2018

RESEARCH IMPACT

THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

DEPARTMENT OF MECHANICAL
AND AEROSPACE ENGINEERING

MESSAGE FROM THE CHAIR

This year in the Department of Mechanical and Aerospace Engineering, our students and faculty have expanded their research efforts even more to create solutions aimed at meeting the needs of a society more reliant on technology than ever before.

Smart cities, artificial intelligence and robotics and automation are becoming more critical in the Department of Mechanical and Aerospace Engineering. We're seeing how these once futuristic ideas are now the new cornerstones of our investigations.

Central Ohio is fast becoming a hub for mobility solutions for the 21st century. We are proud to be integral partners in DriveOhio, an initiative by the Ohio Department of Transportation aimed at the design, development, testing, use and regulation of autonomous and connected technologies. One of our touchpoints is drone traffic monitoring, work actively being conducted by our Aerospace Research Center (page 4).

The department's expertise in engineering for health and wellness also continues to grow. Utilizing a grant from the National Institute for Health, our faculty aim to establish a fundamental understanding of blood vessel permeability, which could ultimately improve ways to limit excessive blood vessel growth during disease progression (page 10).

Faculty in our Nuclear Engineering Program are mobilizing research to develop new, innovative technologies for the next generation of nuclear power plants (page 8). Their involvement in a federally-funded consortium focuses on developing nuclear power plant control systems that utilize artificial intelligence.

Students—our raison d'etre—are involved in every facet of our research initiatives. Developing tomorrow's leaders is high on the department's agenda. With nine doctoral graduates placed into tenure-track faculty positions over the past year and others in technical leadership positions in industry and government, our alumni are making a global impact. Outside the classroom students lead organizations that put classroom skills into action. Many student groups, such as the Smart Campus Organization (page 13), allow collaboration across the university.

As you read this year's *Research Impact*, you will see how solutions have driven our motivation for research and innovation. From novel manufacturing improvements to a better fake leather, improving society is at the heart of what we do.

Vish Subramaniam

Professor and Chair
Department of Mechanical and Aerospace Engineering
The Ohio State University

Cover: Ryan Thorpe, aerospace engineering graduate student, performs drone testing as part of the Route 33 Smart Mobility Corridor pilot project. Read more on page 4.

DEGREES CONFERRED

Academic Year 2017 - 2018

BS	203 MECHANICAL	79 AEROSPACE	
MS	85 MECHANICAL	9 AEROSPACE	6 NUCLEAR
PHD	18 MECHANICAL	7 AEROSPACE	4 NUCLEAR

STUDENT ENROLLMENT

Autumn Semester 2018

BS	629 ME MAJOR	672 ME PRE-MAJOR	163 AE MAJOR	250 AE PRE-MAJOR
MS	129 MECHANICAL	25 AEROSPACE	2 NUCLEAR	
PHD	150 MECHANICAL	43 AEROSPACE	20 NUCLEAR	

DRONES AND TRAFFIC MONITORING

Ohio State pilots project integrating drones in transportation infrastructure

The Route 33 Smart Mobility Corridor is getting even smarter under recently announced plans to study the use of unmanned aircraft systems (UAS), or drones, to monitor traffic and roadway conditions from the air along the corridor.

As drone numbers soar, DriveOhio's UAS Center is investing $5.9 million for a three-year study on how to safely fit these aircraft into an already congested airspace. Led by The Ohio State University College of Engineering, the research will include both air and ground vehicles and will complement DriveOhio's current initiatives in autonomous and connected vehicle testing.

Low-altitude drones will monitor traffic and incident response along the U.S. 33 Smart Mobility Corridor, a 35-mile stretch between Dublin and East Liberty, in conjunction with the state's current fixed-location traffic camera system. Sensors and communication equipment will feed UAS detection and tracking data to the Ohio Department of Transportation's Traffic Management Center. The Unmanned Traffic Management (UTM) solution will enable ODOT to respond more rapidly and effectively to situations on the road.

The UTM system also will ensure the drones controlled by DriveOhio's UAS Center will not collide with each other or with manned aircraft, such as small planes and helicopters that also use the lower altitude airspace. The Federal Aviation Administration (FAA) estimates 7 million UAS commercial and hobbyist purchases by 2020. These unmanned aircraft must also interface with the

5,000-manned aircraft that are in the sky at any given time.

> **"We're excited to develop an unmanned traffic management system for Ohio, which will enable safe flight of drones and personal air vehicles beyond the line of sight of the operator," said Ohio State Professor and Aerospace Research Center Director Jim Gregory. "Our collaborative work will pave the way for the ultimate vision of safe flight of UAS throughout Ohio and beyond."**

Current FAA drone regulations require that the operator maintain the unmanned aircraft within visual line of sight at an altitude of less than 400 feet and without flying over people. These logical restrictions significantly curtail the usefulness of the range of applications that industry, academia, and public entities such as ODOT can envision.

Based at the Transportation Research Center in East Liberty, the UTM system under development is analogous to and draws upon the heritage of the current Air Traffic Management system for the National Airspace System.

"Since there is no pilot on board, we must build a comprehensive surveillance system composed of radar transceivers as well as robust signal processing on the back end, in real time, to track and filter all targets in the area of interest," he added. "With a dynamic UTM solution in place, it will then be possible to make the safety case to the FAA for operations over people and beyond line of sight."

An effective UTM system also accounts for airspace design, traffic flow management, defined flight corridors, management of UAS flights around pop-up no-fly zones, weather conditions or environmental hazards, congestion management, path planning, and collision avoidance.

With the UTM system in place, the corridor will be able to support future UAS and autonomous operations such as package delivery and air taxi services.

"This project will further establish Ohio's lead in UAS technology and help provide a space where the Ohio Department of Transportation, DriveOhio, researchers and developers can explore the intersection between automatous and connected ground and air vehicles," said DriveOhio's UAS Center Director Fred Judson. "This research will also allow ODOT to better understand the changing landscapes of technologic advancements through proactive policies and investments early on in the adoption lifecycles."

Research partners include Cal Analytics, Gannett Fleming, AiRXOS (a GE Venture), SRC, Inc., Transportation Research Center, Inc., Woolpert, The Ohio State University Airport, and Midwest Air Traffic Control.

CAL ANALYTICS

TRC Transportation Research Center Inc.

