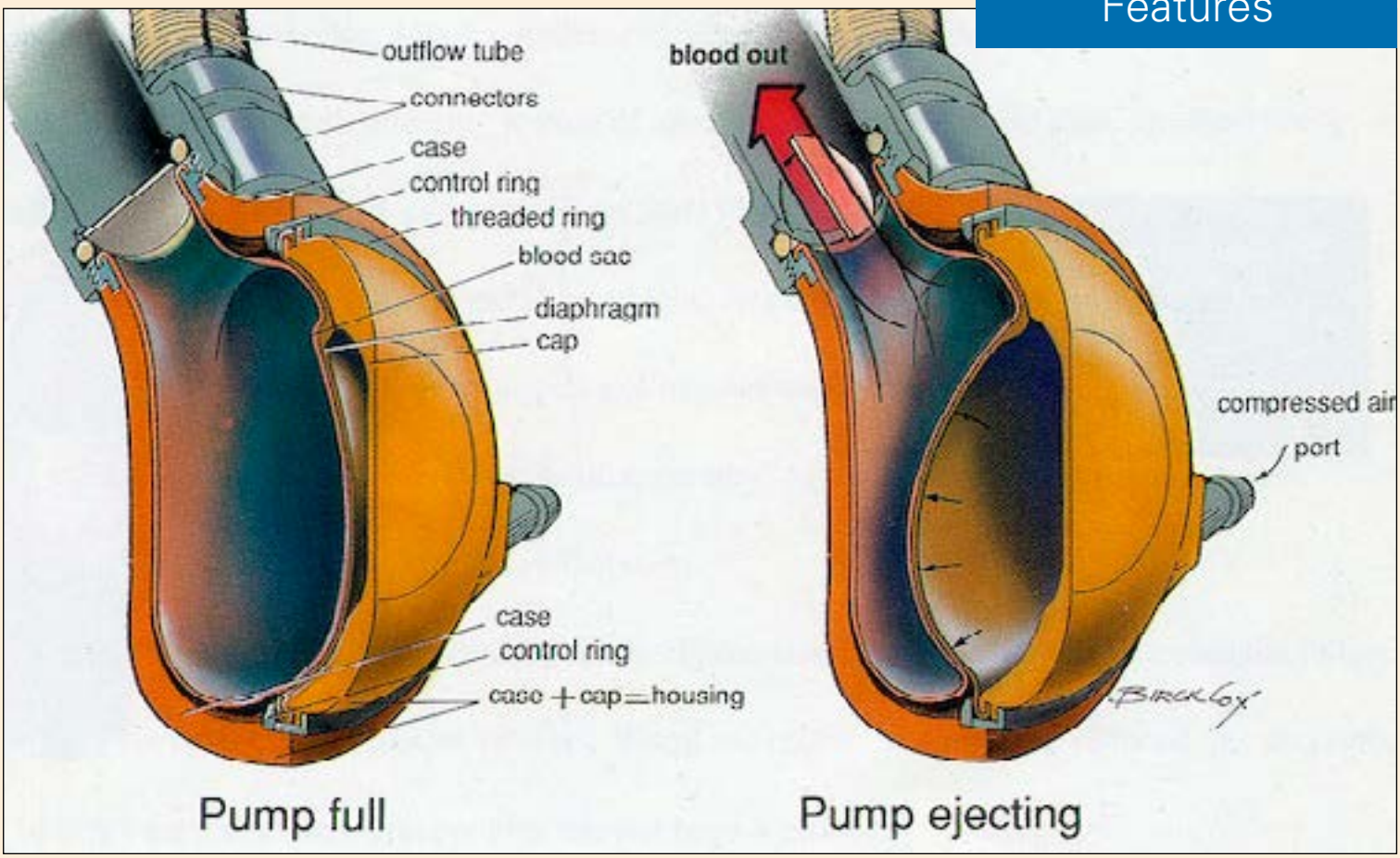
"It was amazing because there were around 200 women – all engineers. And going from almost no women in my science and math classes in high school to seeing all these women engineers in one place gave me confidence," Eldor said.

And now with her first semester under her belt, she is enjoying her time at Penn State, and is an active member in the Penn State Society of Women Engineers and Students Supporting Israel.

Penn State is designated as a "Key School" for Bechtel – one of five such institutions in the United States. "Penn State has earned this distinction because of the excellence of its engineering program, the broad array of engineering degrees offered that align with our business needs and its development of diverse talent," Williams said. "We value our strong relationship with the College of Engineering because it facilitates multiple points of engagement between us, such as collaboration on capstone projects, summer internships and our participation in advisory boards. These engagements help us develop the next generation of engineers, with an emphasis on attracting Penn State's diverse talent."

Thanks to Bechtel's generosity and testament to gender equity in engineering, Eldor will be able to join the ranks of hundreds of thousands of talented women engineers who are making a profound difference in the world.

"The College of Engineering is greatly appreciative of Bechtel's continued generosity. Their commitment to partnering with Penn State to enable the education of the next generation of engineering workforce speaks volumes regarding the long-term commitment Bechtel is making toward advancing humankind around the globe," said **Justin Schwartz**, Harold and Inge Marcus Dean of Engineering. ■



Building a safer heart pump

by Jamie Oberdick

Blood pumps are increasingly used as a temporary treatment for patients with end-stage heart disease or heart failure while they wait for a heart transplant. But the risk of blood clots and strokes endangers patients before they can receive a donor heart, and is a barrier to their use in less sick patients who could benefit from them.

Solving these issues is the focus of a four-year, $3 million grant from the National Institutes of Health awarded to **Keefe Manning**, professor of biomedical engineering and surgery, and Gerson Rosenberg, professor of surgery and bioengineering and chief of the College of Medicine's Division of Applied Biomedical Engineering. Manning and Rosenberg will use the grant to develop both a clot model to predict where clots might form during blood pump use, and methodologies to design safer blood pumps.

"In a small but significant number of patients, bleeding can occur during blood pump use, and in some instances, clots can form in the pumps or tubes leading into and from the heart," Rosenberg said. "Our research focuses on developing methods to design improved pumps that will have a reduced incidence of bleeding and strokes."

Manning and Rosenberg hope their research will help develop blood pumps that can be used, for example, on a congestive heart failure patient at a much earlier state in their disease. This would greatly benefit the patient, because if there is a blood pump intervention early in the disease process, then recovery can occur much sooner because the heart would not have to work as hard.

At the same time, a safer heart pump is important for patients with serious heart disease because they are used temporarily on patients waiting for a heart transplant. The less time needed to use a heart pump the better, given the stroke and blood clot risk. However, waiting times can last for months because of an insufficient number of donor hearts.

According to the United Network for Organ Sharing, as of November 14, 2018, there were more than 75,000 individuals on the active heart transplant waiting list. On average more than 25 percent of those waiting for a heart transplant do not live long enough to receive a new heart due to the long wait time.

"The bottom line is the longer a patient can go with a safer blood pump, the higher likelihood they have of finding a donor heart and surviving," Manning said.

Some of the preliminary data for this proposal was generated through the support of a Huck Institutes of the Life Sciences seed grant. ■

New predictive models may transform personalized treatment of infectious disease

Steven Schiff wins prestigious NIH research award

by Erin Colbourn

A new National Institutes of Health (NIH) High-Risk, High-Reward grant will allow **Dr. Steven Schiff** and team to explore a radically changed approach to predicting, preventing, and treating infectious disease at the individual level at point-of-care. The researchers will investigate a new way of addressing critical unmet needs, especially in the developing world.

As a pediatric neurosurgeon, Schiff has dedicated a significant portion of his career to the study and treatment of brain diseases in children. Brain infection in infants often results in hydrocephalus, fluid build-up in the brain that can lead to brain damage and death.

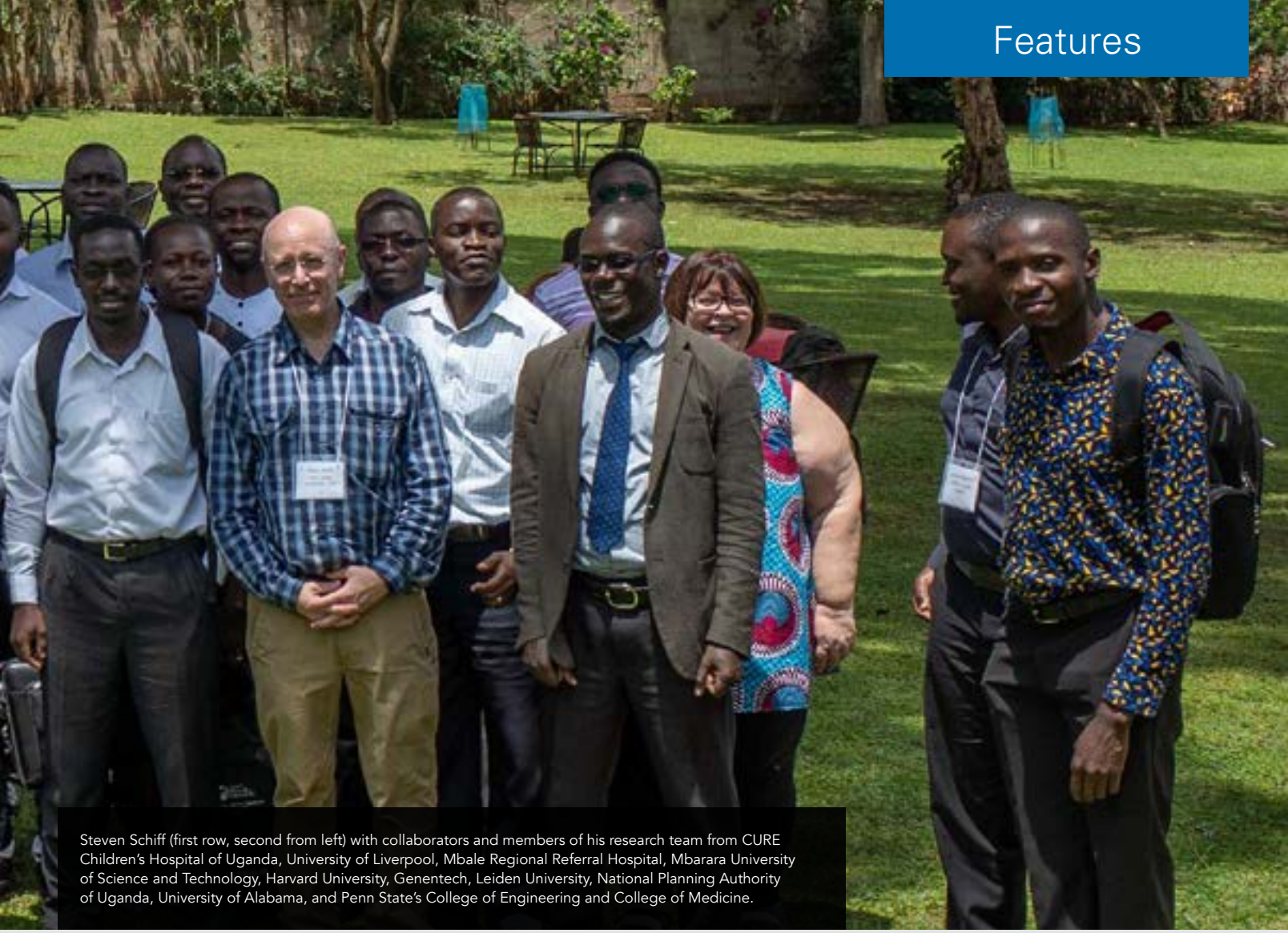
"Infant hydrocephalus is the most common reason for neurosurgery in young children worldwide," said Schiff, Harvey F. Brush Chair in the College of Engineering in the Departments of Neurosurgery, Engineering Science and Mechanics, and Physics. "If we are to best treat infectious disease, we need to start focusing on preventing the infections, instead of training surgeons and building advanced surgical facilities to repair the effects after the infections occur."

