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VILLANOVA ENGINEERING UPDATE
spring 2019

Dr. Robert Traver, recipient of the 2019 EWRI Lifetime Achievement Award

Recognizing a Lifetime of Achievement in Water Resources Engineering

Villanova University's Robert Traver, PhD, PE, D.WRE, F.EWRI, F.ASCE, the Edward A. Daylor Chair in Civil Engineering and director of the Villanova Center for Resilient Water Systems, advanced his already distinguished career with the 2019 Environmental and Water Resources Institute Lifetime Achievement Award. Presented to a member of the American Society of Civil Engineers, this award recognizes a life-long commitment to environmental or water resources engineering through public service, research or education.

With internationally recognized expertise in urban stormwater management and widespread engagement in related disciplines, Dr. Traver has distinguished himself as a registered professional engineer, fellow of the ASCE and EWRI, and diplomate of the American Academy of Water Resources Engineers, which he served as president. Dr. Traver's D.WRE board certification is the highest advanced certification for professional engineers dedicated to the water resources engineering profession.

The EWRI Lifetime Achievement Award is just one among many of Dr. Traver's academic and professional honors, which include:

- Villanova University's 2016 Outstanding Faculty Research Award, which recognizes tenured full professors with national and international scholarly reputations in their fields
- The ASCE's 2014 William H. Wisely American Civil Engineer Award "for his leadership of ASCE's Task Committee on Flood Safety Policies and Practices." Dr. Traver also edited the committee's report, "Flood Risk Management: Call for a National Strategy."
- Serving as a member of the National Research Council committee that authored "Urban Stormwater Management in the United States" (2009)
- The Outstanding Civilian Service Medal in 2007, the third highest honor the Department of the Army can award a civilian, from the commanding general of the Unites States Corps of Engineers for his work on ASCE's External Review Panel of the Corps investigation of Hurricane Katrina

Dr. Traver remains active in the field, serving as an associate editor of the *Journal of Sustainable Water in the Built Environment*, which he helped to create, and leading a number of research projects. In September 2018, he and Civil and Environmental Engineering Professor Bridget Wadzuk, PhD, visited China where Dr. Traver delivered a keynote speech at the first International Sponge City Conference.

In response to his latest award, Dr. Traver says: "I am honored by this recognition from my peers in the water resources community. I am also grateful for the past and future support of Villanova University, my faculty colleagues, and, of course, our students. Service to and care for the community are our guiding principles as we work to solve our future water challenges."

Message From the Interim Dean

The Finneran Pavilion provided a first-class backdrop to another exciting basketball season. The new dorms on Lancaster Avenue, The Commons, will be fully occupied and open for the fall 2019 semester. The performing arts center is going up at breakneck speed. Mendel Field's redesign should be complete this summer. And then there is the addition to the Center for Engineering Education and Research; at minimum, CEER will double in size.

At its December meeting, the Villanova University Board of Trustees approved a $6 million design spend to get us ready to break ground and build, build. Since then, we have hired an architecture and design team. There are now spray-painted lines, colored flags and surveyors all around CEER. We have gathered the student population's needs and wants. Faculty have thought long and hard about the best way to educate engineers and the spaces we need to accomplish this. Research teams have identified the labs, computational facilities and infrastructure required to help solve some of the world's most critical and complex problems. I am excited to say that we are now in full swing in designing a new home for the Villanova Engineering community.

This addition will be the largest factor influencing the College of Engineering for the next 25 years or more. The pressure to get this right is intense, but the payoff is immeasurable. While the expansion will not change the core of who we are or what we do—engineering for humanity and the natural world—it will allow us to be more innovative, solve more problems, attract the best faculty and students, develop new teaching techniques, engage more students in research, have more tinker and innovation spaces, establish spaces for collaboration, and ultimately, better prepare engineers who will serve the global community.

I am nervous, excited and humbled to help lead this process and I can't wait to share designs with you in the coming months. Here's to the future of Villanova Engineering!

Dr. Randy D. Weinstein
Interim Dean of Engineering
Associate Vice Provost for Teaching and Learning
Professor of Chemical Engineering, Villanova University

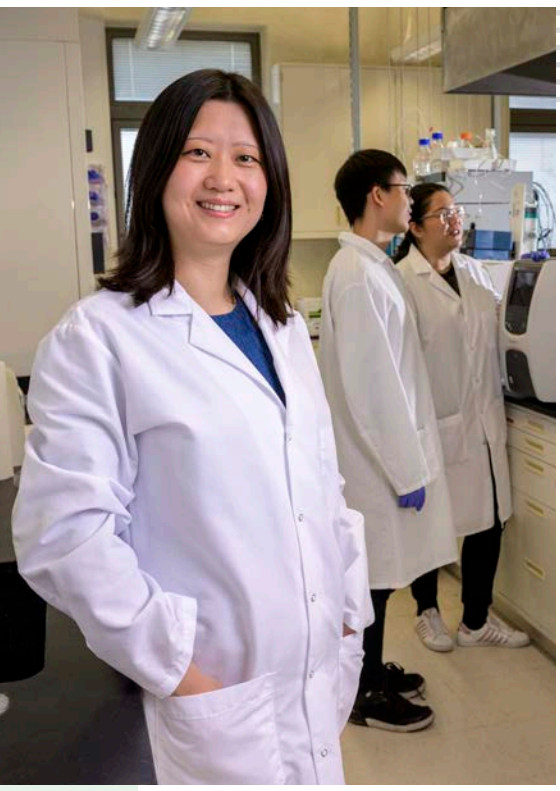
College Will Compete for Best and Brightest With Honors Degree

Each year, Villanova University's most academically talented and ambitious students enter the Honors Program. Through this selective program, they can take Honors classes to fulfill many of their core and major requirements. While Honors students in the College of Engineering have historically taken part in its seminars and electives, earned the Honors minor, and participated in its activities, they have not been able to earn an Honors degree—until now. The anticipated 25-30 Honors students in the class of 2023 will be the first to have that opportunity.

Andrea Welker, PhD, associate dean of Academic Affairs, explains how offering the Honors degree program provides an advantage for the College. "The need for this program was identified during our strategic planning process. Allowing our students to fully participate in the University Honors program will enable us to better engage our highest achieving students and makes us more competitive for the best and brightest."

To earn the degree, 10 Honors classes are required, four of which must be in engineering. Students will work with their advisor within the Honors program, as well as their academic advisor from the College, to develop a plan of study. Dr. Welker notes that all Honors students in engineering begin their experience with an Honors section of EGR 1200, the freshman engineering course.

Thomas Smith, PhD, Anne Quinn Welsh Director of the University Honors Program, says: "Honors seeks leaders who display sharp, critical intelligence; a passion for service; and a broad range of intellectual interests. It will be wonderful to have engineering students even more engaged in the program through this new degree opportunity."



Dr. Wenqing Xu, assistant professor of Civil and Environmental Engineering, has secured a Department of Defense research grant to address explosive residuals.

Faculty Awarded $1.46M to Address Explosive Residuals at Military Sites

As an early career STEM researcher, how do you top a $500,000 National Science Foundation CAREER grant? If you're Villanova University's Wenqing Xu, PhD, you earn a $1.46 million project award from the Department of Defense. In one year's time, this assistant professor of Civil and Environmental Engineering has secured funding that most faculty only dream of. In January 2019, Dr. Xu learned that she and a multi-institutional team of researchers had received a Strategic Environmental Research and Development Program grant for "Optimizing Carbon Amendments that Simultaneously Adsorb and Transform Legacy and Insensitive High Explosives." More simply stated, Dr. Xu and her team are pursuing an innovative means of addressing explosive residuals at military training sites.

"The DoD is replacing legacy explosives, like TNT, with new insensitive high explosives (IHE) whose compounds are less sensitive to shock and safer to transport," explains Dr. Xu. The downside, however, is that many IHE are highly water-soluble and can easily migrate from soil to water, representing a significant source of contamination to ground and surface waters at DoD ranges. Therefore, there is a pressing need to maximize the sorption of explosives, minimize their transport from DoD sites and promote their decay whenever possible. An expert in pyrogenic carbonaceous matter (PCM), Dr. Xu says, "The central objective is to design and optimize PCM in ways that facilitate these objectives." This project will first identify structural features of both the residues and the carbons that will facilitate hydrolysis, and then develop tailored carbons that will accelerate it. Gaining a fundamental understanding of this novel surface process has the potential to transform the field of explosive remediation.