Gannett Fleming

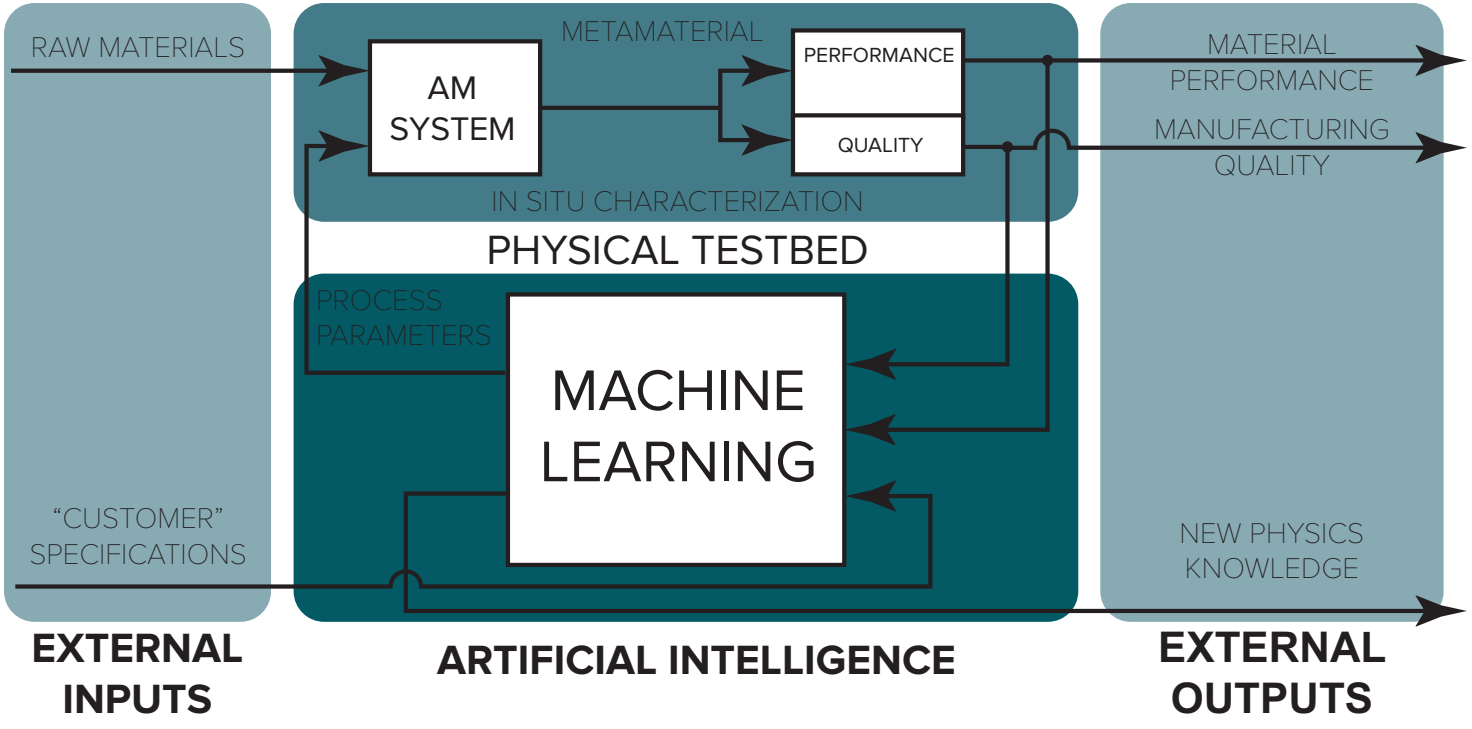
WOOLPERT

GE Ventures

MIDWESTATC

SRC Tec

The Ohio State University
College of Engineering



NOVEL MANUFACTURING FRAMEWORK

$1.5 million NSF award to develop autonomous framework that learns

Interwoven into almost all aspects of our lives, artificial intelligence (AI) has yet to make a substantial impact in the manufacturing field. Currently, the product and manufacturing design process is one of the most time-consuming aspects of the industry. And when that design doesn't perform as planned? Engineering teams have to iterate on the design, which wastes both time and resources.

With $1.5 million in funding from the National Science Foundation (NSF), Assistant Professor **David Hoelzle** will develop an autonomous manufacturing framework that learns on the job. He will take a process that is inherently unpredictable and build manufacturing systems that are robust to that variability.

"Whatever design you make is not going to be exactly what you build," said Hoelzle, who directs the Hoelzle Research Laboratory on campus. "So we're trying to build manufacturing systems that learn. Instead of saying 'here is the design I want to make,' our focus is on the product performances we want."

Hoelzle will use an NSF Scalable Nanomanufacturing for Integrated Systems (SNM-IS) Award to fund his Manufacturing for Directed Evolution of Materials (MADE-Materials) project. This collaborative award, which is sponsored by the NSF Division of Civil, Mechanical and Manufacturing Innovation, will allow Hoelzle to partner with the University of Michigan's Kira Barton, associate professor of mechanical engineering, and Max Shtein, professor of materials science and engineering.

"We hope that this project's lasting impact will give researchers the ability to take our ideas and apply them to the particular manufacturing process they are working on, either in the industry or in their research lab."

- DAVID HOELZLE
Assistant Professor

Members of Hoelzle Research Lab, left to right: Ali Asghari Adib, Antony George, Mindy Lake, Andrej Simuenovic, Chaitanya Vallabh, Nate Wood, Jerrell Ong, Professor David Hoelzle, Md. Ferdous Alam and Jonathan Winkler.

This interdisciplinary team not only wants to develop a framework; they want that system and its algorithm to be replicable and scalable at multiple levels.

"We hope that this project's lasting impact will give researchers the ability to take our ideas and apply them to the particular manufacturing process they are working on, either in the industry or in their research lab," Hoelzle affirmed.

He plans to use a versatile manufacturing tool incorporating in-situ materials characterization techniques, in addition to using a central AI algorithm to autonomously direct material synthesis processing. This can evolve, as needed, to meet the desired specification. In their approach, the team's autonomous system will drive the exploration of the material synthesis space, interpret outputs to statistically diagnose defects or deviations, and learn the process-structure-and-material physics. This closed-loop approach is robust enough to process uncertainties, while also enabling the at-scale manufacturing of sensitive nanostructured smart material synthesis processes, including acoustic metamaterials and optical filters.