An NIH Director's Pioneer Award in 2015 allowed Schiff to shift his professional focus from neuroscience to study the causes of childhood infectious diseases in the developing world. In October, he received an $8.1 million NIH Director's Transformative Research Award for a project that aims to radically change the approach to treatment of these diseases, emphasizing prediction and prevention.

Schiff will now be able to assemble a 'dream team' to develop innovative models that incorporate the ability to predict outbreaks of epidemic disease with predictions of pathogen type and host resistance, allowing real-time preventive treatment at the point of care, instead of relying on standard diagnostic approaches.

"We have demonstrated that it is feasible to predict epidemic disease outbreaks from retrospective seasonal and geographical case data and have shown that we can take climate factors into account in our predictive models," said Schiff, who is also director of the Penn State Center for Neural Engineering. "But predictive strategies have never been used in treatment of individual patients. We believe our approach to predictive personalized public health has the potential to substantially improve patient outcomes."

Today, patients suffering from symptoms of infectious disease are typically treated alike: by drawing samples for laboratory analysis, starting antibiotic therapy with the physician's best guess as to the likely causes, and then hoping to learn the causative reason for the infection over a period of days from



Steven Schiff (first row, second from left) with collaborators and members of his research team from CURE Children's Hospital of Uganda, University of Liverpool, Mbale Regional Referral Hospital, Mbarara University of Science and Technology, Harvard University, Genentech, Leiden University, National Planning Authority of Uganda, University of Alabama, and Penn State's College of Engineering and College of Medicine.

laboratory analysis. Schiff's vision is to move from reactive, delayed diagnoses to real-time treatment using predictive models that incorporate historical microbiological surveillance data, geographic location of the patient, and environmental and climatic factors to determine the likely pathogens and narrow down the best treatment choices at the point of care.

Over the next few years, Schiff and his team will build on his previous work and years of existing research on infant infections. They will take a multi-pronged approach involving disciplines as disparate as epidemiology, meteorology, and genomics, and using tools including machine learning, statistics, and engineering control theory. The Ugandan National Planning Authority, Meteorological Authority, and Ministry of Health have offered their support, and their work will be key to successful implementation trials.

"This is work that no one could ever do on their own. It is the outgrowth of 12 years at Penn State and the opportunity to collaborate through transdisciplinary research with colleagues and personnel in Uganda -- blending medicine, engineering, and science," said Schiff. "One of our unique strengths is the ability to integrate across traditional disciplines, and we have the breadth of expertise required to tackle critical problems of this magnitude."

The Transformative Research Award promotes cross-cutting, transdisciplinary approaches and is bestowed on exceptionally creative scientists proposing paradigm-shifting research. The awards support unconventional approaches to major challenges in biomedical and behavioral research.

"Steve has devoted his career to improving the lives of children coping with serious, sometimes fatal brain disorders, and he's especially passionate about the acute needs of children living in under-developed countries," said Dr. A. Craig Hillemeier, dean of the College of Medicine, CEO of Penn State Health, and senior vice president for health affairs.

Schiff will also collaborate with the Institute for Personalized Medicine and Penn State Health, and his team will include the CURE Children's Hospital of Uganda, leading experts from Harvard and George Mason University, and personnel from Genentech.

"Dr. Schiff's vision exemplifies the type of collaboration unique to Penn State that harnesses the broad talent needed to effectively address critical, universal problems and bridge the gap between the fields of medicine and engineering," said Justin Schwartz, Harold and Inge Marcus Dean, College of Engineering. ■

Reshaping first-year engineering design

SEDTAPP faculty receive funding to improve early engineering education

by Samantha Chavanic

For the last two years, faculty members in the School of Engineering Design, Technology, and Professional Programs (SEDTAPP) have worked to better emphasize world-class engineering principles in EDSGN 100: Introduction to Engineering Design. Project-based course modules focusing on topics ranging from creativity to making have been devised and implemented in order to present first-year engineering students with holistic, real-world design projects.

As the modules are executed in various EDSGN 100 sections, by various faculty members and at various campuses across the Commonwealth, SEDTAPP researchers are now focused on creating a unifying experience for all Penn State EDSGN 100 students.

Nicholas Meisel, assistant professor of engineering design and mechanical engineering, has received a grant from the College of Engineering's Leonhard Center for the Enhancement of Engineering Education to design, implement, and assess a new framework that will create unifying design experiences for all EDSGN 100 students. **Christopher McComb**, assistant professor of engineering design and mechanical engineering; **Jessica Menold**, assistant professor of engineering design and mechanical engineering; and **Sarah Ritter**, assistant teaching professor in SEDTAPP, serve as Meisel's co-principal investigators on the grant.

The team, comprised of experts in engineering design and engineering education, will create a unifying framework that defines key EDSGN 100 project concepts and characteristics.

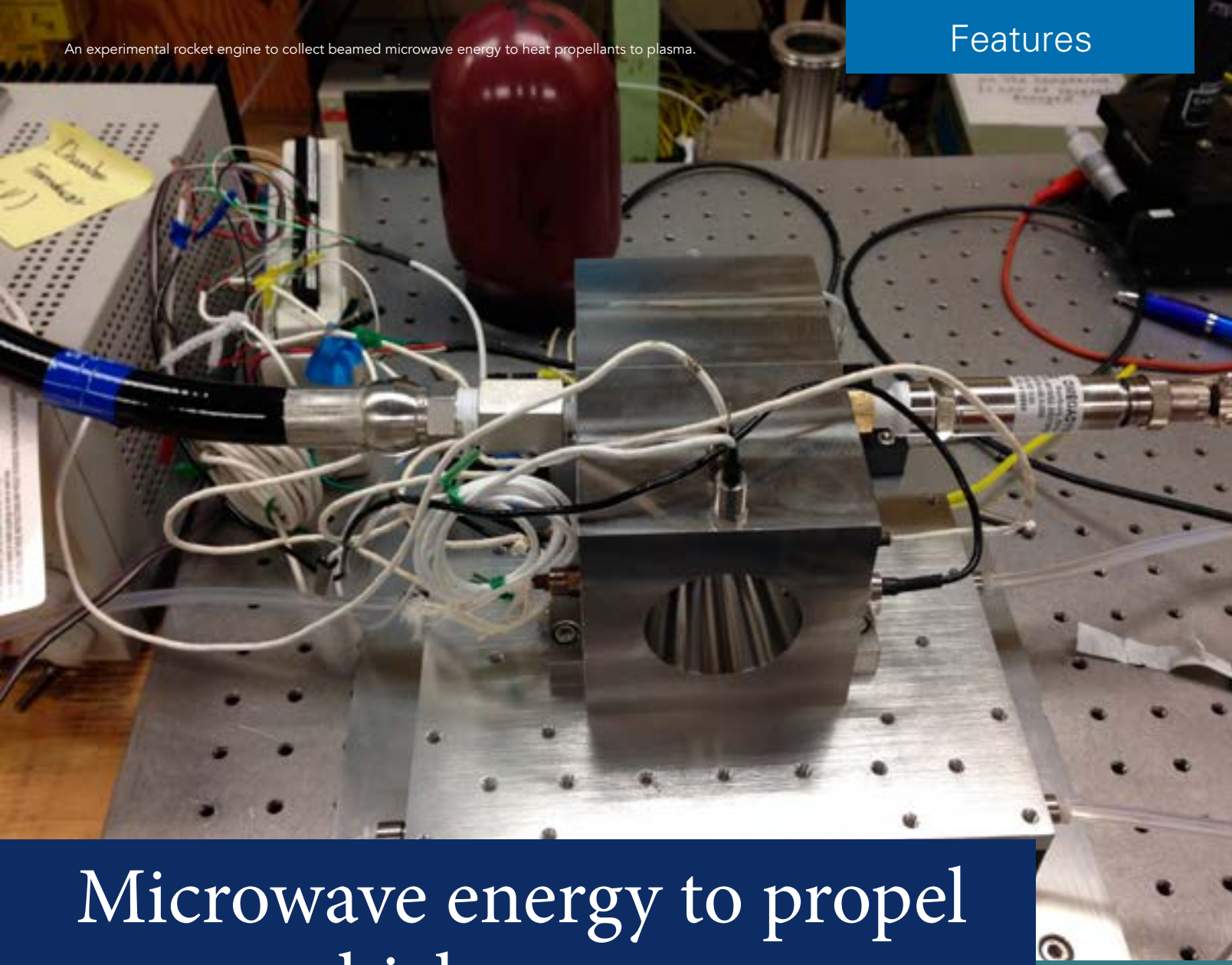
"From the development of the EDSGN 100 modules, we've started to identify the crucial elements of what it means to practice engineering design in today's world and how these elements should be translated to the classroom," Meisel said. "Characteristics like cultural awareness, consideration of environmental impacts, hands-on fabrication experience, and innovative problem-solving are more important than ever."

"Characteristics like cultural awareness, consideration of environmental impacts, hands-on fabrication experience, and innovative problem-solving are more important than ever."

This framework was leveraged at University Park during a fall 2018 pilot study. It featured a project that mimicked virtual teaming scenarios to simulate distance teaming, an increasingly common component of engineering design projects.

Information and data collected from this study is being used to create an initial assessment and redesign of the existing framework. Faculty will use the spring 2019 semester for a second assessment and revision. Researchers will review students' engineering design self-efficacy, engagement with the curriculum, virtual teaming performance, and final design project quality. This information will impact the final framework, which will roll out to all EDSGN 100 instructors in fall 2019.

"EDSGN 100 often acts as a student's first exposure to the engineering design process. We want to make sure that they are able to walk away from the course having had a chance to practice solving the sorts of large and complex challenges that engineers face every day," Meisel said. "But first, we have to identify what characteristics these types of problems all have in common, so that faculty members can more easily incorporate them into the classroom." ■



An experimental rocket engine to collect beamed microwave energy to heat propellants to plasma.

Microwave energy to propel space vehicles

by Chris Spallino

The Air Force Office of Scientific Research (AFOSR) awarded two College of Engineering faculty members, **Michael M. Micci**, professor of aerospace engineering, and **Sven G. Bilén**, head of the School of Engineering Design, Technology, and Professional Programs and professor of engineering design, aerospace engineering, and electrical engineering, funding totaling more than $823,000 for a three-year program to develop and use a facility to study the use of beamed microwave energy to launch space vehicles off the surface of Earth.

The funding consists of two separate awards, with the first being $396,865 provided by the Defense University Research Instrumentation Program, which funds large-scale equipment acquisition by universities. This award will be used to acquire a five-foot diameter by eight-foot-long high-vacuum chamber to simulate both high altitudes and the space environment. The funding also provides for the acquisition of a high-power microwave source and related microwave and optical diagnostic equipment.

The second award of $426,913 from AFOSR is to utilize the facility to examine the feasibility of beaming microwave power to a space vehicle, where it is focused to heat either an on-board propellant or ingested surrounding air to create a plasma with temperatures higher than can be achieved with current chemical propulsion methods. Because of the higher propellant temperatures, more thrust can be achieved for the same flow rate of propellant. Since the microwave source is located on the ground and not on the space vehicle, it is powered by the commercial electrical grid, allowing a large amount of energy to be transmitted to the space vehicle without any weight penalty for the vehicle.

Experiments will also be conducted at the Air Force Research Laboratory in Albuquerque, New Mexico, where a multimillion-dollar 100-kilowatt, 95-gigahertz microwave source is located.

"If this concept proves viable, it has the potential to drastically reduce the cost of placing spacecraft into Earth's orbit, something which has both governmental and commercial applications," said Micci. ■

Duckweed floating in water.

Energizing the food-energy-water nexus: the fortuitous tale of duckweed

by Kevin Sliman

For **Rachel Brennan**, associate professor of environmental engineering, water has long been important. How interesting that her upbringing in southern New Mexico and a tiny aquatic plant would influence her work in sustainability and the food-energy-water (FEW) nexus.