While Dr. Xu is serving as lead principal investigator on the three-year project, she acknowledges the unique set of skills that her co-investigators bring to the table. Creating the synergy that will contribute to the team's success are Joseph Pignatello, PhD, of the Connecticut Agricultural Experiment Station; Paul Tratnyek, PhD, of Oregon Health & Science University; Eric Bylaska, PhD, of the Department of Energy's Pacific Northwest National Laboratory; and Samuel Beal, PhD, of the U.S. Army Corps of Engineers. Given their individual specialties, the project will involve both experimental and computational research. In addition to the multi-institutional team, the project will support one Villanova PhD student, a post-doc and a number of the College's undergraduates—presenting students with an exciting opportunity to contribute to real-world research.

If all goes according to plan, the solution will be an optimized PCM that is inexpensive and easy to deploy as a soil amendment on DoD ranges, maximizing the sorption/degradation of legacy explosives and IHE, minimizing their transport, and mitigating their harmful impact on the environment.

In 2018, Dr. Wenqing Xu was awarded the NSF CAREER grant for "Transforming the Synergistic Interactions between Pyrogenic Carbonaceous Matter (PCM) and Sulfur Species into Solutions for Contaminant Detoxification." Less than a year later, she was named co-PI on a $101,153 Renmatix, Inc. research grant, led by Civil and Environmental Engineering colleague Dr. Metin Duran. The 2019 DoD grant is Dr. Xu's third funding award in just 12 months.

Transforming Wastewater Treatment

Villanova University Civil and Environmental Engineering Professor Metin Duran, PhD, is an expert in the field of environmental microbiology and biotechnology. His specific interests lie in the areas of public health microbiology and biological processes for waste management. Recently, Dr. Duran was awarded a $101,153 research grant from Renmatix, Inc., a Philadelphia-area biotechnology company that specializes in the science of renewable materials. For this 18-month project, Dr. Duran is teaming up with visiting research fellow Lara Pelaz Perez, PhD, and Assistant Professor Wenqing Xu, PhD, a biochar expert also in the Department of Civil and Environmental Engineering. Their objective is the development of an anammox-biochar system for one step, sustainable and cost-effective nitrogen removal and phosphorus recovery from wastewater.

The federal government mandates the removal of organic matter from wastewater. However, it does not require the removal of phosphorus and nitrogen compounds, which are found in industrial waste, runoff from agricultural land and wastewater. These compounds are a major concern in reservoirs, lakes and coastal waters where they stimulate algae growth, which depletes oxygen levels and releases toxins that are harmful to aquatic life, the environment and humans. Dr. Duran explains, "While the best-case scenario is to prevent nitrogen and phosphorus from reaching our water supplies in the first place, a more manageable, short-term objective is to remove them from wastewater, which increasing numbers of states are requiring."

Current technologies for nitrogen removal from wastewater rely on nitrifying and denitrifying bacteria in a two-stage process that is highly energy intensive and costly. Phosphorus, which is also removed in the process, is a non-renewable resource, and U.S. reserves are barely enough to satisfy the nation's needs until 2045. Therefore, there is a need to develop effective and energy efficient nutrient removal processes that allow collection and reuse of phosphorus to better integrate food-energy-water systems.

Drs. Duran and Xu's proposed bioreactor combines the redox capabilities and sorptive properties of biochar with the unique ability of anammox bacteria for a single step oxidation of ammonium ion (NH_4^+) to nitrogen gas (N_2). The proposed research has the potential to:

- Develop a sustainable nutrient removal/recovery technology and thereby mitigate nutrient pollution in water environments
- Reduce energy demand for nitrogen removal from wastewater by up to 75%
- Facilitate phosphorus recovery for subsequent use as fertilizers
- Recycle spent biochar as a soil amendment for food crops
- Reduce emissions of nitrous oxide, a greenhouse gas that is 310 times more potent than CO_2, by 90%

"The challenge," says Dr. Duran, "is that annamox bacteria grow very slowly and require a significant amount of engineering to grow in substantial numbers." It took nearly two years, but he and Dr. Xu have finally been successful in growing a measurable amount in the lab, which Dr. Duran hopes will lead to additional funding through the National Science Foundation. He adds: "We've invested so much time and energy on this research with no idea if it would go anywhere. The fact that we have seen results is very exciting."

Dr. Metin Duran, professor of Civil and Environmental Engineering, and visiting research fellow Dr. Lara Pelaz Perez are investigating sustainable and cost-effective wastewater treatment methods.

Exploring Solutions to Reduce Carbon Footprints of Data Centers

Villanova University's College of Engineering is part of a National Science Foundation Industry/University Cooperative Research Center for Energy-Smart Electronic Systems (ES2), partnering with Binghamton University and the University of Texas at Arlington to develop methodologies, tools and systems to maximize energy efficiency for the design and operation of data centers.

A high growth and energy-intensive sector of the U.S. economy, data centers are responsible for 2.8% of total U.S. energy consumption. Worldwide, they use about 30 billion watts of electricity, roughly equivalent to the output of 30 nuclear power plants.

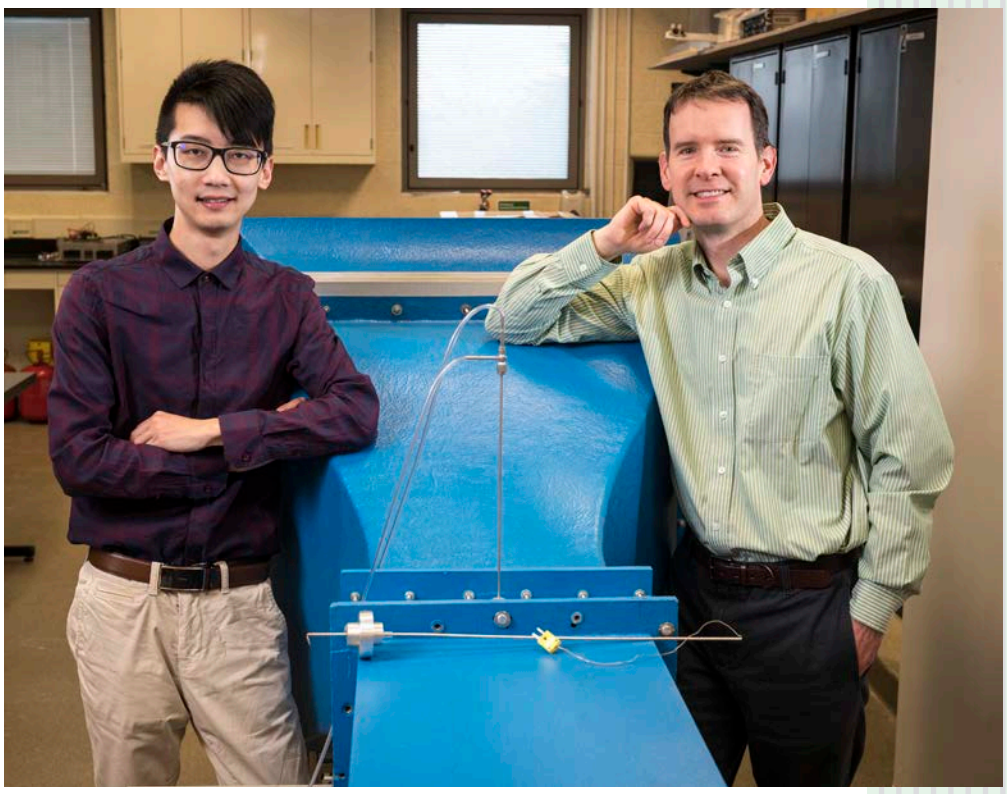
As consumers of such large amounts of electricity and energy, the data center industry is starting to pay more attention to its carbon footprint. The industry has adopted a metric called carbon usage effectiveness, or CUE, that dictates the amount of greenhouse gas emissions generated in a data center based on the electricity used for the computing equipment.

Villanova's ES2 research group is currently exploring the balance of economics, location and environmental burden on data centers to develop strategies for minimizing CUE as much as possible. Their end goal is a set of recommendations that would provide economic and environmental benefits for the industry, potentially reducing the carbon footprint of data centers nationally by a significant margin.

Given their demands for significant amounts of power, there are calls for the development of new electric power plants near—or even next to—where large data centers are proposed. The location chosen for construction then would determine an associated required growth of electric power generation, meaning that various regional policies and available resources would dictate the type of new power plants that would be developed.

These new power plants could have an influence on the carbon footprints of the data centers, since it essentially would be equivalent to that associated with the approach used for additional power generation in the municipality. For example, designing a large data center in a region that relies primarily on coal-based electric generation would result in a larger carbon footprint than a region that has a power generation portfolio largely based in nuclear energy and renewables. This assumes that the data center owners choose to supply electricity in the most economically advantageous way, as opposed to paying more for electricity from renewable energy sources. Fortunately, the location does not have a critical impact on performance for many data center applications, meaning that there is much flexibility in where the data center could be built.