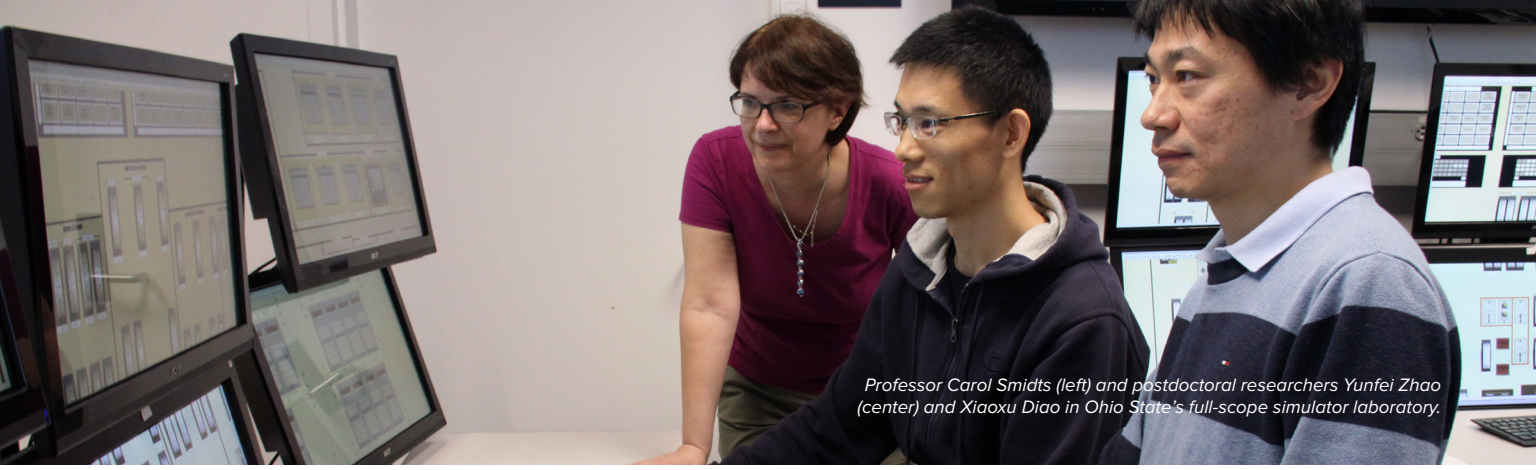
Hoelzle's team of researchers in his lab have explored manufacturing learning-based control for more than four years. Their latest research will go a step further to build a manufacturing system that can continuously build a part, test its performance and then revise the manufacturing parameters.

The final result is a process that yields the ideal product performance each and every time.

NSF

THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

UNIVERSITY OF MICHIGAN



Professor Carol Smidts (left) and postdoctoral researchers Yunfei Zhao (center) and Xiaoxu Diao in Ohio State's full-scope simulator laboratory.

AI CONTROL OF NUCLEAR REACTORS

$3.4 million federal grant from ARPA-E to bolster consortium's efforts

Researchers from The Ohio State University are part of a consortium focused on developing nuclear power plant control systems that utilize artificial intelligence. The team has received a nearly $3.4 million federal grant from ARPA-E (U.S. Department of Energy's Advanced Research Projects Administration-Energy) to bolster its efforts.

Led by N.C. State University, the consortium includes members from New Mexico State University, The Ohio State University, Oak Ridge National Laboratory, Idaho National Laboratory, TerraPower and Zachry Nuclear Engineering.

The group's project—Development of a Nearly Autonomous Management and Control System for Advanced Reactors—is the second largest funded by ARPA-E aimed at mobilizing research to develop new, innovative technologies for the next generation of nuclear power plants. Under the agency's umbrella MEITNER (Modeling-Enhanced Innovations Trailblazing Nuclear Energy Reinvigoration) program, initiatives are funded which enhance advanced nuclear reactors' commercial viability.

Ohio State's principal investigator is **Carol Smidts**, professor and director of the Department of Mechanical and Aerospace Engineering's Nuclear Engineering Program. She is overseeing one of the consortium's four thrust areas, Nearly Autonomous Management and Control (NAMAC) System Technical Components Development.

According to Smidts, "the initial application of the artificial intelligence-based control system is the management of accidents for advanced reactors."

"Ohio State researchers will determine the placement and type of sensors to be used to maximize the ability to detect possible issues and improve system robustness," she said. "Modeling and assessing reactor operator response within the context of a more autonomous operation is another, equally important target."

Building on approaches and tools developed through funding from the Air Force Office of Scientific Research, Battelle Energy Alliance and the U.S. Nuclear Regulatory Commission will be key to their success.

Overall, the consortium seeks to develop a highly-automated management and control system for advanced nuclear reactors. The system will provide recommendations to plant operators and will use artificial intelligence and continuous data monitoring to predict future plant status through machine learning.

A BETTER FAKE LEATHER

Researchers invent nano-coating for synthetic leather that cleans itself

If you've ever stained your favorite leather-look jacket or had to peel your bare legs from a sticky vinyl car seat in the summer, the solution to your woes just might be found on the surface of a lotus leaf.

In the journal Colloids and Surfaces A, researchers at The Ohio State University report that they found a way to adapt a nano-engineered texture based coating to plastic-based synthetic leather. Both water and oil roll off the coating, which keeps the leather-like surface from getting sticky up to temperatures of 70 degrees Celsius (158 degrees Fahrenheit).

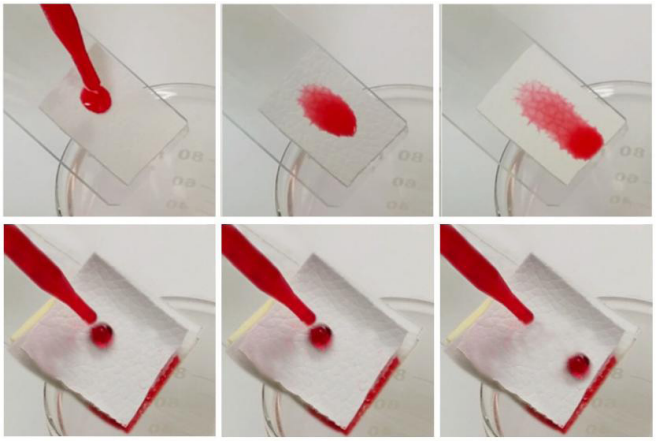
> **"To our knowledge, this is the first time anyone has managed to fabricate synthetic leather that is not just water resistant, but super-liquiphobic—it repels both water and oil-based liquids," said Bharat Bhushan, Ohio Eminent Scholar and Howard D. Winbigler Professor of mechanical engineering at Ohio State.**

Synthetic leather is made from fabric coated with plastic, usually polyurethane (PU) or polyvinyl chloride (PVC). Like genuine leather, synthetic leather is somewhat permeable to liquids. Unlike genuine leather, it gets sticky at high temperatures because heat softens the plastic surface.

Bhushan specializes in biomimetics, the science of creating materials and processes that mimic nature. Much of his work has been inspired by lotus leaves, whose bumpy surfaces naturally repel water.