"I was raised in the desert southwest, and water is very precious there," Brennan said. "Groundwater was our main source of drinking water, and conservation was critical."

Her interest in water has led her to develop a University Strategic Initiative proposal that aims to rally the University community around a framework for solving global FEW challenges.

Brennan has worked on both groundwater remediation and surface water projects while at Penn State. She is also the director of Penn State's Eco-Machine, an ecological wastewater treatment facility that cleans water using diverse microorganisms, plants, and other aquatic life.

"I am not a wastewater person," she said, "but because most of my previous work focused on bioremediation, I thought if there is a biological way to remediate things such as pharmaceuticals, personal care products, and pesticides from wastewater, it would occur in a diverse ecosystem like the Eco-Machine."

As the Eco-Machine purified the wastewater, Brennan considered ways to salvage the aquatic plant biomass from the system and turn it into valuable products. She briefly contemplated making biofuels from the algae in the system, but discovered it was challenging to work with this environment. In fact, the algae had started to take over her research site.

"Some of our algae started to grow out of control," Brennan said. "It started to grow long filaments and clog things."

Enter the duckweed.

"For some reason, just fortuitously, this tiny plant showed up," said Brennan, who noted she doesn't know how the duckweed started to grow, but it flourished with no help from humans.

Historically, duckweed, an invasive species that is now on all continents but Antarctica, has been used as food, and for good reason. Duckweed is rich in protein, comparable to soybeans. It has all 10 essential amino acids, iron, iodine, and vitamin A, all of which are commonly deficient in the diets of malnourished people.

Duckweed is also used as fodder for livestock and fish in some communities.

And if it is not eaten, duckweed is an amazing fertilizer.

"The plant is a hyperaccumulator," said Brennan. "It sucks up nitrogen and phosphorus out of the water extremely well. When you put it in the soil, it takes a while for the duckweed to break down, so it acts like a slow-release fertilizer."

According to Brennan, many commercial chemical fertilizers can get washed away by rain — but not duckweed.

"We've done studies with it out in fields and in greenhouse tests, and we get comparable crop yields as conventional fertilizers but with much less nutrient runoff," Brennan said. "We are closing the loop by using duckweed to recover the nitrogen and phosphorus from a waste stream, and then we put it back into the soil."

Brennan's research group found that duckweed is an excellent fertilizer for grains like sorghum, and many types of vegetables. In fact, tomatoes love duckweed as a fertilizer, and growers can have multiple harvests of leafy greens, such as lettuce, with one application of duckweed.

Soil health is also improved by duckweed because of the plant's carbon content.

"Commercial chemical fertilizers don't contain organic carbon," Brennan said, "but the carbon in the duckweed stays in the soil for multiple seasons, enriching the quality of the soil and contributing to the overall health of the soil ecosystem."

To help with the original research, Brennan said she started collaborating with people who have expertise in plant science and soil microbiology. Now Brennan is also collaborating with experts in food science and science communication as her team looks to validate duckweed as a source of high-quality protein for meat and dairy animals, and eventually humans.

In addition to its uses as a food and fertilizer, duckweed is an exceptional candidate for biofuel.

"Duckweed changes its metabolism depending on the water quality in which it's grown," Brennan said. "If you grow it in very nutrient-rich waste, it synthesizes a lot of protein."

However, if the nutrients to build proteins are in very low amounts, the plant preferentially sequesters starch, which can be easily converted into biofuels such as ethanol and methane, and other commodity chemicals that are eco-friendly.

"For a biofuel to be cost-competitive, you have to be able to use every single component of a crop," said Brennan. "Even after we produce biofuels, there is a small amount of residual waste from duckweed left over, and that can be used as fertilizer or animal fodder."

This little plant may even be heading to space. Because the plant takes very little room to grow (just a couple of inches of water) and is plentiful (doubling every couple days), duckweed is ideal for space travel.

Penn State's Eco-Machine

"The plant could be used to purify the astronauts' air and wastewater," Brennan said. "Or it could be consumed or used as a fertilizer to help grow vegetables. Duckweed has already been tested in the Spacelab, and future experiments to test its ability to survive extended spaceflight missions are underway." ■

Advances in snow removal

by Pam Wertz

It is well known among the State College and Penn State communities that it takes a lot for University officials to shut the campus down after a major snowfall. In fact, since 2010, the University Park campus has been shut down just three full days due to snowfall.

Much to the chagrin of students – and likely some faculty and staff – the snow day at Penn State may just have become even more elusive, thanks to software developed by recent industrial engineering graduate **Achal Goel**.

Goel, who graduated with a master's degree in industrial engineering in May, came up with a user-friendly program that cuts snow removal time from the roadways and parking lots on the University Park campus while saving the University money in terms of costs associated with clearing the snow.

"Until now, snow-removal operations were done based on the snow-removal equipment that was available at the time and what had worked in the past," said Goel. "The process didn't involve any engineering tools or analytical skills so we wanted to create a software solution that uses real data and methodologies and can effectively decrease the time it takes to clear snow from campus."

The name of this software? Real-time Optimization for Adaptive Removal of Snow or ROARS, for short, which is fitting to be used at the home of the Nittany Lions.

Not only were his classmates and adviser, professor and director of the Service Enterprise Engineering Initiative (SEE 360) **Vittal Prabhu**, impressed. Goel's program also got the attention of Penn State President Eric Barron for the potential time and cost savings to the University.

"The development of this software by an engineering student can have a great deal of impact," said Barron. "Anything that we can do to make the snow removal operations more efficient and more effective will ultimately make our campus safer and that is our priority."

Vikas Dachepalli, another industrial engineering master's degree student, did some initial research with Goel on the project before Dachepalli graduated in December 2017.

The calculations within ROARS – which is run through an Excel-based worksheet – are based on the amount of snowfall in inches and the number of snow-removal vehicles the Office of the Physical Plant (OPP) has available to clear the roadways and parking lots at any given time. It also factors in the number of employees who are working during a given shift and the skill level of those employees.

The amount of time it takes the software to calculate all of the information in order to optimally allocate available equipment and personnel to plowing areas, and also determine the time it will take to clear the snow, is an astonishing 12 seconds.

OPP is the office that oversees snow removal at Penn State and has three different crews working at the same time to clear snow from roads and parking lots (which was the focus of this project), walkways on campus, and building entrances.

Nadine Davitt, supervisor of solid waste and labor operations with OPP, was an integral part in the project and was available to answer any questions Goel had about the snow-removal process at the University.

"Growing up in India and living there all of my life, this whole issue of snow and enough snow falling that it was a safety concern – as well as a concern for a university to operate as expected – was foreign to me," he said. "Nadine's immense knowledge and experience was instrumental in shaping this project."

Davitt is responsible for supervising the staff that removes snow from parking lots and campus roads.

"Our primary challenge with snow removal is getting the snow cleared so the University can open at the normal time while meeting the expectations of the campus community," she said. "This modeling software Achal developed takes into account the size of the areas to be plowed, any obstacles within that area, and the type and size of equipment that is needed to clear that area."

While ROARS was under development for much of last year's snow season, it was tested during the last snowfall experienced by the Central Pennsylvania region.

"I expect to use ROARS as a tool to assist in decision-making this year," said Davitt. "For the first time, we will be able to use real-time information to determine the start time and expected finish time to completely remove the snow, and will be ready to pair the right-sized equipment to the area being plowed."

If the forecast changes, the program can be run again to compensate for the variability of the forecasted snowfall amount versus the actual amount of precipitation that accumulates.

All of this allows the snow marshal, police services, and Penn State administrators to better determine if and when to delay or cancel campus operations based on solid data analysis.

Barron said that this type of student engagement fits perfectly into his Invent Penn State initiative.

"Invent Penn State is designed to enable students, faculty, and staff to take their ideas into the marketplace," he said. "It is wonderful to see a real student participating and solving real world problems. This not only sets him on a career path that is far better than classroom learning alone, it allows him to take the solution beyond the walls of Penn State and into the marketplace where it can improve service and make an impact on a much larger scale."

The project also landed Goel a full-time job for a consulting firm in Atlanta, which he started in May.

"I am so grateful that I had the opportunity to work on this real-world problem at Penn State," he said. "The courses I had in programming, supply chain engineering, and distributed systems and control all came together in solving this one problem that the campus faces every year.

"It is very exciting to have been able to help improve a tangible service for the community and to see the positive impact my education has had on the University." ■

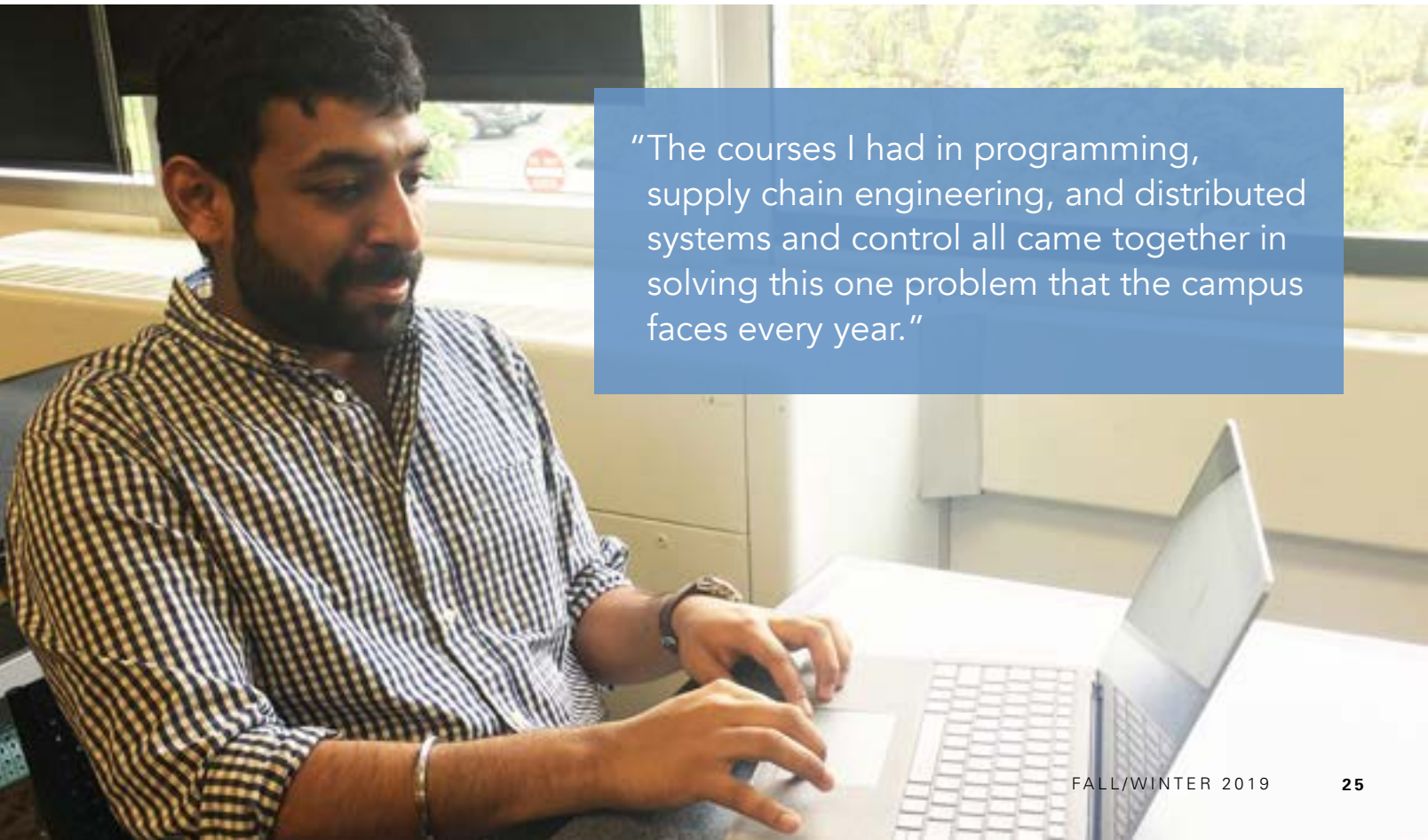


Photo credit: NASA/Bill Ingalls

Concrete in space

Investigating cement solidification in a microgravity environment

by Jennifer Matthews

"Be prepared." This famous mantra isn't just for the Boy Scouts of America. The need to build durable infrastructure on other planets is coming, and we must be ready. To prepare, Penn State researchers have been working with NASA to explore how cement solidifies in microgravity environments.