"Data center owners are starting to look at CUE as a factor in data center design to mitigate any negative public perception of new data center construction," says Aaron Wemhoff, PhD, associate professor of Mechanical Engineering and director of Villanova's ES2 site. "If they can show that the CUE for their proposed center is lower than the industry average, it may garner public support."



PhD student Li Chen and Dr. Aaron Wemhoff, professor and director of Villanova's ES2 center, are exploring methods to reduce data centers' carbon footprints.

CUE is difficult to calculate in general, Dr. Wemhoff notes, so the most straightforward approach is to base an estimate on the anticipated data center power needs and to look at the municipal electric generation portfolio, which is available for each state through the federal government's Energy Information Administration. According to this database, Vermont, Washington, South Dakota and Idaho provide the lowest carbon energy production in the nation.

The Villanova research team is also examining the economic factors that play a role in the strategy used to lower a data center's CUE. The two most direct ways to do so, Dr. Wemhoff says, are by locating the data center in a low-carbon municipality or by purchasing more expensive power from zero-carbon sources. Another way to lower CUE is to provide on-site alternative energy sources such as solar photovoltaics or wind energy production, and a fourth approach is to reduce the data center's overall power needs through a variety of cooling technologies, such as taking advantage of a cold climate to remove the heat from the center. Villanova researchers believe that a combination of these methods can significantly reduce CUE without causing large economic burden.

In Memoriam: Dr. Edward Kresch

The College of Engineering mourns the passing of Dr. Edward Kresch on January 29, 2019. An associate professor of Electrical and Computer Engineering, Dr. Kresch had been a faculty member since 1981, teaching courses in the Fundamentals of Computer Engineering, Analog Electronics, and Electronics and Applications. He was an active member of Villanova's Faculty Congress, formerly serving as treasurer.

Dr. Kresch earned his bachelor's and master's degrees in Electrical Engineering from Massachusetts Institute of Technology, and his PhD from the University of Pennsylvania. His expertise lay in the areas of computer programming, microprocessors and microcomputer design; combinational and sequential circuits; computer architecture; and biomedical engineering. For more than 20 years he served as a consultant at Lafayette Hill Medical Center, where he organized and managed research projects involving spinal conduction of nerve signals in human patients using the technique known as somato-sensory evoked potentials.

Dr. Kresch is survived by his wife Gloria, daughter Barbara and son Andrew. Donations in his memory may be made to organizations supporting climate change issues or Temple Sholom in Broomall, Pennsylvania.

Industry Veterans Bring Insight and Experience to Chemical Engineering

Charles Coe, PhD, Associate Research Professor

Previous Title/Employer: Senior Research Associate—Materials Characterization, and Strategic Technologist, Air Products

Expertise: 30-plus years in the development of catalysts and adsorbents, during which he produced 38 U.S. patents and 37 peer-reviewed journal publications

Villanova Courses: Alternative Energy, Energy Storage Systems, Chemical Engineering Economics

"At Villanova, I'm fulfilling my passion for alternative energy by enabling students—through teaching and research opportunities—to work in sustainable engineering."

Dr. Coe develops and teaches alternative energy courses at both the undergraduate and graduate level, but, as an associate research professor, one of his main contributions is guiding students on how to do research and advising them so they can make significant progress. He involves them in his work, which includes improving the thermal chemical conversion of biomass, using sorbents to capture carbon dioxide, and producing industrial gases with molecular sieves.

Students Say:

"Conducting research with Dr. Coe provided exposure to new technologies and experimental techniques, which proved helpful during my job search." —*Grant Kester '19 ChE*

"Dr. Coe's industrial experience comes with a great sense of knowing what is realistic and brings access to industry research projects, expanded networking opportunities and, most importantly, his management skills. Dr. Coe is my mentor; he pushes me hard, but always has a sense of reality and work/life balance." —*Anthony Vallace, PhD candidate*

Scott Jackson, PhD, Visiting Assistant Professor

Previous Title/Employer: Senior Research Fellow, DuPont

Expertise: 30-plus years in chemical engineering, including 14 years in enhanced oil recovery technologies

Villanova Courses: Petroleum Engineering, Heat Transfer, Process Design

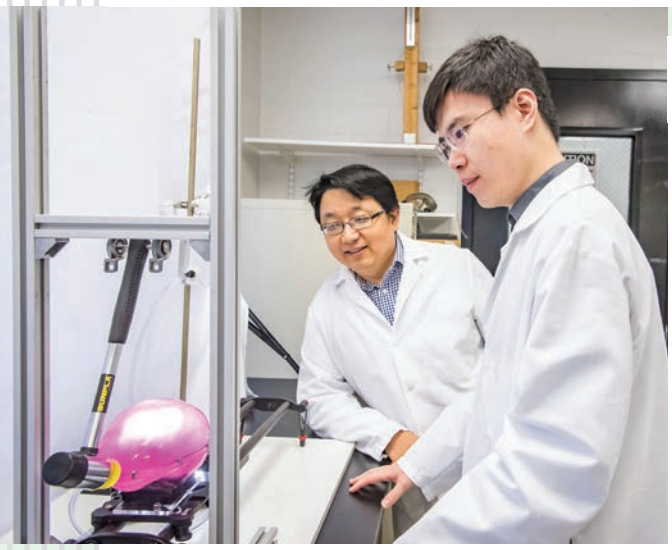
"I tell students, 'Don't settle for simply getting the right answer. Make sure you understand the underlying principles and the big picture that brings you to the right answer.'"

Dr. Jackson's teaching reflects his industry experience—projects and problems that he faced personally—which provides students with a window into the real world. He enjoys providing his perspectives on industry and career choices and happily offers related advice. For example, a discussion about OOIP— "original oil in place"—led to a conversation about people who will try to exert power by using acronyms. "I told them to stay on top of acronyms and don't be afraid to ask what they mean when someone starts to throw one around."

Students Say:

"Dr. Jackson engages, challenges and inspires his students. He brings abstract concepts to life with personal accounts of his time in the field and facilitates innovation and creativity by encouraging students' development of unique ideas." —*Luke Nowlan '19 ChE*

"I had a technical interview that I was super nervous about. Dr. Jackson sat down with me for a couple hours and talked about every possible thing that related to the job I wanted. His advice, work experience and passion for helping students are incredible. Villanova professors like Dr. Jackson make me grateful to be a student here." —*Kate Salva '19 ChE*



With a patented biomimetic model of the brain, PhD student Ji Lang is working with Associate Professor Dr. Qianhong Wu to quantify the motion of brain matter during impact.

Newly Patented Smart Brain Presents Ground-breaking Opportunities to Study Brain Biomechanics

Villanova University's Qianhong Wu, PhD, associate professor of Mechanical Engineering and director of the Cellular Biomechanics and Sports Science Laboratory, has been awarded a patent for his biomimetic model of the brain and skull. Mimicking the human head, Dr. Wu's "smart brain" allows researchers to quantify the motion of brain matter during exposure to impact. Designed with retired Villanova Associate Professor Kei-Peng Jen, PhD; department laboratory manager Chris Townend; and Associate Professor of Engineering Rungun Nathan, PhD, of Penn State Berks, this multi-disciplinary project integrates computational, theoretical and experimental approaches and involves the fields of fluid mechanics, materials science and manufacturing—Dr. Wu's specialties.

Impacts to the head during athletic play are commonly identified as the cause of concussion injury. Repetitive head impacts, even those with no acute symptoms or signs, have been suggested as a possible cause of chronic brain injury. At present, most of the studies on this topic focus on the statistics of brain injuries in relation to various head impacts. Dr. Wu explains, "There has been no quantified research that relates the head impacts to the motion of the brain matter inside the skull, and thus the fundamental mechanism of the brain injury related to head impacts is not clear." His invention is providing scientists and engineers with never before seen access to the brain's response to impact.

With a model consisting of a transparent skull, brain matter, supporting structure and cerebrospinal fluid, as well as full instrumentation, including high speed cameras, accelerometers and displacement sensors, Dr. Wu's smart brain enables the motion of the brain matter to be tracked and captured. Most importantly, his model allows for varied frequencies, locations and magnitudes of impact—as well as repetition—to better reflect real-life scenarios. In addition, multiple pressure sensors record the pressure generation inside the interstitial fluid, which Dr. Wu believes is one of the major factors that determine the brain matter motion, as well as the damping effects (that which reduces the vibrations caused by impact).