As in their previous experiments creating water- and oil-repellant surfaces, the researchers tried to create a bumpy texture by spraying a coating of silica nano-particles on the surface of the synthetic leather.

But Bhushan and doctoral student **Dev Gurera** quickly discovered that the plasticizers in the synthetic leather prevented the nano-particles from sticking, especially



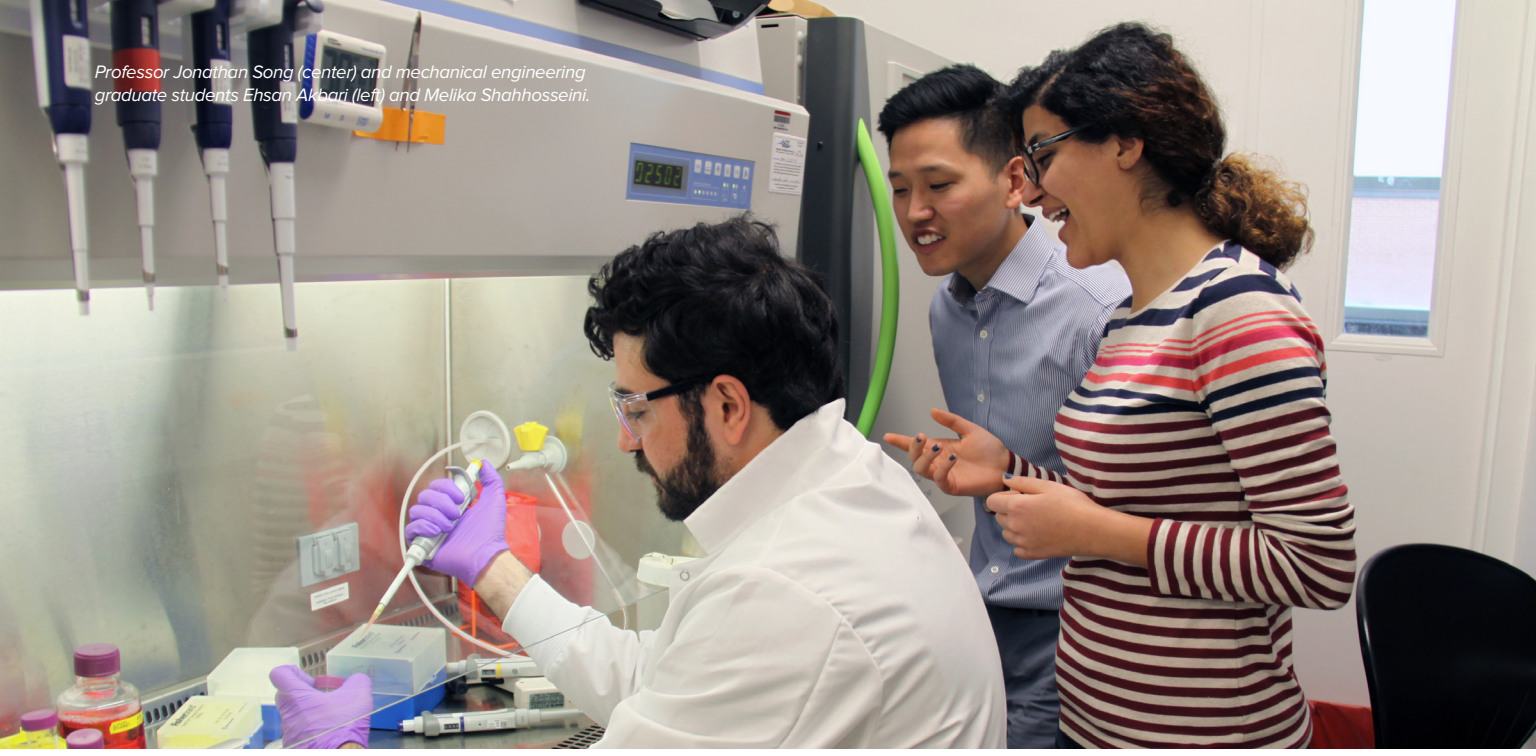
inside its leather-look grooves. So they cleaned the surface with an ultraviolet light treatment commonly used in computer chip manufacturing.

The result: The nano-particles stuck to the cleaned synthetic leather, creating a bumpy surface. Then the researchers sealed the nano-particles with a silicone resin. The coating was mostly transparent, so the leather-like texture was still visible.

To test the results, the researchers squeezed droplets of oil and water onto the synthetic leather and to determine how much the surface would have to be tilted for the droplet to roll off. Water rolled off with a tilt of 2 degrees and oil with a tilt of 4 degrees. Any tilt below 10 degrees is considered super-liquiphobic.

Durability and self-cleaning tests were also performed with successful results. Tests also showed that the coating did remain un-sticky up to 70 degrees Celsius (158 degrees Fahrenheit), so it could keep your legs from sticking to a car seat on most hot days.

Excerpts from original article by Pam Frost Gorder, Ohio State Research News



Professor Jonathan Song (center) and mechanical engineering graduate students Ehsan Akbari (left) and Melika Shahhosseini.

BLOOD VESSEL STRUCTURE

National Institutes of Health grant awarded to Song, Prakash and Castro

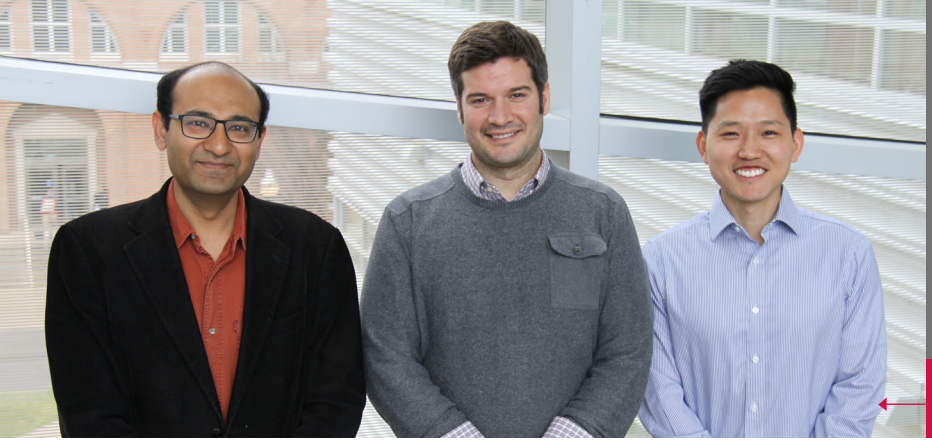
Research by a team of engineers from The Ohio State University Department of Mechanical and Aerospace Engineering aims to establish a fundamental understanding of blood vessel permeability, which could ultimately improve ways to limit excessive blood vessel growth during disease.