"It is no longer a question of if we will need to colonize other planets, but a question of when," said **Aleksandra Radlińska**, assistant professor of civil engineering at Penn State and principal investigator on the project. "Once we begin sending humans on missions to the Moon and Mars, we will have to provide them with safe environments to stay in for the duration of their mission."

Researchers have long been studying the reaction of cement when it mixes with water here on Earth; however, there are still questions remaining and little is known about how this process plays out in space, where there is little to no gravity. The goal of this research is to better understand the complex process of cement solidification when gravity is taken out of the equation.

"We're looking at how cement hydrates and how its microstructure develops over time," said Radlińska. "We want to know what grows inside cement-based concrete when there is no gravity driven phenomenon."

Microstructural development of concrete occurs in stages—when the cement is exposed to water and when the mixture undergoes the complex process of solidification. What happens during these stages leads to the development of elaborate combinations of amorphous and crystal phases. The shape, volume, and distribution of these determines the properties of the hardened material. This process is altered when gravity is minimized considerably, which changes the crystalline structure, and ultimately the material itself.

To learn more about how cement reacts in these environments, the researchers embarked on a two-phase study.

During the first phase, the team sent 120 pre-packaged samples to the International Space Station (ISS), a working science lab in space. Sample packets included two or three separated compartments containing cement and water, or cement, water, and alcohol (the latter was used to stop the hydration reaction at given time interval). While in orbit, an astronaut onboard the ISS was tasked with hydrating each sample by bursting the water packet into the cement packet and then halting the hydration at a given point using the alcohol for certain samples. This series of experiments varied the type of cement, the type of additives, the number of additives, the amount of water, and the length of time until the hydration was stopped. The samples were then returned to the Marshall Flight Center in Huntsville, Alabama and then transported to Penn State where they are currently being tested and characterized in detail.

During the second phase, the researchers sent 28 additional samples to the ISS. In this phase, the astronauts mixed the two-compartment samples as they did in the first phase but then used a centrifuge to simulate three gravity levels. These gravity levels included the Moon, Mars, and 0.7-g, which is in between the other two. This phase of the study will help the team determine the differences in the hydration reaction based on varying levels of gravity.

"All planets vary in their gravity levels," Radlińska said. "Mars is only one third of the Earth's gravity, but there is still some gravitational force."

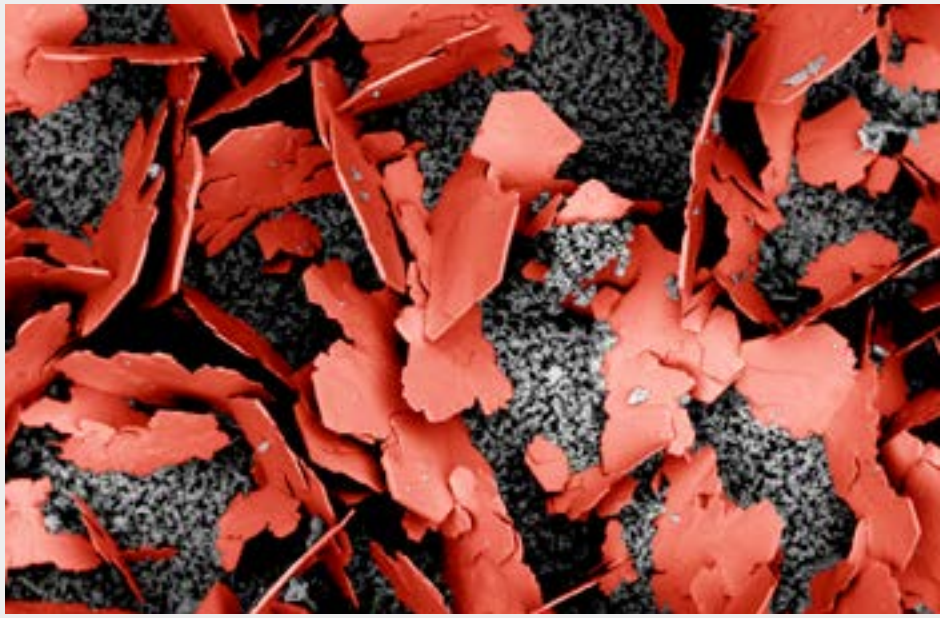
Once the results have been compiled, this research will be helpful in understanding how to use cement as a building material in space, but the knowledge gleaned will also be beneficial to improving Earth-based cement and concrete processing. Concrete is the single most widely used human-made material in the world, with global production reaching roughly 10 billion tons per year – and it has a carbon footprint to match. Even a slight improvement in the process could have huge implications on the sustainability of cement-based infrastructure.

"There is nearly a ton of carbon dioxide emitted into the atmosphere for each ton of cement produced," said Radlińska. "The more we understand those early stages of hydration, which we don't on Earth yet because it's a very complex process, the more we can improve it."

Once the team has a better understanding of the hydration process of traditional, Portland-based cement, it would like to begin testing the process using materials indigenous to Mars. Though direct samples are hard to come by, the team can recreate these materials based on the chemical composition of existing samples tested by the Mars rovers.

"That's why this research is so important," said Radlińska. "Once we've run the research in space, we know the principles, and we can further test the materials on Earth … The next stage of industrial development will be colonization of space and civil engineers will play a crucial role."

Researchers on this project include Richard Grugel, a materials scientist with NASA; ***Barry Scheetz****, professor of materials, civil, and nuclear engineering at Penn State;* ***Juliana Neves****, a doctoral student in civil engineering at Penn State, and* ***Peter Collins****, a graduate student in civil engineering at Penn State. Implementation partners for the space flight were Leidos and Techshot, Inc. Industry collaborators include BASF, Ipenex, and Sauereisen.* ■



This image, taken from a scanning electron microscope, shows false-colored portlandite (calcium hydroxide) crystals sitting on top of a C-S-H matrix, seen from the surface of a 3mm thick sample. The sample is hydrated tricalcium-silicate, which is the main compound of ordinary Portland cement. Photo: MSFC - EM31 Materials Diagnostics Lab

Visualizing vitals through video

by Samantha Chavanic

Researchers receive funding from the Bill and Melinda Gates Foundation to capture vital signs via video

As biometric systems – technologies which measure biological information to identify a person – continue to advance, their potential impact on health care capabilities surge. Via tools such as fingerprint recognition, face recognition, iris and retina recognition, and vein recognition, health care workers are provided with increasingly sophisticated ways to monitor patients.

Researchers from Penn State and Johns Hopkin University are working to develop additional capabilities by capturing vital signs of patients in resource-constrained environments with a device most Americans use every day – a cellphone camera.

Funded by an initial $100,000 pilot grant from the Bill and Melinda Gates Foundation, the project, "Non-Contact Estimation of Biomarkers in Resource-Constrained Environments," uses cellphone camera and computer vision techniques to capture patients' vital signs at distances of up to four feet away – a critical distance needed for highly contagious diseases like Ebola or tuberculosis.

Led by **Conrad Tucker**, associate professor of engineering design and industrial engineering at Penn State, the mobile application will register natural head and body movements, distinguish between different skin tones and lighting conditions, and capture vital signs such as an individual's pulse rate.

Collaborators at Johns Hopkins include Dr. William Checkley, associate professor of medicine and director of the Johns Hopkins Center for Global Non Communicable Diseases Research and Training, and his team of researchers. Jeffrey Gray, professor in the Department of Chemical and Biomolecular Engineering at Johns Hopkins, played an instrumental role in connecting the Penn State and Johns Hopkins teams.

"Our mobile-based application seeks to expand beyond a 'wellness app' classification by the FDA, to an FDA-approved tool that can be used by patients and health care officials for measuring vitals at a distance and in varying environments and populations all across the globe," Tucker said. "This pilot grant is a first step toward this goal, as it will enable the team to evaluate the technology that we've developed in real-world settings involving hardware, environmental, and societal constraints."

To test the proposed application in real-world situations, Tucker and doctoral student **Sakthi Prakash** traveled to India and Sierra Leone in December 2018 and will return in March 2019. Testing locations were selected due to the team's hands-on experience in these countries, along with the opportunity to engage with a diverse group of individuals to test in varying environmental conditions.

Penn State faculty members **Soundar Kumara**, Allen E. Pearce and Allen M. Pearce Professor of Industrial Engineering, and **M. Jeya Chandra**, professor emeritus in industrial engineering, have helped the team forge new collaborations in India. University of Illinois faculty member Paul McNamara, associate professor of agricultural and consumer economics, helped the team achieve similar collaborations through his established stakeholder network in Sierra Leone.

Initial findings will be presented to the Bill and Melinda Gates Foundation in early 2019. A return trip to India and Sierra Leone will take place in summer 2019 to collect additional data. Pilot results are expected to be released after the return trip.

"This will be an excellent opportunity to integrate user-centered design, concepts that form the foundation for many of the engineering design courses that are taught in SEDTAPP here at Penn State."

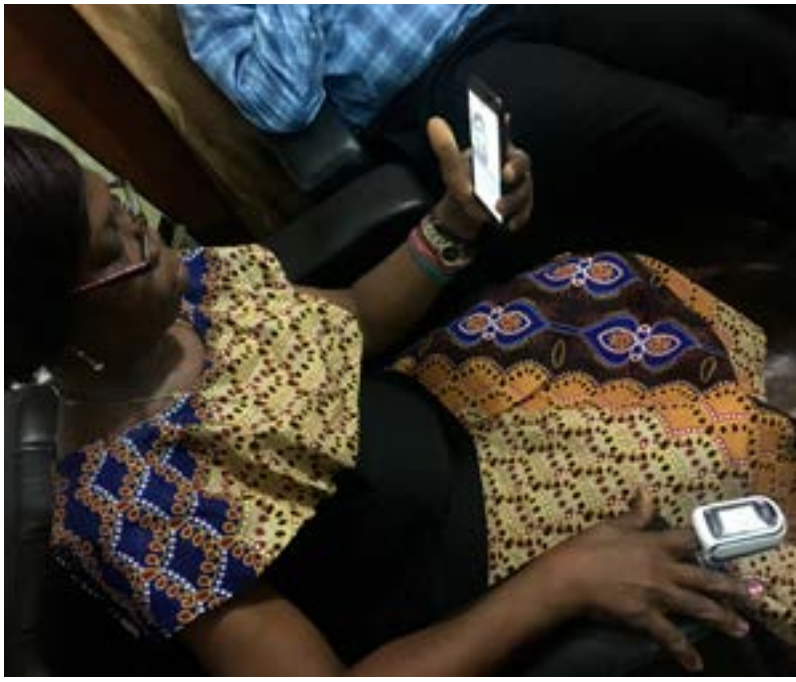
The team has tested the application's functionality on the Xiaomi Redmi 6 and the Samsung Galaxy J7 Prime, cellphones that are typically used in these countries, due to their relative affordability and availability in these areas.

"It's one thing to demonstrate the feasibility of an algorithm in a controlled environment in a research lab. It's another thing for technology to function as intended in the field, where researchers have less control of the human and environmental factors," Tucker said. "This will be an excellent opportunity to integrate user-centered design, concepts that form the foundation for many of the engineering design courses that are taught in SEDTAPP here at Penn State."

On November 26, Tucker traveled to the Bill and Melinda Gates Foundation headquarters in Seattle to meet with a program manager from the foundation and members of the team to demo the mobile app that the team has developed and to discuss the team's plan of action for their upcoming international travel.