Excited about the possibilities for his patented model, Dr. Wu says, "The proposed study, to our knowledge, is the first of its kind and will have very broad impact in both brain biomechanics and helmet design."

The Chemical Engineering Department is home to a cadre of industry veterans who bring an invaluable insider's view to the topics they teach. These experienced professionals are having a profound impact in the classroom and the lab.

Kenneth Leffew, PhD, Adjunct Professor

Previous Title/Employer: DuPont Fellow (highest level of technical distinction)
Expertise: 30-plus years in polymerization, polymer processing and advanced process control
Villanova Courses: Process Design, Polymer Science

"The students appreciate the fact that I bring real-world experience to the answers to their questions."

Dr. Leffew rewrote the curricula for both Villanova courses that he teaches. He presents students with actual projects and problems that he's worked on, several of which resulted in commercial products. Those real-world, practical examples—for which he's personally discovered the traps, mistakes and solutions—keep students engaged, and allow them to compare their results to verified outcomes. He describes it as "having 20/20 vision in reverse."

Students Say:

"Dr. Leffew brings an incredible amount of industry experience and insight to his classes, which gives us a fundamentally stronger understanding of why the material we are learning matters." —*Noah Seng DeLong '21 ChE*

"Dr. Leffew wanted to make sure that we walked out of every class having learned something new. Because he brought the industry to the classroom, I firmly believe that I am prepared for a future career." —*Maria Lorusso '20 ChE*

"I took polymer science with Dr. Leffew and he had a lot to say about the meaning behind many of the important variables. He also always emphasized the value of a work-life balance and, after 30 years in the industry, he emphasized the importance of doing what you love." —*Sarah Settlecowski '20 ChE*

Peter Staffeld, PhD, PE, F.NSPE, Assistant Teaching Professor

Previous Titles/Employers: Engineering Consultant; Vice President, Polymer Dynamics; Mobil Oil
Expertise: Process and product development in petroleum, plastics and specialty chemicals
Villanova Courses: Technical Communications, Mass Transfer, Equipment Design & Specifications

"I draw a direct connection between theory and practice by helping students to see the relationships between what they are learning and what they will be doing as chemical engineers."

Recognizing that most Villanova chemical engineering graduates will enter industry, and knowing first-hand what will be expected of them, Dr. Staffeld helps prepare students to "hit the ground running." This not only helps their professional reputations, but also strengthens Villanova's reputation as a high-quality supplier of chemical engineers for industry.

Former Students Say:

"When I started working, having the knowledge and experiences from Dr. Staffeld's class gave me confidence when I was solving real technical problems for the first time." —*Julie Bellfy '11 ChE, Improvement Engineer, Dow Chemical*

"Dr. Staffeld's constant professionalism, experience and commitment to his students' success outside of the walls of White Hall are an irreplaceable aspect of Villanova's undergraduate Chemical Engineering program." —*Ryan Flynn '15 ChE, '18 MSBChE, Engineering Specialist, Merck & Co.*

"From engineering composition skills and resume writing to a commitment to accuracy in statistics, Dr. Staffeld develops in his students highly marketable qualities that industry professionals look for when hiring." —*PhD candidate Brooks Hopkins '12 ChE, Manager, Pilot Campuses, Mars Wrigley Confectionery*

Industry Partnerships Provide Students with Real-World Experience

Since 2005, the recently named Richard K. Faris '69 CE, '70 MSCE Structural Engineering Teaching and Research Laboratory has been providing Villanova's Civil Engineering students with opportunities for real-world research in a space equipped with full-scale and component-size infrastructure elements. In a facility that Civil and Environmental Engineering Associate Professor Eric Musselman, PhD, describes as "particularly impressive for a school of Villanova's size," undergraduates and graduate students have worked on industry-sponsored projects ranging from the testing of steel-frame, multi-story residential building construction for Girder-Slab Technologies to current testing on shear resistance of wood frame shear walls for the residential structural engineering firm Mulhern & Kulp.

With the growing desire for buildings that invite greater natural light through larger windows and doors, there is increasing concern for accurately quantifying the resistance of wood walls subjected to hurricanes and earthquakes. "Limited data exists," says Dr. Musselman, who notes that Villanova's structures lab—with its two-story strong wall, test frames and hydraulic actuators—enables testing based on a worst-case scenario.

Throughout the first year of the three-year research partnership, PhD student Mohammad Fard-Sanei; master's students Remington Barrer, Bryan Seitz and Ryan Schnabel; and two undergraduates have fabricated and modified the structures, determined the boundaries, and established the test setup, including mounting instrumentation and developing models for data analysis. With the test results, they will work with Mulhern & Kulp to modify current design practices.

Villanova's Civil Engineering connections with Mulhern & Kulp: Dana Flood '15, '19 MSCE; Nick Martignetti '09, '10 MSCE; Mike Arensmeier '15, '17 MSCE; Victoria Franzen '13, '14 MSCE; Tyler Pruden '15; Associate Professor Eric Musselman; and current graduate student Ryan Schnabel '18

Managing partner and founder Mike Mulhern says, "Our vision at Mulhern & Kulp is to be the industry leader in residential wood-frame structural engineering; this would not be possible without collaborating with a university like Villanova, which can provide the resources and expertise to help us improve design methodologies that can have a significant impact on the industry."

Associate Professor Dr. Zuyi "Jacky" Huang and PhD student Brooks Hopkins '12 ChE are developing a strategy to combat cytokine release syndrome.

Graduate student Canaan Coppola and NovaCell Director Dr. William Kelly are working on an improved method of CAR-T therapy manufacturing.

NovaCell Researchers Make Strides in Center's First Year

In June 2018, the College of Engineering introduced its sixth center of excellence: NovaCell, the Center for Cellular Engineering, whose mission is to lead efforts to improve cell and gene therapy products and the bioprocesses used to make them. In less than six months' time, NovaCell faculty have been successful in securing grants and publishing important research to further knowledge in this life-changing field. The Center is led by William Kelly, PhD, professor of Chemical Engineering.

Improving CAR-T Therapy Manufacturing

The National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL), a Manufacturing USA institute designed to advance biopharmaceutical manufacturing in the U.S., selected a NovaCell initiative as one of its 14 technology projects. "A Transcriptome-Based Model for Improved CAR-T Therapy," under the leadership of Dr. Kelly, was awarded $150,000 from NIIMBL, with partner Redbud Labs, Inc. contributing an additional $50,000 to the proposal. Merck & Co., Inc. is also named as a project participant.

NovaCell's mission is to advance adoptive immunotherapies like CAR-T cells, which provide patient-specific treatment. One of the limiting factors of the Center's work, however, is the common failure of CAR-T batches due to slow growth rates of T-cells during the expansion step of the process. Furthermore, the starting material for every CAR-T batch differs, as does the availability of mixing/fluid motion and gas (oxygen), and levels of cytokines (small proteins that are important in cell signaling). All of these factors contribute to the limited number of T-cells available for research.

Given the small volume of T-cells available, a properly scaled-down bioreactor is required to add motion to accomplish cell growth. Dr. Kelly explains, "Cells don't like to sit on top of each other without mixing a little, especially T-cells, which are used to being in your blood." Redbud Labs is developing a microscale bioreactor platform that the project requires; its micro-sized magnetic posts may allow for micro-mixing and improved oxygen transfer to T-cells and show the impact on T-cell growth at that microscale. Thus, the first aim of the project is the optimum configuration of Redbud's bioreactor technology.

The second aim of the proposal is to test the T-cells under a variety of conditions and different mediums to see if there's a difference in growth rates. Co-PI Zuyi "Jacky" Huang, PhD, an associate professor of Chemical Engineering, will develop a mathematical model that can predict cell growth rate based on conditions. In addition to Drs. Kelly and Huang, the year-and-a-half long project will involve Villanova graduate student Canaan Coppola, who is pursuing a master's degree in Biochemical Engineering.

Encouraged by the project's potential, Dr. Kelly says: "The development of a micro-scale bioreactor and a transcriptome-driven mathematical model would allow for screening of CAR-T patients' cells for enhanced growth prior to the start of the clinical batch. This innovation could become a new standard that provides more efficient (cell therapy) manufacturing."

Combatting Immunotherapy's Deadly Side Effects

NovaCell researcher Zuyi "Jacky" Huang, PhD, associate professor of Chemical Engineering, leads the College of Engineering's Biological and Environmental Systems Engineering group, which published a paper this winter in the journal *Processes* detailing a modeling-based strategy to combat cytokine release syndrome. CRS is a deadly side effect found in immunotherapy patients whose cytokine levels have dramatically increased. (Cytokines are any of a number of substances that are secreted by certain cells of the immune system and have an effect on other cells.)