Co-led by mechanical engineering Assistant Professor **Jonathan Song** and mechanical engineering Associate Professors **Shaurya Prakash** and **Carlos Castro**, the researchers were awarded a $1.7 million grant from the National Institutes of Health (NIH) to investigate the biomechanical mechanisms that control the remodeling of blood vessels.

“To me,” says Song, “this project represents an ideal collaboration that both leverages and aligns the respective strengths of our labs toward addressing very important questions in biomedical science.”

Many diseases of the body involve the excessive growth of blood vessels, called pathological angiogenesis. It is believed that such growth is initially triggered by fluid forces—in this case leakage of blood plasma across the wall of the blood vessel. The target of this research is to establish an awareness of the role of endothelial cells—the cells of the blood vessel walls—in order to provide baseline knowledge for developing strategies for controlling the pathological angiogenesis.

While current research has proposed numerous ways in which fluid forces against the endothelial cells cause



"We are already seeing positive impact of the collaborative research environment for our students on related projects"

- SHAURYA PRAKASH
Associate Professor

Shaurya Prakash, Carlos Castro and Jonathan Song

blood vessels to form and remodel, a complete model of such interactions does not exist. Having a systematic framework would provide a foundation for researchers to discover methods of controlling angiogenesis, which often happens during inflammation, cardiovascular diseases and cancer.

Castro describes the significance of the group's studies. "This interdisciplinary collaboration brings a unique integration of nanomechanical devices with microscale systems for mimicking biological environments to study fundamental aspects of vascular function and investigate life-saving technologies and procedures to address some of today's most prevalent pathologies," he says.

During the four-year project the research team will accurately engineer in vitro platforms to systematically study and develop a comprehensive model of the fluid forces impacting vascular remodeling and permeability, including blood vessel architecture. Completion of these studies will help establish a new standard for controlling angiogenesis, which will benefit the treatment of vascular diseases.

A unique feature of this NIH grant combines the researchers' three complementary areas of expertise.

"I am excited to work on this interdisciplinary project that brings together diverse intellectual capabilities," says Prakash.

Prakash's expertise in the project focuses on nanofluidics and electron microscopy, while Song leads in areas related to microfluidics and angiogenesis and Castro brings his knowledge of DNA nanotechnology and nanoscale force spectroscopy.

"Moreover, working with passionate and scientifically curious students makes this project even more fun," Prakash continues. "We are already seeing positive impact of the collaborative research environment for our students on related projects."

Mechanical engineering PhD student **Ehsan Akbari** is contributing to the project. Along with Ohio State co-authors, including Prakash, he has already published the team's initial discoveries and background work for the project.

Additional contributers to the project include Ohio State Presidential Fellow **Kaushik Rangharajan**, mechanical engineering PhD student; **Melika Shahhosseini**, graduate student in mechanical engineering; and **Griffin Spychalski**, a senior honors student majoring in biomedical engineering and recipient of the Barry M. Goldwater Scholarship and Excellence in Education Program.

"Research reported in this publication was supported by the National Heart, Lung, And Blood Institute of the National Institutes of Health under Award Number R01HL141941. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health."

NIH National Institutes of Health
Turning Discovery Into Health

At the Big Data for Nuclear Power Plants Workshop, participants explored the potential applications and challenges of using big data in the nuclear power generation field.

WORKSHOP DRAWS NATIONAL EXPERTS

Big Data for Nuclear Power Plants

On September 8, 2017, the Department of Mechanical and Aerospace Engineering hosted the Big Data for Nuclear Power Plants Workshop in Columbus, Ohio.

Organized by The Ohio State University's Nuclear Engineering Program, the workshop drew nuclear energy researchers from across the nation with a keen interest in big data. Defined as high-volume and velocity digital data that requires information processing for insight and decision making, big data can have a direct impact on industrial performance.

At the Big Data for Nuclear Power Plants Workshop, participants explored the potential applications and challenges of using big data in the nuclear power generation field.

The event's keynote presenter Alper Yilmaz, professor of geodetic engineering, discussed human-cyber-physical systems (H-CPS) engineering and its impact on civil infrastructures. As a leader in computational modeling research, Yilmaz's presentation explored the technologies that nuclear engineers can use when diagnosing and controlling H-CPS shutdowns – which are stops in service to transportation networks and electricity infrastructures.

The workshop also hosted two riveting panel discussions. The first, "Use of Big Data Analytics for Improving Operational Efficiency of Nuclear Power Plants," included panelists Paul Tobin, of Rolls-Royce, Jim Heishman, of the Electric Power Research Institute, and Shawn St. Germain, of the Idaho National Laboratory (INL). The panel was moderated by Bruce Hallbert, director of nuclear-enabling technologies at the INL.

The second panel, which was moderated by Professor **Carol Smidts**, was titled "Challenges Associated with Implementation of Big Data Analytics in Nuclear Power Plants." The panelists included Wayne Lee, of Duke Energy, Clinton Carter, of Luminant, and Vivek Agarwal, of the INL.

In addition to the panel discussions, the workshop's breakout sessions allowed participants to tackle some of the most demanding challenges facing the nuclear engineering field.

Smidts and **Marat Khafizov**, assistant professor of nuclear engineering, and Hallbert served as the workshop's organizing committee.

SMART CAMPUS ORGANIZATION

New student group brings Smart Columbus initiative to campus

As researchers, local businesses and citizens of Columbus prepare to improve transportation and sustainability through the Smart Columbus program, **Danny Freudiger**, a mechanical engineering graduate student, hopes to bring similar changes to the university.

Freudiger is leading a new student organization called the Smart Campus Organization, which partners with the Center for Automotive Research (CAR) and Ohio State to "engage in internal campus projects, use campus as a test bed for industry-sponsored projects, and collaborate with the Smart Columbus initiative through the blending of students from diverse academic backgrounds."

Freudiger worked with **Maryn Weimer**, senior associate director of CAR, to bring students and CAR together to solve similar connectivity and mobility problems on campus.

Current members are a collection of undergraduate and graduate students from a variety of backgrounds.

"The main thing we look for in a new student," Freudiger disclosed, "is the ability take off their 'blinders' and look at the big picture. I think too often students have the tendency to keep their head down and only focus on their particular research area. The beauty of building a smart campus is that it encompasses so many different academic areas. The ability of our students to visualize how all these diverse pieces fit together for the betterment of the university is crucial to the success of the organization."

"Most of our projects will probably be focused on our own campus, but we want there to be significant collaboration between our student organization and the City of Columbus," said Freudiger.