To follow research efforts, findings, and method validation, visit www.videovitals.org. ■

During a recent trip to India, Prakash presents a prototype of the vital-capturing mobile application to local medical professionals.



In Sierra Leone, a woman compares her heart rate captured by the mobile application to a finger pulse oximeter and heart rate monitor's measurement.

NSF selects Penn State to establish, lead Center for Trustworthy Machine Learning

by Megan Lakatos

Patrick McDaniel, William L. Weiss Chair in Information and Communications Technology, Penn State College of Engineering, has been awarded a National Science Foundation (NSF) Frontier grant to establish and lead the Center for Trustworthy Machine Learning.

Awarded through the NSF's Secure and Trustworthy Cyberspace (SaTC) program, the five-year, $9,979,647 grant will allow members of the multi-institution, multi-disciplinary Center to develop a rigorous understanding of the security risks of the use of machine learning and to devise the tools, metrics, and methods to manage and mitigate security vulnerabilities.

"NSF's investments in SaTC are advancing knowledge to protect cyber systems from malicious behavior, while preserving privacy and promoting usability," said Jim Kurose, NSF's assistant director for Computer and Information Science and Engineering. "Our goal is to identify fundamentally new ways to design, build, and operate secure cyber systems at both the systems and application levels, protect critical infrastructure, and motivate and educate individuals about security and privacy."

Machine learning is fundamentally changing the way everyone lives and works. From autonomous vehicles, digital assistants like Amazon Alexa and Siri, to robotic manufacturing, computers are performing complex reasoning in ways considered science fiction just a decade ago.

While machine learning is very accurate when the machine is given expected inputs, it can be exposed to adversarial behavior, causing the systems built upon them to be fooled, evaded, and misled in ways that can have profound security implications. As more critical systems employ machine learning, such as financial systems, self-driving cars, and network monitoring tools, it is of vital importance to develop the rigorous scientific techniques needed to make machine learning more robust to attack.

"We seek to develop a new science of safe machine learning that will provide a basis for applying intelligent algorithms in new domains," explained McDaniel. "This science will ensure that these new technologies cannot be exploited in ways that will hurt the people who use them."

The Center, consisting of a broad cross-disciplinary group of researchers from many different fields in technology and math, includes Dan Boneh and Percy Liang, Stanford University; Kamalika Chaudhuri, University of California San Diego; David Evans, University of Virginia; Somesh Jha, University of Wisconsin; and Dawn Song, University of California Berkeley.

"The membership of this new Center consists of some of the most accomplished senior faculty as well as rising stars in security, machine learning, and statistics," said McDaniel. "Interaction across these communities will lead to new thinking and ultimately enable the Center to achieve its long-term vision of safer machine learning."

The Frontier project also consists of several planned outreach and education efforts, including a joint summer school for underrepresented students, graduate students, and researchers; a massive open online course (MOOC); an annual conference; webinars for She++, an organization dedicated to exposing high school girls to the magic of computer science; and outreach to policy makers.

"This project shows how Penn State has become one of the leading institutions in the world addressing cybersecurity and privacy," said McDaniel. "Our leadership also provides opportunities for faculty and students to have a major influence on how one of the most impactful technologies of our lifetime will be used. In so doing, Penn State is positioned to have substantial impacts on all of our digital futures."

"I am very proud to once again congratulate Patrick McDaniel on his leadership in building this new Center and securing the NSF funds for him and his outstanding team of collaborators to advance the security of our society," said Justin Schwartz, Harold and Inge Marcus Dean of Engineering. "Our mission at the Penn State College of Engineering is to impact the world though transformative research and education that enhances human life. The technologies of tomorrow are increasingly more dependent on secure information transfer between devices of all sorts; the research of Professor McDaniel and his collaborators is thus fundamental to the security of our future everyday lives." ■

Improving indoor air quality to increase health and well-being

by Samantha Chavanic

From homes, schools, and offices to hospitals, sporting venues, and buildings of worship, nearly 90 percent of the average American's time is spent indoors. Because a person is indoors for a significant portion of time each day, most of the air he or she inhales, including toxic particles, comes from within buildings.

Known as indoor air quality (IAQ), the air quality within buildings directly impacts the health and comfort of a structure's occupants. The importance of understanding how to better control IAQ and the pollutants associated with it continues to increase as health issues related to poor air quality continue to rise.

Donghyun Rim, assistant professor of architectural engineering, focuses his research on understanding the sources, distribution, and transportation of critical air pollutants in indoor environments. He examines pollutant dynamics around humans, nanoparticle generations from consumer products, low-cost indoor air quality sensing, and smart ventilation strategies that specifically focus on the interactions between building systems and occupant activities. Rim's research helps engineers, architects, and building scientists achieve healthy building design and operation.

"These days, we put significant efforts to build airtight buildings for improving energy-efficiency. Such airtight buildings, however, lead to accumulation of chemicals and synthetic products inside buildings, which in turn can cause indoor air quality problems that are detrimental for human health and well-being," Rim said. "My study results reveal pollutant dynamics in buildings and how to control hazardous air contaminants generated indoors or entered from [the] outdoors in energy efficient manners."

Through his IAQ research, Rim provides information on to how to reduce human exposure to indoor pollutants in critical facilities such as nursery schools, as well as effective ways of improving human health and productivity in residences and commercial buildings.

Due to the complex nature of buildings and human behavior, Rim often collaborates with colleagues in fields such as chemistry, electrical engineering, and medicine to produce meaningful research results aimed at improving health and well-being of building occupants. Currently, he is involved with a two-year research project funded by the Alfred P. Sloan Foundation in which he collaborates with a molecular physicist and chemists to develop comprehensive, integrated physical-chemical models. These models include a realistic representation of indoor chemical processes under influences of occupants, indoor activities, and building conditions.

Next, Rim hopes to conduct experiments at the MorningStar Solar Home, a 100-percent renewable energy powered home located on Penn State's University Park campus, to measure airborne nanoparticles associated with consumer products and human activities. Using these measurements, Rim hopes to develop a computer model for predicting physical, chemical, and transport characteristics of nanoparticles discharged from home appliances, personal care products, and cleaning agents under varied building conditions including cooling, heating, and mechanical fan operation.

"We tend to focus on monthly building energy bills, but unfortunately we don't get monthly health bills associated with poor indoor air quality," he said. "Indeed, we know very little information about how building conditions and human activities affect our exposure to outdoor-generated and indoor-generated contaminants in buildings." ■

CHALLENGE ACCEPTED:

Penn State chosen by Department of Energy to help modernize the nation's power grid

by Erin Cassidy Hendrick

In an effort to modernize and reimagine the United States' power grid, Penn State researchers have qualified for a highly selective, innovative competition sponsored by the Department of Energy.

The Penn State team of researchers, one of only ten universities chosen for the Grid Optimization (GO) Competition's first challenge, is being led by **Uday V. Shanbhag**, the Gary and Sheila Bello Chair and professor in the Harold and Inge Marcus Department of Industrial and Manufacturing Engineering.

"As the United States begins incorporating more renewable energy sources, there are some new and unique challenges that today's infrastructure simply can't handle," Shanbhag said.

Announced by the Advanced Research Projects Agency-Energy (ARPA-E) within the DOE, the competition challenges researchers from universities and national laboratories to solve the fundamental issues facing the electricity infrastructure, while addressing the concerns that widespread renewable energy sources will introduce in the future.

"With a network as large as the U.S. power grid, the optimization problems we need to solve are incredibly large and complex," Shanbhag said. Not only does every power generation facility, including wind, solar, coal, nuclear, and

"Providing for every contingency possible in a network like this, serving more than 65 million nodes, it's a large and nasty problem. And it is one that has to be solved every ten minutes." **– Uday V. Shanbhag**

hydroelectric sources, need to route their energy in a responsive, cost-conserving way, there are also an enormous number of contingencies that arise at a moment's notice.

With the first round of funding, the teams are being challenged to design algorithms that address the next generation of security-constrained optimal power flow (OPF), essentially finding ways to provide electricity more quickly, efficiently, safely, and reliably within the current grid. Distinct from past models, the new set of models are complicated by the need to model the flow of electricity, as governed by power flow equations, with much higher fidelity.

Using the mathematical principles of optimization, the software controlling the grid signals that a certain set of generators need to be ``dispatched'' to meet current demand. But if one of those generators fails, Shanbhag says, "Can the algorithm controlling the power grid take recourse and keep the lights on?"

"Providing for every contingency possible in a network like this, serving more than 65 million nodes, it's a large and nasty problem," Shanbhag explained. "And it is one that has to be solved every ten minutes."

Over the past few decades, the models used in the power grid have been adapted to handle these situations. "But in their expanded, nonlinear form, it is computationally challenging, so coarse approximations were used," Shanbhag said. "But now, it is essential to consider more accurate models that are complicated by size and uncertainty."

Between the sheer number of customers, the speed in which contingencies need to be solved, and the fluctuating nature of renewable energies like solar and wind power, the nation is ready for the next generation of power grid technology.

As researchers, innovating these solutions is a Herculean, but inspiring, challenge ahead of the team.

"There are many reasons why this is a daunting mathematical and computational challenge, and why Dr. Shanbhag's vision for computationally efficient solution methods could be a major game changer," said **Hosam Fathy**, the Bryant Early Career Professor of Mechanical Engineering. "If the Penn State team wins this competition, it will be an indication that we have made substantial strides in the stochastic grid optimization domain, thereby paving the way toward significant leaps in how the electric power grid is operated both now and in the future."

Their approach will focus on creating a method that is able to both scale appropriately with the size of the underlying optimization problem and address the underlying nonlinearity. The underlying code needs to be able to adapt instantaneously, while also conserving computing resources so the system doesn't become overburdened.

"With this mindset, the power grid will be able to better deal with the challenges expected to emerge in future power systems," said **Mort Webster**, professor of Energy and Mineral Engineering in the College of Earth and Mineral Sciences. Their project will also aim to develop the mathematical tools to enable a trustworthy infrastructure well into the future.

In the next phase of the competition, ARPA-E will provide each team with sample data from the power grid to test their algorithms. "We'll take this actual network information, apply our algorithms, and see how well we do!" Shanbhag said.

Participants that develop scalable schemes for finding minimum-cost solutions to these problems will advance to the next round.

Capitalizing on interdisciplinary strengths, a team has been assembled from the College of Engineering and the College of Earth and Mineral Sciences, and also comprises of **Nilanjan Ray Chaudhuri**, assistant professor of electrical engineering and computer science, **Fathy**, Chiara Lo Prete, assistant professor of energy economics, and **Minghui Zhu**, assistant professor of electrical engineering.

"Penn State has always been a global leader in energy systems research, but in order to maintain this leadership we need to join forces across different disciplines in order to build larger, cohesive teams in the energy area," said Fathy.

Collectively, the group has been curated to include experience with both the theoretical and applied principles surrounding sophisticated power systems, with a particular emphasis on addressing the new questions that renewable energy pose.

"The hope was to build a team at Penn State that is not just capable of solving today's energy problems, but also to establish a research infrastructure for the future of power systems and markets," Shanbhag said.

Given the University's pursuit to be at the forefront of a re-imagined energy infrastructure, this competition and team of researchers presents a critical turning point.

Fathy added, "This is an example of what Penn State's Energy University initiative is about: it is not about our individual successes within our individual research silos, but rather about how we come together to do something much bigger."