The objective of immunotherapy is to primarily harness a patient's own immune system to fight the proliferation of cancer and disease. In CAR-T cell therapy, the patient's blood cells are extracted, and the T-cells are then isolated and exposed to a viral vector that integrates the coding sequence for a chimeric antigen receptor (CAR). This receptor enables the modified T-cells to attack cancer cells when the T-cells are infused back into the patient's body.

The year 2017 was a hallmark year for CAR-T cell therapy with two products gaining FDA approval. They delivered remarkable complete remission rates of between 51 and 83%, but many patients experienced serious adverse effects of cytokine release syndrome. A marked imbalance in cytokine levels occurs in these patients, with inflammatory and anti-inflammatory cytokines competing with one another, causing a multitude of symptoms ranging from flu-like symptoms to organ failure and death.

Dr. Huang says, "It is crucial to determine the intervention strategy to inhibit cytokines in the therapy." He adds, "While experimental investigation for cytokine inhibition may put patients' lives at risk, a good modeling approach can help generate hypotheses to guide experimental investigation." With the help of Villanova Engineering PhD student Brooks Hopkins '12 ChE, Dr. Huang's group studied the uncertainties in cytokine release profiles from an ordinary differential equation model and designed the first quantitative formula to grade the severity of CRS from cytokine profiles. In addition, for the first time, they provided a rational approach to determine the sequential cytokine inhibition targets. These results pave the way for further experimental investigation of cytokine release syndrome.

Cellular Engineering Course Responds to Industry Demand

Villanova University is now offering a Cellular Engineering course in the Department of Chemical Engineering, taught by assistant professor and NovaCell researcher Jacob Elmer, PhD. "In the past year, graduates who have experience in cellular engineering or gene therapy have been hired immediately. Companies contact me for the names of students who have some knowledge in these areas," he says.

The first third of the semester is spent on genetics—what a gene is, how cells decide when to express some genes and not others, and how DNA is transcribed to RNA and translated into protein. The second part of the course is dedicated to tools and techniques—how to deliver a gene to a cell, how to ensure that it's going to express and how to culture cells.

Dr. Elmer describes the last module of the course as a general survey of the different ways in which cells have been engineered, from using algae to create biofuels and growing genetically modified crops to stem cell/tissue engineering for artificial organs and using T-cells to kill cancer cells. Throughout the course, there are conversations about the inherent risks—and ethics—of genetic and cellular engineering.

An assessment tool developed by Mary McRae '86 EE, '13 MSSE , '19 PhD, has caught the attention of the Department of Defense.

Sustainable Engineering graduate student Sean Carney '17 ME was recognized by the Global Water Alliance.

PhD Graduate Develops Novel Method for Assessing Impact of Climate Change on Aircraft Performance

As a retired Air Force officer and the first PhD graduate in Villanova University's Sustainable Engineering program, Mary McRae '86 EE, '13 MSSE, '19 PhD, decided for her dissertation to develop a tool to help the Department of Defense make sustainable decisions. To test her model, she needed to select a technology that was directly affected by climate change. Initial inquiries led her to the impact of high temperatures on aircraft performance, a topic she was surprised to learn had seen very little research. As she investigated further, she concluded that, in combination, dew point and temperature played an even more significant role. In "A Risk-Based Approach to Planning Aircraft Acquisitions in a Warming Climate," Dr. McRae has analyzed climate change data in a way that will help the DoD make smarter decisions on everything from mission planning to aircraft acquisitions and performance requirements by determining which assets are most vulnerable to the effects of global warming.

Experts agree that air temperature and dew point are projected to rise due to anthropogenic climate change. Both of these variables are key factors that will cause an increase in density altitude (DA). High DA corresponds to reduced air density and thus reduced aircraft performance. Operational impacts include reduction in power because the engine takes in less air, reduction in thrust because a propeller is less efficient in thin air, and reduction in lift because thin air exerts less force on the airfoils. Dr. McRae has found that Global Climate Model projections of maximum and minimum air temperatures can be utilized to quantify these increases into risk probability of occurrence at individual base locations around the world. She says, "Translating increased temperature and dew point into DA thresholds is a fundamental way to bridge climate data and aircraft performance and create a hybrid approach to decision-making."

Integrating dew point into DA threshold calculations will become increasingly important as these values are projected to rise in a warming climate. Dr. McRae stresses: "The consequences of high DA can be catastrophic to aircraft performance. Therefore, assessing the full spectrum of potential DA impacts to include dew point is critical."

Incorporating her sustainable engineering background, Dr. McRae notes that STEEP factors (social, technological, environmental, economic and political) enable a holistic assessment and provide a decision-making tool that can address various stakeholder perspectives. Translating these sustainability factors to DA thresholds takes an often unquantifiable issue and enables a quantifiable assessment and comparison.

Dr. McRae says, "By assessing projected aircraft performance impacts now, the DoD can take proactive steps in the aircraft acquisition process." These steps include identifying changing mission requirements and defining aircraft performance criteria that will best meet these changing requirements. Furthermore, identifying potential future aircraft performance impacts from increased DA will enable discussions with industry and encourage these challenges to be met sooner rather than later with the most efficient process and lowest price.

Dr. McRae's research has already caught the DoD's attention. In October 2018, she was invited to present her findings to the Air Force's monthly climate working group meeting. Positive feedback resulted in a follow-up invitation to present at the Strategic Environmental Research and Development Program's (SERDP) annual symposium "Enhancing DoD's Mission Effectiveness" in Washington, D.C. in November. That presentation led to a request for McRae to participate in a DoD SERDP workshop on "Resilient Aviation Infrastructure" in April 2019 at NASA headquarters.

Dr. McRae notes that the next phase of this effort will include the contributions of computer scientists and engineers. "We'll be working toward automation of this proposed vulnerability assessment model to enable multiple installations and aircraft specifics to be analyzed in a timely and accurate manner." She adds, "Increased development of the STEEP criteria based on extensive user feedback will ensure the assessment criteria meets the needs of tomorrow's warfighter."

Global Water Alliance Honors Grad Student

Villanova University Sustainable Engineering graduate student Sean Carney '17 ME won the inaugural Arun Deb Promise of Excellence in WASH (Water, Sanitation, Hygiene) Award from the Global Water Alliance. The award, named in honor of GWA's founding board member Dr. Arun Deb, recognizes student contributions through research or fieldwork in the area of clean water and sanitation.

Carney began working with the Villanova Engineering Service Learning program as an undergraduate. He spent one summer as a WASH engineer intern with Catholic Relief Services in Madagascar, and the summer before his senior year he served as an engineer and education intern with the Caramanico Foundation in Cambodia. These experiences prompted Carney to pursue his graduate degree, and his credentials earned him a fellowship in international development through Villanova's Sustainable Engineering program.

For his graduate work, Carney designed, implemented and evaluated low-cost remote monitoring systems to continuously measure water levels in storage tanks and transmit this data to system managers and other relevant stakeholders via SMS and email. Working with CRS, he installed prototype devices in privately managed rural water supply systems in Madagascar, and, after operating for several months, he evaluated the devices based on their technical performance, financial feasibility and user acceptance. Based on his analysis, design changes were recommended to improve the system in all areas. In May, Carney presented his findings at the 2019 ICT4D (Information Communications Technology for Development) Conference in Kampala, Uganda.

VESL Director Jordan Ermilio says: "Sean's involvement in the engineering service learning program exemplifies the importance of having both depth and breadth of opportunity for our students. He initially became involved as an undergraduate student volunteer and continued his involvement through his senior design project and now graduate research."

26 Creative Ways to Flex Your Engineering Muscles

When the number of interesting and exciting student projects underway in the College of Engineering makes it too difficult to select just one or two to feature in a publication, the logical solution is to do a roundup. A conversation with Edmond Dougherty '69 EE, '86 MSCS, director of the Engineering Entrepreneurship program, and George Simmons '87 MSCS, director of the Multidisciplinary Design Lab, revealed the following sampling of projects, which they say range from "promising" to "pretty weird." The list includes senior capstones for Mechanical, Electrical and Computer Engineering seniors; Engineering Entrepreneurship concepts; and independent research/design projects.

ANIMAL ATTRACTION

What: Projects with the Philadelphia Zoo have included:

- An animal tracking app to locate popular animals
- Facial recognition technology to identify individual lions, tigers and gorillas
- Telepresence project to virtually bring elephants back to the Philadelphia Zoo through an immersive, 3-D experience from a Florida elephant sanctuary

Who: Electrical and Computer Engineering seniors Patrick Egan, Branden Garrett and Kevin Kan are being advised by Dougherty and Simmons, with support from alumnus Dick Faris '69 CE, '70 MSCE, who serves as vice chair for the Philadelphia Zoo's board of directors.