"Ohio State's campus really is the heart of this city, so it only makes sense that we work together with city officials for the betterment of our community."

Members of the Smart Campus Organization supported a Ride & Drive event at CAR. Mechanical engineering graduate student Danny Freudiger (far right) is leading the student organization.

"My hope is that this organization will engage students from different academic backgrounds and teach them how to work together to achieve a common goal. That goal is the improvement of campus life here at Ohio State," Freudiger stated. "We want to use data analytics and technological advancements to improve university services. Whether those improvements are in the field of mobility or connectivity, we want students to feel as though they are connected to the campus and to each other."

Excerpts from original article published by the Center for Automotive Research.

MEMBERS OF THE DIGITAL DESIGN AND MANUFACTURING LABORATORY: *(front)* **PAYAM HAGHIGHI, LS WANG, PROFESSOR JAMI SHAH, CHRIS KIM** *and* **SATCHIT RAMNATH;** *(back)* **KAUSHALYA PUTTA.**

"Honda values practical hands on education, and our collaboration with Professor Shah continues to be extremely successful in producing students that are sought-after as recruits by many Honda Engineering Divisions."

- DUANE DETWILER
Division Director of Strategic Research Operations and Chief Engineer at HRA

DONATION SUPPORTS DESIGN EDUCATION

Honda Research & Development donates customized Acura TLX frame for research, teaching

Thanks to the generosity of Honda Research & Development Americas, Inc. (HRA), the Department of Mechanical and Aerospace Engineering has received a customized 2014 Acura TLX frame to be used in teaching and research.

The HRA facility in Raymond, OH, a close partner of the department, used a production TLX to create a one-off display in order to expose core body frame components made suitable for design education. Design specifications were created by HRA engineers, who contracted with the university's Center for Design and Manufacturing Excellence for final preparation of the display.

The department's Digital Design and Manufacturing Laboratory houses the vehicle frame, which is color-coded to indicate its different materials. Under the direction of **Jami Shah**, Honda Professor of Engineering Design, it will be used to inform research aimed at improving vehicle structures.

> **"The TLX frame will be a great educational resource for teaching and research in structural design, topology optimization, materials and joining technology for lightweight structures," said Shah. "It will allow students to get a detailed and up-close look at automotive frame structures, one of my lab's research areas."**

Since being designated as the Honda Professor of Engineering Design three years ago, Shah has spent one day per week at HRA in the Strategic Research Area. There, he's able to collaborate with engineers, access CAD files and develop research projects of mutual interest.

The relationship has also been instrumental in developing new mechanical engineering courses taught by Shah, which will utilize the vehicle frame donation.

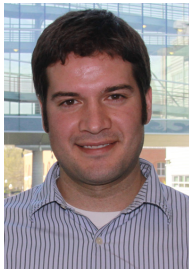
"HRA engineers have been a big part of helping me with the development of new courses in advanced CAD and finite element analysis," said Shah, who teaches both undergraduate and graduate students. "The TLX will benefit students enrolled in these classes, helping them conceptualize key elements of vehicle structures."

Division Director of Strategic Research Operations and Chief Engineer at HRA **Duane Detwiler** (BS AE, MS AE) described the significance of the donation. "Honda values practical hands on education, and our collaboration with Professor Shah continues to be extremely successful in producing students that are sought-after as recruits by many Honda Engineering Divisions."

FACULTY RECOGNITION

Associate Professor **CARLOS CASTRO**

Associate professor awarded Fulbright U.S. scholar grant



Carlos Castro, associate professor of mechanical and aerospace engineering, was the recipient of a prestigious U.S. Fulbright Scholar Grant provided by the U.S. Department of State.

Castro traveled to Dublin, Ireland during summer 2018, where he was affiliated with the Advanced Materials and BioEngineering Research (AMBER) Centre and the Royal College of Surgeons in Ireland. The title of Castro's research was "Multiscale targeted delivery of DNA origami nanodevices," and the overall goal was to establish methods for the targeted delivery of DNA nanodevices to cells or tissues by incorporating the devices into biomaterials that can safely be injected into biological systems.

"The outstanding scientific and collaborative environment of AMBER Centre, the Royal College of Surgeons in Ireland and Trinity College Dublin allowed me not only to forge invaluable connections, but also helped me take our research on nanodevices and nano robotics in a new direction of biomaterials integration, which I think will be an exciting approach to realize biomedical applications," said Castro.

Excerpts from original article published by the Office of International Affairs.

Assistant Professor **HANNA CHO**

Cho expands research initiatives with two prestigious funding awards

Assistant Professor Hanna Cho was awarded funding from the National Science Foundation (NSF) Partnership for Innovation and her previous Defense Advanced Research Projects Agency (DARPA) Young Faculty designation was converted to a prestigious Director's Fellowship.

Cho received funding in the amount of $200,000 to commercialize an atomic force microscopy (AFM) tool for enhanced materials characterization. A previous NSF-funded project enabled Cho and her team to invent the new tool: an AFM probe that significantly enhances the capabilities of current technology. Now, the new NSF-PFI funding will support the team in commercializing that technology.

In addition to the NSF award, Cho also received an extension to her DARPA Young Faculty Award, converting it to a Director's Fellowship. The original award allowed Cho to investigate mechanical resonances in microelectromechanical systems (MEMS) for two years. The competitive Fellowship will extend project funding in the amount of $471,383 to a third year, enabling groundbreaking research to continue.

Assistant Professors **RYAN HARNE** *and* **JONATHAN SONG**

Assistant Professors Harne and Song named NSF CAREER Award recipients


Harne


Song

Assistant Professors **Ryan L. Harne** and **Jonathan Song** have individually been awarded the prestigious National Science Foundation (NSF) Faculty Early Career Development (CAREER) Award. According to the NSF, the awards are given in support of early-career faculty who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization.

Harne, who joined Ohio State in 2015 and is director of the department's Laboratory of Sound and Vibration Research, will be awarded $500,000 over five years. He received the award for his proposal entitled "Adaptive Origami Structures for Acoustic Wave Guiding."

Song's proposal, "Probing the Physiochemical Regulators of Tumor Stroma Interactions Using Microfluidic Biomimicry," has been awarded just over $546,000 over five years. Song has been with the university since 2014 and is director of the Microsystems for Mechanobiology and Medicine Laboratory.

Read more about the awards: **go.osu.edu/CXp7**.

Professor Emeritus **MICHAEL DUNN**

Professor Emeritus Michael Dunn receives GPPS Lifetime Achievement Award

The Global Power & Propulsion Society (GPPS) recently selected Professor Emeritus **Michael Dunn** as the recipient of the 2018 GPPS Lifetime Achievement Award.