"By bringing these minds together, we believe that we have a chance to solve this problem," Shanbhag concluded. ■

Making an Impact

Microstructure Sensitive Ultrasound: Advancing Biomedical Additive Manufacturing

Fall 2018 Capstone Design Project Showcase

Inside the Additive Manufacturing Master's Program at Penn State

Thank you from the College of Engineering

Hard work pays off as the G-Chaser rocket launched with the help of EECS students

Adding layers to Penn State's Nittany Lion pride

Nanotechnology center to help broaden participation of minorities in STEM fields

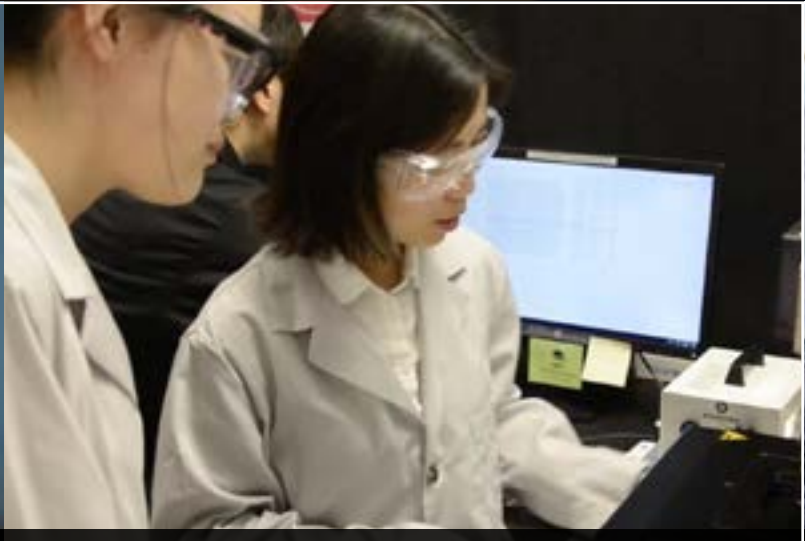
School of Electrical Engineering and Computer Science holds engineering camps for girls

Girls Coding the Future with Robots / Watch CSE video

Anything is POssible for Girls in Electrical Engineering (APOGEE) / Watch EE video

We Are: Introducing the new College brand

Penn State again most recognized in U.S. News' Best Online Programs



Raman enhancement through 2D materials (RE2D)

2018 Leonhard Center Celebration of Educational Innovation

2018 College of Engineering Endowment Dinner

College of Engineering Launch Party

Students build bridge to give access to food, education in isolated Bolivia

by Alexandra Kohr

B2P team on bridge. (Front Row: Jules Kadien, Samantha Devens, and Stefany Baron. Middle row: SJ Roh, Megan Smajda, and Joshua Killian. Back row: Jack Blarr and Christopher Biesecker)

After six months of fundraising and planning efforts, the Penn State chapter of Bridges to Prosperity (B2P) traded in their summer vacation for an adventure to Machacamarca, Bolivia to build a suspended pedestrian foot bridge for an isolated farming town.

"When a community becomes unable to cross a river, its people often become extremely isolated and lose access to the nearby schools, hospitals, and markets," said project manager **Stefany Baron**, a recent graduate in civil engineering. "The goal of our project is to reduce poverty caused by rural isolation by means of a pedestrian bridge."

The project began six months before the team of eight arrived in Machacamarca, with the selection of a project manager, design manager, and travel team. Then the bridge site was assigned to the group in mid-January.

"For this project, a standard design was not sufficient, so we used an iterative process to change certain parts of the bridge – such as the size of the ramps and the number of tiers – until we met the required factor of safety," said design manager **Josh Killian**, senior in civil engineering.

To raise funds for materials and travel costs, they hosted local restaurant fundraisers, apparel sales, a crowdfunding campaign, and a 5K race.

The team then left for Bolivia in mid-May. Once there, on their way to Machacamarca, the team was greeted with blizzard-like conditions that made traveling narrow mountain roads at night difficult.

Then the 12,000-foot altitude of the town left the team fatigued and short of breath.

On the last day, the team gathered with community members for a celebratory feast. Each team member was given a full bowl of potatoes. Pictured: Jules Kadien and Christopher Biesecker

The team members painted all of the metal for the bridge (the rebar, crossbeams, and fencing) using a combination of diesel fuel and paint in order to preserve the metal from rust. They used red, yellow, and green paint because those are the colors of the Bolivian flag.

Furthermore, materials had to be carried in by hand as the path was impassible by trucks. This meant that mixing concrete, bending rebar, and transporting wood and steel all had to done by hand.

"This project was a little more physically challenging," said Baron, who has participated in two other B2P trips. "There are days when the cold, exhaustion, and craving for a nice pizza can start to feel overwhelming, but this can all be overcome by reminding each other that, at the end of the day, this is still an amazing experience where we are making a real impact."

In total, the finished bridge was approximately 45 meters long and 1 meter wide.

Not only did the team come back with valuable engineering skills, but they also returned with a renewed sense of camaraderie, leadership, and a deeper worldview.

"As I got more involved, I realized we were a group of students with many majors who share a passion for serving others around the world and are willing to make some sacrifices to do it," said Killian. "There are a lot of big dreamers in our club, and I love pursuing such worthwhile goals with them." ■

Engineering to benefit humanity

by Erin Cassidy Hendrick

Tak-Sing Wong (left) and Birgitt Boschitsch (right) collaborate in the Wong Laboratory for Nature Inspired Engineering

Birgitt Boschitsch has earned many titles – mechanical engineer, Penn State doctoral student, bourgeoning entrepreneur. But no matter how she's using her talents, she always remembers why she pursued engineering.

"Day-to-day, I get to work on interesting technological problems," she said. "But there's also a long term societal impact that engineers can have, which is ultimately solving problems for people around the world."

Through her research, Boschitsch hopes that she can make an impact far beyond the walls of the Penn State Department of Mechanical Engineering.

Having received a prestigious National Science Foundation Graduate Research Fellowship, she is already tenaciously pursuing this goal.

Her research, housed in the Wong Laboratory for Nature Inspired Engineering, has been focused on creating innovative membranes. "Conventional membranes allow small particles to pass through and large ones to stay behind, like a sieve," she said. "But I've been developing a membrane that does the opposite."

"It's a reverse filter," she explained. "Anytime you want to have small particles retained and large objects pass through, that's a solution that we don't have right now."

Her adviser, Tak-Sing Wong, the Wormley Family Early Career Professor, said of her work, "It's truly mind-blowing, and it will enable a number of applications that were previously unachievable using conventional filtration mechanisms."

Although the applications are endless, Boschitsch is particularly interested in applying this technology to solve problems that developing regions face every day. "One billion people in the world still openly defecate. There are a lot of reasons for this, but one is because latrines smell bad," she said.

But if these facilities were equipped with her technology, it would allow human waste to reach the toilet while trapping the small odor particles within. "This could help address problems related to foul odors," she said.

Another could be in surgery in developing nations. Without access to clean operating rooms, surgeons may be wary of performing surgery due to a higher possibility of contamination. However, by applying this membrane onto an area where someone is receiving medical treatments, Boschitsch said, "A liquid membrane could allow medical devices to pass through while keeping contamination out. With further development our membranes could be a valuable tool in medical applications such as surgery."

Wong believes she has the potential to make a significant impact. "Her drive to make the world a better place will guide her to create new technological innovations that will impact people's lives," he said.

Never losing sight of those goals, Boschitsch always keeps the impacts of engineering forefront in her mind. "As engineers, we often only focus on figuring what to make and how to make it," she said. "But I'd encourage all engineers to also figure out why we're making it." ■

Robotic wheelchair maps out path for mechanical engineer

by Erin Cassidy Hendrick

Kelilah Wolkowicz tests the robotic wheelchair she helped build with the Intelligent Vehicles and Systems Group.

Kelilah Wolkowicz, a graduate student studying mechanical engineering, found her path at a young age. After successfully battling a brain tumor at age 11, she asked herself, "What do you do with the life you've been given back?"

"I wanted to do something to help people."

Mechanical engineering provided that avenue, as a way to build and implement technologies to alleviate struggles that people face every day. Specifically, within the Intelligent Vehicles and Systems Group, a multidisciplinary lab in the College of Engineering, Wolkowicz helped create a robotic wheelchair.

RE-THINKING THE WHEELCHAIR FROM THE GROUND UP

With an estimated three million people in the United States relying on wheelchairs, the need for advanced technology is apparent. When designing the robotic wheelchair, Wolkowicz and other researchers carefully considered how to assist people with diverse conditions and lifestyles, including amyotrophic lateral sclerosis (ALS), Parkinson's, or others with mobility issues.

"I'm hoping to improve the quality of life for them," she said. "We don't want a person to adapt to a wheelchair that exists; we want to create a wheelchair that adapts to the person."

The team's robotic wheelchair is outfitted with sensors, such as ultrasonics that are incorporated to automatically detect and avoid obstacles.

But they didn't stop there. By using lasers that collect and analyze environmental information, the wheelchair can effectively create a map. "This could help people with Alzheimer's, who can then easily find their way if they've gotten lost," she said.

Wolkowicz's research uses a novel approach to create this 'indoor GPS'. By measuring ambient magnetic fields, the wheelchair detects the spatial non-uniformities due to differences between all devices that have metal, like refrigerators and computers, in addition to constructional materials used within the walls and floor of a structure. Using that data, the wheelchair can pinpoint its location in a room within a few millimeters.

She said, "It works because every room is slightly different – even small differences in construction leads to unique magnetic fields."

But Wolkowicz hoped to make operating a wheelchair less taxing. "I'm trying to reduce the user input and exertion into the wheelchair," she explained. "The downside of using a wheelchair is the person has to constantly command it."

However, most people have a daily routine in familiar locations, like in a home or office. By enabling the wheelchair to map these locations and follow frequently used paths, the user's need to 'drive' the wheelchair can be reduced by 73 percent.

In the future, the Group plans to enable the wheelchair to measure brain activity using electroencephalogram (EEG) sensors, a breakthrough that could be extremely beneficial for users with limited mobility, including advanced ALS patients. By pioneering ways for a person's brain to communicate directly with a device, the need for physical control lessens.

The next steps for the project will be refining the user inputs, particularly those from brain activity. "It's the most difficult input to measure, so classifying those signals would be the next steps for the undergraduate and graduate students who work on this project after me," she said.

MAPPING A PATH FOR THE FUTURE

The potential impacts for the wheelchair will only grow with time, as the demand for wheelchairs will likely increase for the baby boomer population. "There will definitely be more of a need for smart wheelchairs," she explained. "There are so many 'smart' products being introduced and I believe a wheelchair will be an important one."

The interdisciplinary nature and emphasis on collaboration within the University is one Wolkowicz credits with deepening her research. Particularly in working with her advisers, Sean Brennan, professor of mechanical engineering, Jason Moore, associate professor of mechanical engineering, and Bruce Gluckman, the associate director of the Penn State Center for Neural Engineering, as well as Andrew Geronimo, assistant professor in the College of Medicine, whose expertise helped shape the project.

Fusing mechanical, electrical, neural, and biomedical engineering with computer science, Wolkowicz said, "It's a unique aspect that really added to the complexity of the wheelchair."

With her newly minted doctorate in mechanical engineering, Wolkowicz is poised to pioneer tech that has tangible impacts. "This is what I went to graduate school for," she said. "I just really want to help people, especially in the medical field." ■

Perspective is EVERYTHING

by Sarah Small

Penn State football player and engineering student John Reid, Jr. finds success in viewing adversity as opportunity

Like most computer science and engineering seniors, **John Reid, Jr.** had an academically rigorous fall semester, balancing four 400-level courses immediately after his summer internship with Intel while keeping his eye on ambitious but attainable post-graduation plans. Unlike most engineering students, Reid couldn't count on weekends for extra time to get ahead on course work; for him, Saturdays were gamedays.

Most students might find the dual demands of a Division I sport and a challenging major to be too much, but Reid, a cornerback on the Penn State football team and a data science major in the School of Electrical Engineering and Computer Science, sees a natural connection between the two.

"In football, you can work really hard at something and put a lot of time in and improve. And I feel like it's the same with computer science," said Reid. "They kind of play off each other because the same type of discipline and hard work you need to have for football is the same type of discipline and hard work you need to have with data science. And you kind of need to increase it."