Recognition: Branden Garrett won the 2019 Meyer Innovation and Creative Excellence (ICE) Award for the College of Engineering.

A BETTER BOAT

What: Students are improving the stability and hydrodynamic properties of surface vehicles by equipping them with stronger propellers and motors to make them more robust in the water.

Who: Mechanical Engineering seniors Bakir Abdus-Sabur, Joseph Bauman, Nicholas Bishop, Zachary O'Gull and Samuel Vitale, working with Professor Hashem Ashrafiuon, PhD

CALENDOUR

What: CalendOur's goal is to simplify the lives of its users and mitigate the stress and chaos that comes with an unorganized and disjointed planner.

Who: Civil Engineering juniors David Sepulveda and Sophie Shipe, Chemical Engineering junior Andrew Feiner, CpE junior Matthew O'Connell and ME junior Samantha Sandler

Recognition: "VUer's Choice" prize in the Villanova Student Entrepreneurship Competition (VSEC) for best video submission

COCOA BEAN DRYER

What: Many farmers in Indonesia use simple concrete slabs or bamboo mats placed in the sun to dry their cocoa beans, which results in uneven drying and poor-quality beans. Students are designing a more efficient and cost-effective drying method using a renewable energy source.

Who: Senior ME students Brooke Bowers, Nicholas Burns, Erin Cahill and Savannah Restori

DESIGN, BUILD, FLY

What: The American Institute of Aeronautics and Astronautics sponsors a Design, Build, Fly competition that requires teams to design, fabricate and demonstrate the flight capabilities of an unmanned, electric powered, radio-controlled aircraft that can best meet the specified mission profile.

Who: ME seniors Cole Chebi, Nolan Lauber, Tyler Meluch, Neal Peng and Eric Robinson

DORM DISHES

What: As long as there have been dormitories, there have been arguments over whose turn it is to wash the dishes. That explains why there is a nearly constant flow of engineering student projects related to solving the problem with as little human effort as possible. This concept involves a low-cost, countertop dishwasher that's driven by water power from the faucet.

Who: Senior Mechanical and Computer Engineering students Nicholas Ferrante and Alex Garino, and junior Mechanical and Computer Engineering students Christopher Bowers, Alyssa Cunningham and Robert Pink

DRONE DEVELOPMENTS:

What: The Harris Corporation is sponsoring three drone-related capstone projects:

- Applying game theory to search strategies
- Securing and protecting a drone once it's returned to its base
- Enabling a drone to land at sea and float, sending a signal that indicates it's ready to be retrieved

Who: *Project 1:* CpE seniors Michael Chen, Timothy Kubista, John Munshower and Dante Schank

Project 2: ME seniors Caitlin Callahan, James Conway, Joseph Liquori, Daniel Pino and Lauren Tschirch

Project 3: ME seniors Sarah Dehnert, John Evans, Maria Manfredi, Claire Schmidt and Michael Valentine

FISH PERTURBATION

What: Students are studying the way fish interact with vortex rings to help improve the capabilities of underwater robots.

Who: ME sophomores Spencer Gold, John Meehan, John Saffian and Tomas Seager are working with ME Assistant Professor of the Practice Deeksha Seth, PhD, on this follow up to her doctoral dissertation research.

FLY AND DRIVE:

What: The goal is to take an existing quadrotor and add the ability to land and drive autonomously. This must be done in a way that does not compromise the ability of the quadrotor to fly while also satisfying sufficient ground operations.

Who: ME seniors Christopher Abruzzo, Zachary Mateja, Jonathan Nikolaidis, Albert Tebbetts and Zachery Wypych, working with Dr. Hashem Ashrafiuon

LAVOBO

What: For the REALtech competition, the Lavobo team created a laundry model that incorporates washing, drying and folding into one system, controlled through an app, that would save water, as well as residents' time.

Who: ME seniors Matthew Bakey and Brendan Lundquist, EE senior Christopher LeClerc and CpE senior Matthew Massina

Recognition: Second place in the REALtech competition on Pitch Day, presented by the DiLella Center for Real Estate in the Villanova School of Business

JAW DROPPING

What: Students are developing a dynamic model of a snake's biting motion that will integrate biology and engineering for an interactive learning experience to be used at the Academy of Natural Sciences and in classroom demonstrations.

Who: Having a history of collaboration with Philadelphia's Academy of Natural Sciences, Dr. Deeksha Seth has brought this project to the College where it's being developed by ME seniors Hannah Drazan, Matthew Eckles, Kelly Jusczak and Gabrielle Van Der Gaag.

PITCH PREDICTOR

What: Utilizing Colorado Engineering's advanced computer technology, along with a 60 GHz radar and a high-speed camera, this system would track the speed of a pitcher's throw and position of a pitch.

Who: Lawrence Scally, PhD, '83 EE, '85 MSEE, '06 MBA, co-founder and president of Colorado Engineering, is sponsoring this project, which is being undertaken by ECE juniors Kevin Calhoun, Joseph Orr and Jessica Vilarino. The team is advised by Assistant Professor Mark Jupina, PhD.

PIVPOD

What: Many parents know the frustration of trying to film their child athlete while at the same time enjoying and experiencing the game. By equipping the child with a tracking device, i.e., something that blinks, the so-called PivPod would follow and record their actions.

Who: ME seniors Caitlin Callahan, Daniel Pino and Michael Valentine and ChE senior Stephen Sobota

Recognition: First place in the 2019 VSEC Competition

PLUMBOTICS

What: With the average cost of a plumber's visit being about $300, it could pay to have your own personal plumbing inspection robot. This creatively named prototype would climb through the pipes and determine the source of your problem.

Who: CE senior Patrick Maher and CpE junior Robert Pink

POWER MESH

What: Through constant measurements of the tilt of the transformer, voltage and temperature, Power Mesh detects if a power line or transformer is out, damaged or needs repair.

Who: EE sophomores Gregory Alboum, John Egan and William Hubschmitt

Recognition: Finalists in the 2019 VSEC Competition


c)


d)


e)


f)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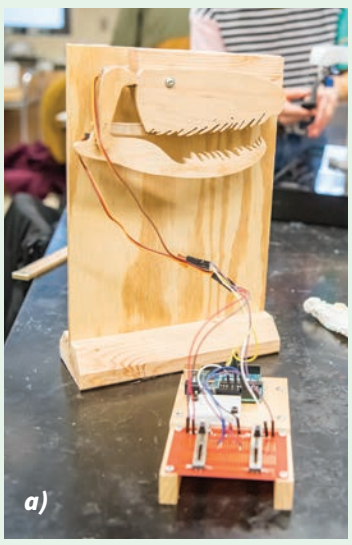
a)


h)


g)

a) Jaw Dropping; b) Design, Build, Fly; c) Cocoa Bean Dryer; d) Fly & Drive; e) PVC Pipe Connection; f) Thermal Interface Tester; g) Variable-Air-Volume Unit; h) Power Mesh

PVC PIPE CONNECTION

What: Father Walter Kasuboski, Villanova's partner in Panama, wants to expand a gravity-fed water system using 12 kilometers of 6" PVC pipe. He does not, however, have affordable or effective connectors, so students are developing a method of connecting the pipe that will meet a set of quality parameters.

Who: ME seniors Elizabeth Hagerty, Peter Herlihey, Adrienne Jacob, Andrew Lee and Katy Reteneller

ROLLI:

What: An Alexa-type device for specific applications, "Rolli" could live in the lobby of Villanova's Center for Engineering Education and Research and provide visitors with information about the College or CEER.

Who: 2018 CpE graduates Matthew Gross, David Lewis, Andrew Pistana and Noah Schwanke developed the project through the Engineering Entrepreneurship minor. Most of them are continuing the work as Villanova Engineering graduate students.

SIMULATING FLIGHT

What: Students are developing a flight simulator for Boeing, using the University's virtual reality CAVE environment.

Who: EE seniors Joseph Edler, Patrick Enright, Robert Mancini and Vu Tran, with support from Colorado Engineering and the Mythbusters' Jamie Hyneman, who provided mechanics expertise

SONRAD: SOund Navigation by RAdio Detection

What: By combining SONAR and RADAR, radio waves are used to detect objects in an environment. These signals are then converted into a 3-D sound profile to help a user navigate his/her surroundings.

Who: ECE juniors Justin Carlton, James Pederson and Matt Webster are working with Dr. Mark Jupina.