This annual award is given in recognition of outstanding technical and professional contributions to industry, and as recognition of the hard work and extraordinary contributions to research carried out within the engineering community. According to GPPS, the award is one in a series designed to recognize excellence and achievement in specific and general fields of power and propulsion. Dunn received the award at a ceremony held during the May 2018 Global Power & Propulsion Forum in Montreal.

GPPS is a volunteer-led international community and forum for rotating machinery professionals in industry and academia. The society's aim is to provide an environment for professionals to meet and exchange results and ideas, with specific focus on power generation and propulsion systems.

FACULTY RECOGNITION

Professor **AHMET KAHRAMAN** *and Assistant Professor* **DAVID TALBOT**

Faculty and alumni author paper honored by Society of Tribologists and Lubrication Engineers

Credit Society of Triologists and Lubrication Engineers

A peer-reviewed paper led by authors from the Department of Mechanical and Aerospace Engineering received recognition from the Society of Tribologists and Lubrication Engineers (STLE). The group earned the society's 2018 Wilbur Deutsch Memorial award, for most outstanding technical paper written on the practical aspects of lubrication published by the society in the year preceding the annual meeting. The paper—"Development and Validation of an Automotive Axle Power Loss Model"—was published in the society's peer-reviewed journal, Tribology Transactions.

Research Assistant Professor **David Talbot** is lead author, with co-authors **Ahmet Kahraman**, Wright State University's **Sheng Li**, and General Motors' **Avinash Singh** and **Hai Xu**. The external authors are also all associated with the department's Gear and Power Transmission Research Laboratory. Li (PhD ME '09, MS ME '08), Singh (PhD ME '97, MS ME '92) and Xu (PhD ME and MS ME '05) each worked as graduate research assistants in the lab during their time at Ohio State.

Professor **JAMES GREGORY**

Gregory honored as Purdue Outstanding Aerospace Engineer

Professor **James Gregory** received the designation of Outstanding Aerospace Engineer from his alma mater, Purdue University's School of Aeronautics and Astronautics.

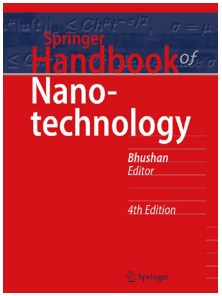
Gregory, who also serves as director of Ohio State's Aerospace Research Center, is among 2018's six distinguished honorees. According to the citation, the award recognizes the professional contributions of alumni in demonstrating excellence in industry, academia, governmental service or other endeavors that reflect the value of an aerospace engineering degree.

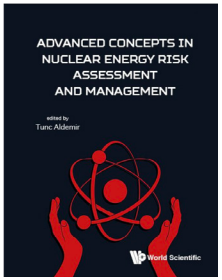
The award recipients represent just over 2 percent of the school's alumni, of which Gregory is one of the more than 8500. He received his doctorate and master's degrees in aeronautics and astronautics in 2005 and 2002, respectively.

Recent career highlights include serving as Ohio State's principal investigator as a core member of the ASSURE FAA Center of Excellence on Integrating UAS in the National Airspace System, as well as leading an Ohio State research team to set a world record for an unmanned aerial vehicle flight.

Professor **BHARAT BHUSHAN** *and Professor* **TUNC ALDEMIR**

Department faculty produce new textbooks





Professors **Tunc Aldemir** and **Bharat Bhushan** have each recently edited new textbooks.

The Springer Handbook of Nanotechnology, edited by Howard D. Winbigler Professor Bharat Bhushan, an Ohio Eminent Scholar, has become a leading reference in the nanoscience field since it was first published 13 years ago. The fourth edition of the handbook was published in October 2017 and was written by a team of more than 140 international experts in the field. An internationally recognized leader in the bio/nanotribology and bio/nanomechanics fields, Bhushan was the ideal editor for this handbook.

Professor Tunc Aldemir from the department's Nuclear Engineering Program is editor of a new book entitled Advanced Concept Nuclear Energy Risk Assessment and Management with World Scientific Publishing. The book, released in April 2018, is targeted for use by researchers and practicing nuclear engineers and contains chapters authored by investigators on advanced concepts in nuclear energy risk assessment and management. As an internationally-recognized contributor to the field of dynamic probabilistic assessment research, Ohio State's related work is reflected in four of the publication's chapters.

Professor and Neil Armstrong Chair in Aerospace Policy **JOHN M. HORACK**

National Air and Space Museum's Wall of Honor engraved to honor Horack

The Smithsonian Institution National Air and Space Museum's Wall of Honor received a new addition in 2018. **John M. Horack,** professor and Neil A. Armstrong Chair in Aerospace Policy, has been added to the distinguished list in recognition of his contribution to the nation's aviation and space exploration heritage.

Spanning over 30 years in the field of space-flight and exploration, Horack's work has been transformative. His career launched at the National Aeronautics and Space Administration (NASA) George C. Marshall Space Flight Center in 1987. Now, as inaugural Neil A. Armstrong Chair in Aerospace Policy at The Ohio State University, Horack uses his joint appointment in the College of Engineering and John Glenn College of Public Affairs to connect the university's expertise in aerospace policy and aerospace engineering. The resulting linkage aims to propel the university forward in the global spaceflight community.

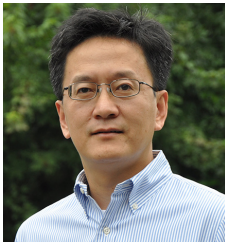
A tribute from long-time friends and colleagues of Horack, father and son Michael Griffith, PhD, and Scott Griffith, paved the way for the inclusion of Horack's name on the Wall of Honor.

NEW FACULTY APPOINTMENTS | 2018-19

AYONGA HEREID | Assistant Professor

Ayonga Hereid, joining the mechanical engineering faculty, focuses his on work on legged robots. His research interests are hybrid dynamical systems, motion planning and numerical optimization, and exoskeletons.

DEAN WANG | Associate Professor



Dean Wang's research areas are nuclear reactor design, modeling and simulation, systems and safety. He joins the Nuclear Engineering Program and is interested in solving time-dependent problems in nuclear reactor systems.

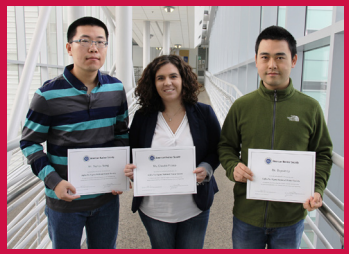
RUIKE ZHAO | Assistant Professor

Ruike Zhao is a member of the department's mechanical engineering faculty. Her research focuses on bioengineering; design, materials and manufacturing; and micro- and nanotechnology.