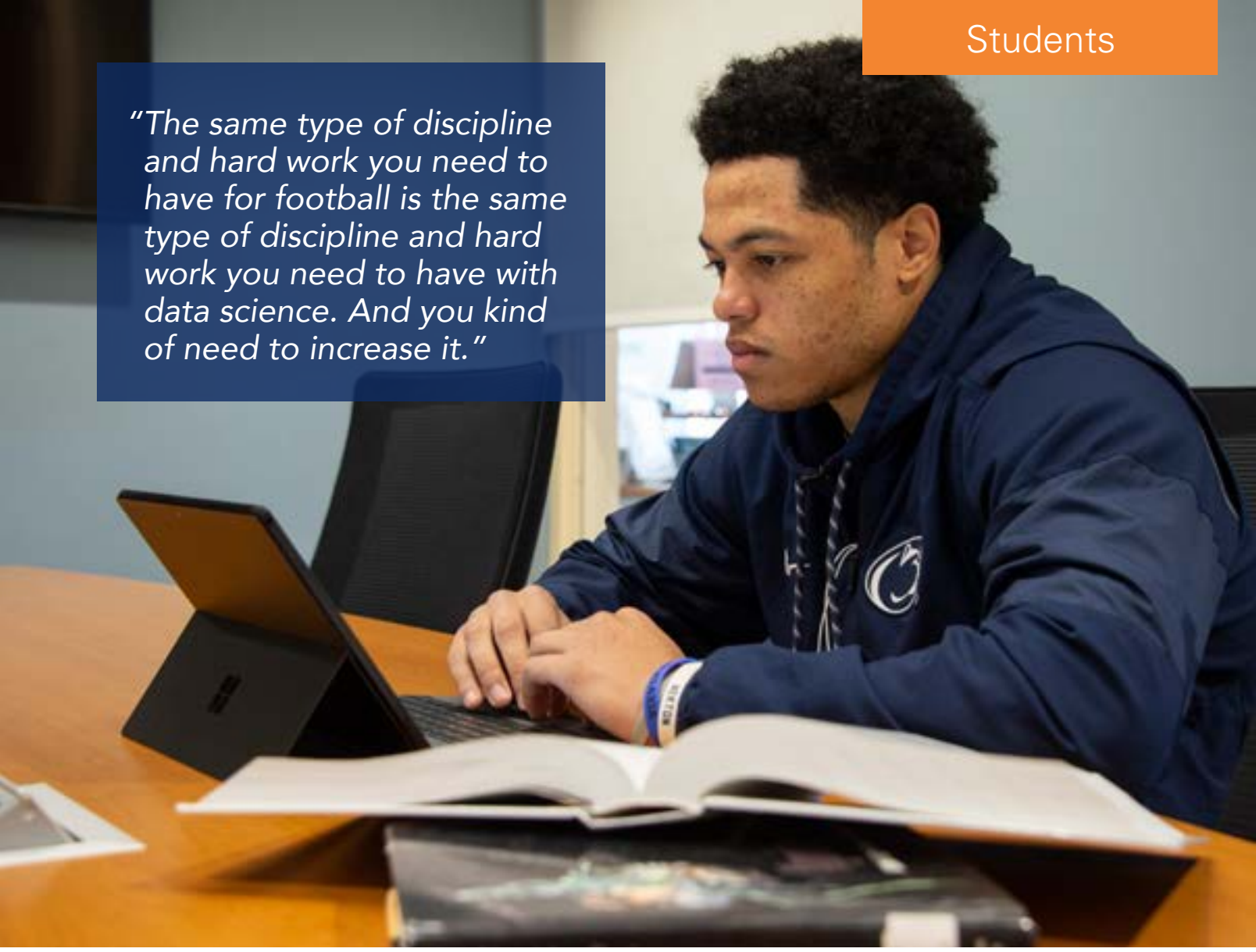
According to Reid, playing college football while taking on a computer science major was a path he has been on for a long time. Reid played basketball, football, and track all through high school at St. Joseph's Prep in Philadelphia, earning numerous accolades for his athletic performance, particularly in football. Then, during his junior year, his high school offered a computer science course, which he took, and he's been hooked ever since.

In fact, learning how to code in the classroom wasn't enough for Reid; he decided to build his own computer by himself.

"I'm kind of competitive in everything I do, and I needed a powerful computer for gaming. But I didn't want to just buy a regular computer. I wanted to make my own. So I kind of spent two years or so getting the money together, and getting different computer parts, and then my junior or senior year, I finally put it all together and built it, and I've kind of been updating it every summer."

This ability to push himself has led to multiple opportunities, including a spot in Penn State's Summer Research Opportunities Program (SROP) and

Photo credit: Penn State Athletics



an internship in Oregon with Intel. While he has known for years that he wanted to be in the field of computer science, these experiences helped him refine his track more specifically.

"My computer science classes and SROP got me really interested in the machine learning side of everything. I still wanted to program a lot, and I wanted to keep all my comp-sci classes, but I wanted to pick up more statistics classes so I could understand a lot better what was going on in the background of machine learning," said Reid. "When they offered [a data science major within computer science and engineering], it kind of seemed like one of the best options to do that."

Despite his impressive success to date, it hasn't always been an easy journey.

"I'm one of the first people in my family to go to college so I didn't know what to expect. So I thought, 'I'm going to go into computer science, so I'm going to take computer science classes. I don't need calculus, or physics.'" It didn't take long for Reid realize this was not the case. "The beginning of my college career was just trying to play catchup with everyone else. My freshman year I felt so behind."

Reid credits his work ethic, confidence, and dedication to the subject and the sport for getting him through adversity.

"You have to really want to do it, to the point where you're passionate about it. You've got to be ready to sacrifice because like, for me, I give up a lot of time to be able to do both [football and engineering], and I want to do both," said Reid.

He also acknowledged that Penn State provided him with opportunities needed to succeed, saying that it enabled him to play football at a high level while enrolled in a competitive engineering program. He added that the large Penn State community was also appealing to him.

"Everywhere you go, there are people from Penn State, and I think just always having that big network is important."

After graduation, Reid will be able to count himself among the ranks of successful Penn State alumni, although where exactly is yet to be determined. He hopes to play football at the next level, and after that to do something in the field of software engineering. Wherever the future takes him, the attitude that has helped him through his college career as an athlete and a student surely will lead to continued success.

"Since there aren't many football players in engineering, I feel like if I do well here, I can make an impact, and that is a way to separate myself in a good way. I see it as an opportunity, not as a negative. Perspective is everything." ■

Kelsie McElroy named 2018 Google Women Techmakers Scholar

by Megan Lakatos

Kelsie McElroy, a junior majoring in computer science in the School of Electrical Engineering and Computer Science, has been named a 2018 Google Women Techmakers Scholar for her advocacy for gender equality in the field of computer science and for serving as a leader and role model for others.

"Kelsie is an outstanding student and a role model for anyone considering a career in computer science. Her first-hand experience of competing (and succeeding) in an environment with few women provides her with a great perspective on how to break down barriers," **John Hannan**, associate department head of the Department of Computer Science and Engineering and associate professor of computer science and engineering, said.

The Women Techmakers Scholars Program consists of an academic scholarship, awarded based on academic performance, leadership, and impact on the community of women in tech; a retreat that connects fellow scholars and Google mentors, while participating in professional and personal development trainings and workshops; and an online network with fellow scholars program participants designed to share resources, support the global community of women in tech, and collaborate on projects to make continued impact.

The scholarship, given to 20 women across North America each year, provides funding for McElroy to implement outreach initiatives within the Department of Computer Science and Engineering.

"I want to look at how we can keep women in the field, specifically those who are later in their high school career and are going off to college, because that's often the timeframe where people get lost," McElroy said.

"I want to look at how we can keep women in the field, specifically those who are later in their high school career and are going off to college, because that's often the timeframe where people get lost."

At Penn State, McElroy is currently the co-executive director for HackPSU, a 24-hour event where approximately 800 students from Penn State and other universities across the nation develop technology to solve real-world problems by working with industry leaders and collaborating with peers.

"One of my goals for the upcoming year is to bring more diversity to HackPSU," McElroy said. "We have a great support system here at Penn State – we have a lot of companies who know our name, they come to the event and want to recruit students – but smaller schools may not have that privilege, which may make it harder for minority students to find internships because their school is lacking such resources. Through this scholarship, I'm hoping to bring these students to the event and do some talks on building them up and empowering them, which are the types of talks that I received at the retreat that really helped me."

Throughout the fall semester, McElroy worked diligently, collaborating with faculty in the Department of Computer Science and Engineering to make the most out of her scholarship.

"I am happy to see that the department cares so much about this initiative, and I have their support, because whatever I can do with outreach, I want to make sure it can be sustained long term," McElroy said. ■

Undergrad student research suggests biomass can remove lead from drinking water

by Jeff Mulhollem

When Penn State student **Katelyn Schiffer** got an email notice from her landlord a few years ago warning that she and her apartment mates should not drink water from their unit's taps unless it was filtered to remove lead, the sophomore agricultural and biological engineering major started thinking about the problem.

Shortly after, when she met with a faculty adviser who specializes in biomass energy production and utilization about developing a research project, she decided what she wanted to do – experiment with biomass plant material to learn whether it would be effective in absorbing lead in water.

From that unusual beginning has grown a research project that will train at least three undergraduate students in research and laboratory procedures and promises to advance the science of removing contaminants from water.

Researchers in the College of Agricultural Sciences the last few years have been studying the ability of biomass to absorb industrial spills, according to **Dan Ciolkosz**, assistant research professor of agricultural and biological engineering.

"We believe it's a good idea to use renewable materials for cleaning up spills, and we think a lot of companies will be interested in that concept," Ciolkosz said. "So, when Katelyn came to us and wanted to do research and happened to mention the situation with water at her apartment, it turned out to be the germ of an idea that led to her research project — to see if biomass can not only absorb spilled material, but maybe even clean it up in the process."

Researchers have learned that torrifying biomass – essentially roasting it at temperatures approaching 400 degrees F for an hour or more – and grinding the material into small particles both boost its capacity to absorb contaminants. So Ciolkosz taught Schiffer how to torrify shrub willow branches in an oven in the bioconversion laboratory, and also grinding techniques using equipment in a barn at the edge of campus. They used screens to collect various particle sizes to compare.

Schiffer demonstrated that shrub willow, torrified and ground into very fine particles was very effective at removing lead from water, and she presented a research poster to the American Society of Agricultural and Biological Engineers documenting the findings.

The next year, Jenny Desplat, a biorenewable systems major from River Edge, New Jersey, essentially replicated and extended Schiffer's experiments using miscanthus, a robust, warm season grass. It, too, absorbed lead at an impressive rate, and Desplat also presented a research poster at an American Society of Agricultural and Biological Engineers gathering.

Ciolkosz pointed out that he intends to have a third undergraduate student do some final experiments in this line of research investigating biomass absorption of lead from water, and then have the three students' work combined into an article for publication in a peer-reviewed journal.

The students might not be aware of it, but researchers in Penn State's Department of Agricultural and Biological Engineering are on the cutting edge of research to make biomass more capable of absorbing contaminants, Ciolkosz said.

"While lead is a common problem in terms of water quality, many other contaminants exist that we might be able to deal with using specially prepared biomass as a renewable, sustainable cleanup material," he noted.

Some types of biomass may be better than others at absorbing contaminants, Ciolkosz said, partly because of their varying amounts of lignin, a complex organic polymer deposited in the cell walls of many plants, especially woody biomass from trees and shrubs. However, more research similar to the project started by Schiffer is needed to know for sure.