THERMAL INTERFACE TESTER

What: Thermal interface materials (TIMs) seek to greatly increase heat flow through components in computers and other electronic equipment. To characterize their performance, a TIM tester is utilized. This project aims to design and produce a testing device that is cost effective, easy to use, accurate and convenient. It will compute and display results in Villanova labs and future collaborative projects with industry.

Who: ME seniors Andrew Dallman, Matt LaRose, John Lockhart and Yannis Nyktas

UNI-PARK

What: Uni-Park began as an engineering entrepreneurship project and has continued as an ECE capstone. The goal is to make it possible to find that elusive parking spot with the use of parking lot sensors and an app.

Who: Seniors James Galasso, Shelly Henling, Christopher LeClerc and Matt Massina

VARIABLE-AIR-VOLUME UNIT

What: Variable Air Volume is a type of HVAC system in which the airflow volume varies while the temperature remains constant. Currently, these terminal boxes are tested manually after installation, requiring a lot of time and money on construction jobs. This project consists of developing and implementing an algorithm that remotely monitors the functionality of a VAV terminal box and easily relays that information back to the contractor. In addition, the VAV unit will have the ability to make self-repairs for common malfunctions.

Who: ME seniors Tim Filos, Brian Hayes, Demetrios Kyriannis and Zach Yohon are working with project sponsor Turner Construction and equipment vendor Siemens.

Spending Summer "Vacation" on Innovation

The Harris Summer Innovation Program is a competitive, self-directed engineering design program for multidisciplinary student teams. This partnership program of the College and Harris Corporation allows students to engage in the open design process to pursue innovative solutions to unmet societal and technological needs. Students manage all aspects of their projects, from initial design concepts through the delivery of prototypes and final presentations at Harris Corporation. During their two-month residency, students receive stipends; free on-campus room and board; project budgets; and access to subject matter experts, labs and facilities. The 2019 teams are tackling the following projects:

DIY Cyber Lab: Preston Genett '20 EE, Scott Panasci '20 EE and Dominik Schab '20 CpE are creating original models and hardware for use in educational settings to train students in cyber-physical systems security.

Drastic Plastic: Alec Cárdenas '21 CE, Andrew DelDuca '21 CpE, William Mallory '21 ME and Connor Zendzian '21 ME are producing a mechanical prototype that will allow households to convert plastic water bottles into reusable materials.

Food Calculator: Anthony Etim '21 EE, Aldo Pierini '21 CE, Computer Science major Rahul Thapa '21 and Math major Barbara Fiedorowicz '21 are applying machine learning to create a novel software platform that dining services organizations can use to minimize food waste.

Virtual Realm Interface: Sung Hyun "Richard" Kim '21 CpE, Youngmin Kim '21 EE, Bennett Steinbach '21 CpE and Yuhan Wang '20 ME are working on combining sensor technologies to track the motion of both an object and the user (e.g., an athlete), such that the user interacts with a real-world object through the means of a virtual realm interface.

Engineers in the spotlight: Kelly Jusczak '19 ME, John "Jack" Evans '19 ME, Aileen Bancroft '19 ME and Brian Jacko '20 ChE

Engineers Embracing their Creative Sides

For the past decade, Villanova's College of Engineering has made great strides in developing "whole-brain engineers" who engage both the logical, analytical, mathematical and scientific parts of their brains and the intuitive, creative, problem-solving side. Villanova's commitment to entrepreneurially minded thinking throughout the curriculum is built on the premise that the best engineers bring all of these skills to the table. But, while every engineering undergraduate is exposed to these principles, some take creativity to another level, literally shining a spotlight on it.

Several of Villanova University's engineering students have found an outlet for creative expression on and behind the stage. They are in good company—the College's Interim Dean Randy Weinstein, PhD, is himself an actor, who originally tried theatre as an extracurricular activity to help him get into college. "I needed something that wasn't purely academic, and I decided to pursue theatre because it was outside my comfort zone. I really enjoyed it and have stuck with it ever since."

While his new role as interim dean doesn't allow Dr. Weinstein much time for the stage, these students are finding that the theatre offers them a welcome respite from the rigors of an engineering major. Aileen Bancroft '19 ME, John "Jack" Evans '19 ME, Brian Jacko '20 ChE, Kelly Jusczak '19 ME, Kevin Key '21 CpE and Luigi Siligato '20 ME answered questions about their experiences:

What drew you to the stage/theatre?

Brian: Theatre was suggested to me a few years ago as something to fill time outside of school. After doing my first show, I just had to keep going with it!

Kelly: My parents always had an appreciation for the arts and would take my sisters and me to musicals and plays when we were younger.

Luigi: When my friends performed in shows in high school, I saw how much fun they were having and wanted to be a part of it myself!

Kevin: My love of entertaining others and performing for them is what initially drew me to the stage.

Aileen: I have always loved the theatre for the stories it tells. At Villanova, I found that I could help tell those stories from backstage as a wardrobe manager.

When did you first get involved?

Jack: I've been in musicals every year since I was 5 years old. When I decided to pursue an engineering degree, I thought that I would have to say goodbye to the stage, but I was overjoyed to find a vibrant, active undergrad theater club on campus that is open to students from all majors.

Brian: I first got involved towards the end of high school, performing in the ensemble of a few shows. It wasn't until freshman year at Villanova, though, that I began performing regularly and getting more involved back stage as well.

Kelly: I've been doing theatre since I was about 8 years old, so I was glad to have the chance to continue when I got to Villanova. I have performed in seven shows with Villanova Student Musical Theatre since my freshman year and was in countless shows before that.

Luigi: I've now been doing theatre for four years, since my sophomore year of high school, and I have performed in three plays and six musicals.

Kevin: I first got involved in elementary school while performing in *Willy Wonka Jr.* with the Columbia Center for the Theatrical Arts summer camp in Columbia, Maryland.

Aileen: I was looking for a work-study job that would allow me to embrace my creative side. As a freshman I worked in the costume shop helping to sew and repair costumes; I soon became a wardrobe manager and focused more on tracking costumes, planning quick changes, helping with hair and makeup, and overseeing the dressing rooms.

What connection do you see between theatre and engineering? Is there anything about it that can help you in your future career?

Jack: Being on stage has helped develop my public speaking and improvisation skills, but I have found the bridge between my love of theater and engineering with set design and construction. Working on the sets has required a great amount of planning, budgeting, operational risk management and of course, creativity.

Brian: In set design, I often use what I've learned about force balance and torque to ensure that what we build lasts for the performance. Additionally, I have found that being on stage has greatly increased my presentation and interview skills.

Kelly: I think performing teaches you many different things that can be applied to any profession. It takes a lot of hard work to put a show together and teaches you physical and mental discipline, problem-solving skills, and excellent public speaking skills.

Luigi: Theatre, by its very nature, is a team effort. This is not unlike a team-oriented, engineering work environment.

Kevin: Performing has made me more comfortable presenting to audiences, both large and small, and this will be helpful in my career when I present my work to others.

Aileen: When working backstage as a wardrobe manager, it is vital to have quick problem-solving skills. Learning to think as an engineer has helped me in systemically planning costume changes and developing last minute solutions. Engineering and the arts are often viewed as competitors, but many problems cannot be solved merely by technical knowledge.

What is your favorite theatre role/experience at Villanova or elsewhere?

Jack: After two and a half years, people still recognize me from my role as Mr. Mayor in *Seussical* my freshman year. I think that's the closest I'll get to being famous!

Brian: I performed in my eighth show as Pippin in *Pippin* and I've had many great theatre experiences at Villanova. My favorite role, though, is being president of VSMT. It allows me to share my love of theatre with others and make the arts present on campus in a real, accessible way.

Kelly: Every show has been so much fun to be a part of! I've played many different roles, from a dancer in a sleezy night club in Nazi Germany in *Cabaret* to a Dr. Seuss character in *Seussical*, and everything in between.

Luigi: Some of my fondest memories of theatre at Villanova come from my first show— *First Date*. It got me into VSMT, an organization in which I have found some of my closest friends.

Kevin: In 2016, I performed in Stephen Schwartz's *Children of Eden* with the Young Artists of America. The directors invited Schwartz to the final rehearsals and performance, and it was incredible to be able to work with him and hear about how and why he wrote the show.

Aileen: My favorite experience with Villanova's graduate theatre was our spring 2019 production of *Youth*, during which I started training three new wardrobe managers and we grew as a team.

Engineering Alumni Travel to Panama to Explore VESL Projects

During spring break 2019, teams of undergraduates, graduate students and faculty traveled to five countries to volunteer with humanitarian organizations as a part of the Villanova Engineering Service Learning program. One of the highlights of the week was a University Advancement alumni trip to visit a project site in the Alto Bayano region of Panama. Engineering alumni Calisto Bertin '77 CE; Frank "Joe" Feyder '74 CE, '77 MSCE; John McFadden '65 ME; Bob Pizzano '70 CE; and Tom Portland '69 ChE, '72 MSChE, along with spouses, faculty and staff, traveled in parallel to one of the student teams in that region. They spent the week networking with Panama's Villanova alumni, working with students at the project site and learning about the extensive partnerships that have been established in-country over the past five years.

In Panama City, the group visited the Panama Canal Authority where they were hosted by project engineer Luis Ferreira who provided an exclusive tour of the new canal locks. They also took in a screening of a documentary about the extraordinary effort to improve the sustainability of the water supply infrastructure in the region of Wacuco. Additionally, the visit included a networking event, which introduced alumni to Panamanian Vice President Isabel St. Malo de Alvarado—whose daughter is a current freshman in the College of Liberal Arts and Sciences—as well as other influential Panamanian alumni.

A highlight of the week was a visit to Wacuco, where Fr. Walter Kasuboski OFM—whom Pizzano describes as "a living reminder of the power of one person to change the world"—has worked for the past 25 years to bring potable water to more than 8,000 Panamanians living in rural areas. There, alumni joined the student teams on several different projects, including bridge construction, water tank rehabilitation and expanded water distribution. After work-filled days, the evenings included hours' long conversations between students and alumni, which became emotional displays of humility and passion for helping others. McFadden describes the trip as "a great spiritual retreat" that led to "waves of gratitude." Portland adds, "I have a much better appreciation and understanding of all the great VESL programs and was most impressed by our Villanova students. The College and University are doing a great job turning out such high-quality young people."

Jordan Ermilio '98 ME, '06 MSWREE, director of the VESL program, appreciates the contributions of the trip's alumni participants. "These alumni have generously sponsored projects over the last several years, and VESL would like to engage others, with a goal to raise a $2 million endowment." In addition to enabling more Villanova Engineering students to travel abroad on VESL trips, this endowment will support research on sustainable development and provide financial resources to program partners who are immersed in these challenges in low-income communities.

"We provide students with invaluable and life-changing experiences working on projects that improve the lives of people living in developing communities," says Ermilio. "In the process, they forge friendships that will last a lifetime."

Back row: Jim Rutenbar '91 MBA; Bob Pizzano '70 CE; Tom Portland '69 ChE, '72 MSChE; John McFadden '65 ME; Calisto Bertin '77 CE; Fr. Walter Kasuboski (Fr. Wally); Frank "Joe" Feyder '74 CE, '77 MSCE; Director of Professional Development and Experiential Education Frank Falcone '70 CE, '73 MSEC; Major Gift Officer Joelle DePietro; Assistant Professor of Mechanical Engineering James O'Brien '71 CE, '79 MSCE

Front row: Senior Director of Development Cindy Rutenbar '88 MBA, Director of Villanova Engineering Service Learning Jordan Ermilio '98 ME, '06 MSWREE

It Took Me 45 Years, but I Finally Found Jimmy McMonagle

Their shared faith finally brought Jimmy McMonagle '63 ME and Jerry Curtin '75 ME together after Curtin had started looking for McMonagle more than 40 years earlier.

It was September 1971, my first day at Villanova, when the freshman engineering class of about 300 students gathered in a lecture hall on the second floor of Tolentine to be addressed by Engineering Dean John Gallen. Included in his advice was a warning not to get too involved in extracurricular activities, especially sports. He said, "No engineering student has graduated from Villanova and played varsity basketball since Jimmy McMonagle did many years ago. I would not recommend that you try." I wondered, "Who is Jimmy McMonagle?" but I hit dead ends whenever I tried to find out more about him.

As the years passed, my determination to learn about McMonagle faded until I eventually forgot about it altogether. That changed in May 2016, when at Mass at St. Bede the Venerable Church in Holland, Pennsylvania, a tall, older man passed by me wearing a dark blue sport coat with an embroidered "V." He also wore a Villanova tie clip. I had seen this man many times before but had never learned his name. On this particular Sunday, I introduced myself and asked about his jacket. He said that he once played basketball at Villanova and that the school gave it to him. I asked his name. He extended his hand and said, "I'm Jim McMonagle."

Since that time, I have seen Jimmy often in church and gotten to know what a wonderful person, successful businessman and faithful Catholic he is. After an outstanding basketball career, which included serving as co-captain his senior year, Jimmy graduated from Villanova with a Mechanical Engineering degree in 1963. He spent four years as a lieutenant in the submarine corps, where he was recruited to play basketball for the Admiral's team, which became All Navy Champions. Later, he earned an MBA from the Wharton School and served as president or chief operating officer for several companies. Even in retirement, Jim is involved with several emerging businesses and is a board member of the Villanova Engineering Alumni Society. He is a wonderful role model for all Villanova graduates, and while it took me 45 years to find him, I'm very glad I did.

About the Author: Jerry Curtin is a retired engineer who graduated from Villanova University with a Mechanical Engineering degree in 1975. He is a friend and fan of Jimmy McMonagle's and lives near him in Richboro, Pennsylvania.

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spring 2019

Villanova Engineering Students Named Knight-Hennessy Scholars at Stanford University

Villanova Engineering students have won Gates Cambridge and Mitchell Scholarships, received National Science Foundation graduate research fellowships, and been awarded Fulbright teaching and research grants. Now, the College can add Knight-Hennessy Scholars to its impressive list of student distinctions.

Bridget Gile '19 CE and Andrew Lee '19 ME are among 68 students selected from more than 4,400 international applicants as part of the 2019 cohort of Knight-Hennessy Scholars at Stanford University. The program curates a multidisciplinary community of scholars, offers a platform for purposeful leadership development and empowers its scholars to effect large-scale positive change in the world. Both Gile and Lee have been accepted to PhD programs, in civil and environmental engineering and in materials science and engineering respectively, at Stanford School of Engineering.

A Morris, Illinois, native and Villanova Presidential Scholar, Gile graduated this year with a bachelor's degree in Civil Engineering and minors in Sustainability Studies and Honors. Aspiring to solve critical water resources challenges and become director of the U.S. Environmental Protection Agency Water Infrastructure Division, she has gained invaluable experience through internships with the Villanova Center for Resilient Water Systems, AKRF Water Resources in Philadelphia and LyondellBasell in Illinois. Gile was a research fellow in the National Science Foundation's Research Experiences for Undergraduates programs at the University of Nebraska-Lincoln and at Virginia Tech. At Villanova, she was vice president of the Villanova Environmental Group and president of Peers Enhancing Educational Resources for Students, a tutoring and mentoring program. Somehow, she found time to engage in STEM outreach activities at local schools and captain the University's Women's Ultimate Frisbee club team.

Gile, who was recognized as a National Science Foundation Graduate Research Fellow and also received the offer of a Fulbright grant to conduct flood management research at Delft University of Technology in the Netherlands, says: "I am honored and humbled to have this opportunity, which ties together the impactful learning and community engagement that have defined my Villanova engineering experience. I am deeply grateful to my mentors, friends and family for inspiring and encouraging me throughout my journey."

Also a Presidential Scholar, Lee, from Leonardtown, Maryland, graduated with a bachelor's degree in Mechanical Engineering and minors in Mathematics and Physics. He began his research career during his freshman year, working with Associate Professor Gang Feng, PhD, studying thermal enhancement of phase change materials via conductive nano-scale networks. He won a Villanova Undergraduate Research Fellowship in 2016 but chose to accept an engineering research position with the Pax River NAVAIR Materials Division.

In addition to serving as a research assistant in the College's Mechanical Engineering department, Lee was a coordinator in the University's Math Learning Resource Center. Internationally, he surveyed jungle terrain for clean water systems in Nicaragua and developed a system to passively collect water as part of the GIANT Internship Program in France. As a PATHWAYS intern in the Naval Air Warfare Center Aircraft Division, he advanced understanding of corrosion prevention.

Lee—who also was recognized as an NSF Graduate Research Fellow—aspires to meet the challenges of climate change and the energy crisis by developing novel materials that fuel the next generation of global energy processes.

He says, "This scholarship is the culmination of relentless support from countless friends, mentors and family members in addition to the incredible academic and professional opportunities made possible by the Villanova community. I'm excited to strive to create innovative materials to solve today's global challenges."

The Knight-Hennessy Scholars Program's academic founder is John Hennessy '73 EE, a Villanova College of Engineering alumnus who is the chairman of Alphabet Inc. and was president of Stanford from 2000 to 2016. His co-founder is Phil Knight, philanthropist and chairman emeritus of Nike Inc.