Photo credit: Michael Houtz, College of Agricultural Sciences ■

Novel endoscopy tool could open new doors for pancreatic cancer treatment

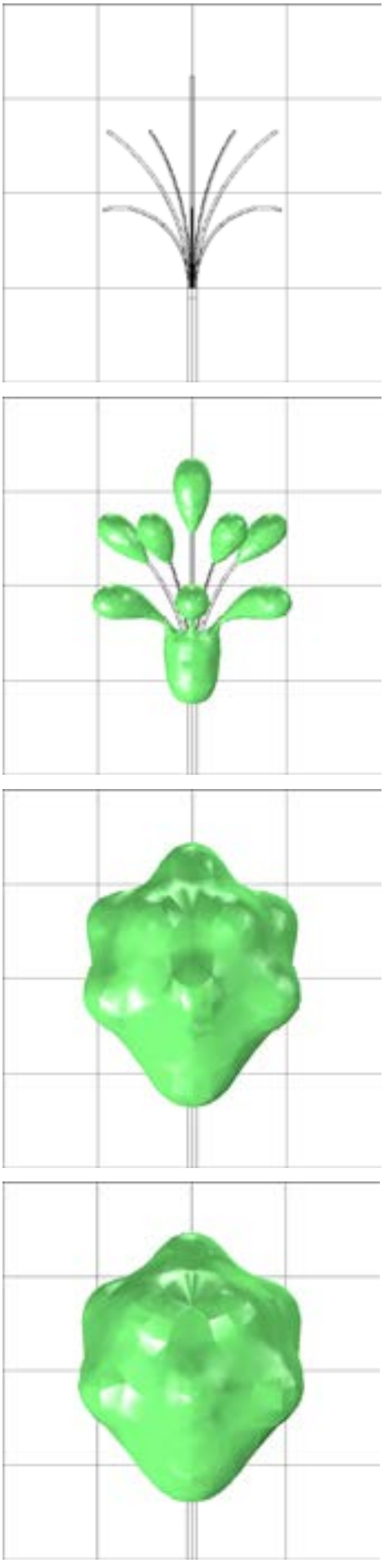
by Erin Cassidy Hendrick

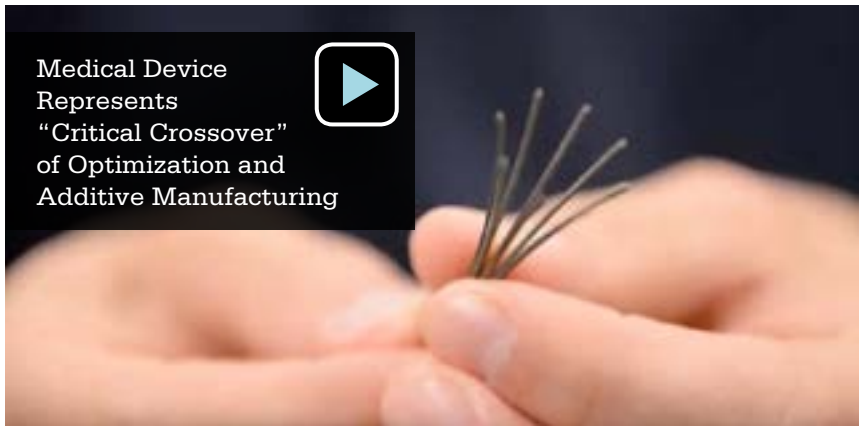
A new endoscopy tool, created in the Penn State Department of Mechanical Engineering, could one day provide a more effective, minimally invasive treatment for pancreatic tumors.

On average, only about 20 percent of pancreatic cancer patients are eligible for a surgical removal of the tumor, the currently most-effective treatment option. The location of the pancreas in the abdomen and the difficulty to detect the disease make it one of the most difficult to treat.

In an attempt to change that prognosis, **Brad Hanks**, a doctoral student studying mechanical engineering, created a new type of electrode to be used in endoscopic radiofrequency ablation (RFA) procedures. His work will be presented at the upcoming 2019 Design of Medical Devices Conference in Minneapolis, Minnesota.

A minimally invasive procedure, RFA is conducted by inserting an electrode into the abdomen and administering high-frequency energy that heats the tumor and as a result, neutralizes the cancer cells. While the RFA treatment itself is well-established and effective, the current endoscopic tools that exist to perform this procedure are "one size fits all," rather than customized to each tumor.





A standard RFA electrode produces an elliptical ablation zone, while most tumors are approximately spherical. Since the RFA treatment zone doesn't usually match the shape of the tumor, the untreated remnants can continue the spread of the disease.

"It's like trying to fit a square peg in a round hole," Hanks said. "Without a surgical tool to match the shape of the tumor, the effectiveness of the treatment can be severely limited."

However, by harnessing finite element analysis and evolutionary algorithms, he designed an electrode that deploys, spreading electrode "fingers" that could produce an ablation zone that is better matched to a specific tumor's shape.

Though the electrode itself may not be able to completely eradicate the tumor, the method could provide additional benefits to on-going treatment.

Currently, gold beads called fiducials are often inserted in another procedure to provide guidance for radiation treatments. Marking the edges of the tumor through X-rays, the fiducials provide a clearer outline for targeting and eradicating the tumor. The custom electrode, designed to detach and stay in the tumor, could provide a similar purpose, according to Hanks.

In collaboration with Matthew Moyer, a physician at the Penn State Hershey Medical Cancer, Hanks became interested in the concept of creating innovative endoscopic tools.

"I seriously considered becoming a doctor while I was earning my bachelor's degree," he said. "But I also like the building and designing aspect of engineering – being able to blend the two fields is so exciting to me."

Moyer approached the researchers with the initial idea to create more effective endoscopy tools and he presented the idea of the electrode as a fiducial substitute.

The product is currently being refined and tested at Actuated Medical, Inc., a company based in Bellefonte, Pennsylvania that develops next-generation FDA-compliant medical devices.

Mary Frecker, professor of mechanical engineering and Hanks' adviser, said, "We are very pleased to partner with Actuated Medical, Inc. to develop this device. Their expertise in manufacturing of medical devices is a great compliment to the modeling and optimization work that we are developing at Penn State."

"We help support the company with simulations and experiments and having a partner in industry has been a great experience," Hanks said. "I'm hopeful that patients will one day be able to benefit."

There is an on-going partnership with Penn State and Actuated Medical in the development of the device.

This project was initially funded by a National Science Foundation Emerging Frontiers in Research and Innovation grant. The researchers later partnered with Actuated Medical on a Small Business Innovation Research grant to begin testing. ■

Side view of a treatment zone simulation for a 12-tine deployable endoscopic RFA electrode, optimized for a 2.5 cm spherical tumor.

Fall 2018 ExecutiveXcellence Speaker Series featured College of Engineering alumni Dan Heller and Stanley Kocon

Dan Heller (left), vice president of Engineering & Technology, Lockheed Martin Rotary and Mission Systems (RMS), and **Stanley Kocon** (right), president and CEO of Voith Hydro Inc., North America, visited Penn State University Park on September 25 and October 23, respectively, as part of the College of Engineering's ExecutiveXcellence Speaker Series.

The ExecutiveXcellence Speaker Series was created to not only give engineering students and faculty a firsthand opportunity to hear from successful executives in the industry, but to also create awareness in the industry for Penn State's wealth of expertise in areas of interest to them.

In addition to talking about their respective company and industry, Heller and Kocon each shared insight on how to have a successful career in engineering. Heller encouraged students to find their passion. "I love being an engineer. It's the only thing I ever wanted to be," he said. "If you love engineering and you're working in an industry you're passionate about, you'll be able to power through the times when you get frustrated."

Other important advice he shared is to commit to continuous learning, have a work-life balance, and master your communication skills, among many others.

"In the end, the governor of your career that will have the biggest impact on how far you go will be how good of a communicator you are," he said. "Brevity, clarity, and being able to explain complex issues in a short period of time is an incredibly valuable skill."

Heller ended his presentation by saying ethics matter. "How you treat people is really important, especially how you treat people that can't do anything for you," he said. "Treat them with the same level of respect that you would treat your boss. Trust me; people pay attention to how you treat others."

Kocon shared, "The more you prepare yourself and dominate what you're doing now, the more the opportunities will open up in front of you like you've never imaged. You'll go through ups and downs in your career but never give up, stay focused, make the most of the motivation you get from those around you and use it to push you forward."

After his talk, Kocon presented certificates to the first group of students awarded with a Voith Women in Engineering scholarship—annual $25,000 scholarships created by Voith and given to Department of Mechanical Engineering students who live near the company's York County facilities and are enrolled in Penn State College of Engineering's Women in Engineering Program.

Heller received a bachelor's degree in electrical engineering from Penn State and a M.B.A. from Pepperdine University. Kocon earned both bachelor and master degrees in aerospace engineering from Penn State.

FROM YOUR PRESIDENT

It's a great time to get involved with the Penn State Engineering Alumni Society!

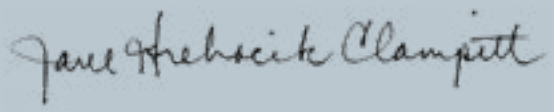
This past June I took the gavel to proudly serve as your new president of the Penn State Engineering Alumni Society (PSEAS), and **Casey Moore** ('89 BS CE) was elected as vice president. It is such an honor to be representing all of our engineering alumni. The PSEAS Board and I would like to hear from you and, more importantly, have you get involved with the exciting and important work we are doing for our alma mater.

Our aim is to support the College of Engineering by better engaging alumni, and fostering interactions among alumni, students, faculty, and industry. Supporting the College, for us, means finding ways for alumni to demonstrate and promote the ways that Penn State engineers inspire change in the world through our creativity and know-how. Wherever our career paths have taken us, we are impacting a better tomorrow by involving ourselves in our communities with family, friends, and the institutions where we give our time.

As an alumni society, we have organized ourselves by forming two new committees to help elevate our support of the College and Dean **Justin Schwartz**'s vision, and our Board is looking for the ideas and involvement of our alumni. Our Strategic Messaging Committee is working on sharing more information about what is happening in and around the College of Engineering in a way that inspires as many of our engineering alumni as possible to get and stay involved with the University and give back to the College of Engineering through time, talent, and treasure. Our Alumni Engagement Committee is working to better identify and resource activities that we hope more of our alumni will want to participate in, contribute to, and engage with.

Our Board of Directors, Casey and I hope to meet and hear from as many engineering alumni as possible by way of social media, our website, email, and upcoming activities. Please look out for our messages, share your reactions and ideas, and get involved in whatever ways are interesting and convenient for you. We appreciate your continued support of the College and our alumni society and hope you will find ways to volunteer your time to the important and exciting things that we are trying to accomplish through our society's strategic plan, and the mission and vision of the College of Engineering.

We are … Penn State engineers and we can do so much!



Jane Hrehocik Clampitt, '79 BS ChE
President, Penn State Engineering Alumni Society
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THE PENN STATE ENGINEERING ALUMNI SOCIETY

Building an active, engaged community of engineering alumni since 1959

The alumni society provides:

- Membership in a worldwide network of almost 100,000 engineering alumni.
- Fellowship among engineering alumni, faculty, staff, and students.
- Volunteer and service opportunities on campus and in your own community.

We want to hear from you! **Visit PSEAS** on the web to submit your latest news and to learn more about becoming a member.

FOR MORE INFORMATION, CONTACT:

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Events and Volunteer Engagement
101 Hammond, University Park, PA 16802
814-863-3384 | ext120@engr.psu.edu

PennState
College of Engineering

The Pennsylvania State University
101 Hammond Building
University Park, PA 16802-1400

Calendar of Events

Feb. 15-17	Interfraternity Council/Panhellenic Dance Marathon
Feb. 17-23	Engineers Week
Feb. 22	Penn State Engineering Alumni Society Board Meeting
Mar. 3-9	Spring Break
Mar. 12-14	Industrial and Professional Advisory Council Meeting

Apr. 7-8	Outstanding Engineering Alumni Awards
Apr. 12-14	Blue-White Weekend
Apr. 25	College of Engineering Design Showcase
May 3-5	Spring Commencement
May 31	Penn State Engineering Alumni Society Board Meeting
May 31-Jun. 2	We Are Weekend