Three nuclear engineering students and one alum inducted into ANS honor society

As one of the leading organizations for nuclear engineering professionals, the American Nuclear Society (ANS) advances and promotes research and scholarship within the nuclear community.

The department's nuclear engineering program created the ANS Ohio State Student Chapter more than 50 years ago to stimulate interest in nuclear science and technology on Ohio State's campus.



In 2017, four outstanding ANS Student Chapter members were inducted into the ANS Alpha Nu Sigma National Honor Society. Graduate students **Claudia Picoco**, **Boyuan Li** and **Yuzhou Wang** and recent graduate **Ryan Gallagher** were given membership into the highly selective honorary.

Professor **Vish Subramaniam**, department chair, presented Picoco, Li and Wang with their certificates during the Nuclear Engineering External Advisory Board Meeting on October 13. Gallagher, who is conducting post-graduate research at the Oak Ridge National Laboratory in Oak Ridge, Tennessee, was unable to attend the ceremony.

"This prestigious membership is a lifetime honor, and it is highly selective," said Assistant Professor **Vaibhav Sinha**, faculty advisor for the student chapter. "The newly inducted members represent the outstanding students from the nuclear engineering program at The Ohio State University."

"With this fellowship, I have the freedom and opportunity to engage in research that I find fascinating and will advance the aerospace field."

- BRAXTON HARTER
Graduate Student

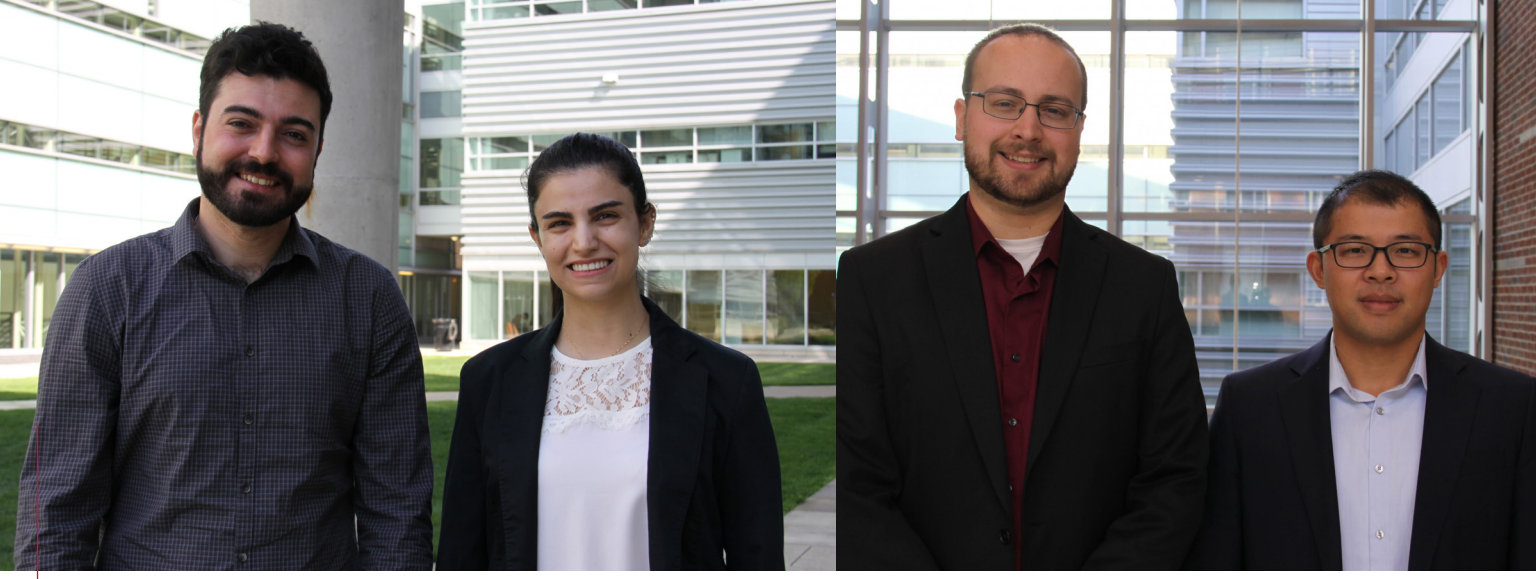
BRAXTON HARTER | *PHD AEROSPACE ENGINEERING*

Aerospace engineering PhD student honored with national fellowship

In recognition of academic excellence and science, technology, engineering and math achievements, aerospace engineering PhD student **Braxton Harter** was awarded a 2018 National Defense Science and Engineering (NDSEG) Fellowship Award.

The fellowship lasts for a period of up to three years, and covers full tuition and mandatory fees, according to its website. The Department of Defense awards the fellowships as a means of increasing the number of U.S. citizens and nationals trained in science and engineering disciplines of military importance.

Under the guidance of his advisor, Professor **James Gregory**, Harter plans to focus his research on phenomena related to the aerodynamics of Unmanned Aerial Vehicles (UAVs) in anticipation of their full integration into the National Airspace System. He's enthusiastic about the opportunities the fellowship will bring, which includes a monthly stipend and provides coverage for two trips for training and/or conferences in support of educational initiatives.



EHSAN AKBARI, **HODA HATOUM**, **LOGAN RILEY** *and* **YU SHE**

Four graduate students honored with Presidential Fellowships

Mechanical engineering PhD candidates **Ehsan Akbari**, **Hoda Hatoum**, **Logan Riley** and **Yu She** were each selected by The Ohio State University Graduate School as recipients of the distinguished Presidential Fellowship.

The most prestigious award given by the Graduate School, awardees are described as embodying the highest standards of scholarship in the full range of Ohio State's graduate programs. The esteemed designation will provide the students with full-time financial support for one year to allow them to complete their dissertations unimpeded by other duties.

Both Akbari's and Hatoum's research projects involve the intersection of engineering and medicine, specifically involving fluid mechanics and vascular health.

Akbari, advised by **Jonathan Song**, is investigating the use of DNA-based nanostructures to study how blood vessel cells communicate with each other.

Hatoum is studying the fluid mechanics of transcatheter heart valves and is advised by **Lakshmi Prasad Dasi** in the Department of Biomedical Engineering.

Advised by **Datta Gaitonde**, Riley will use his Presidential Fellowship to help hypersonic vehicles fly faster and further by exploring the unsteady operation of hypersonic vehicles.

She, advised by **Haijun Su**, is focusing his dissertation research on keeping humans safe when interacting with robots by designing a variable stiffness arm that can be used to assist human employees during manufacturing and industrial processes.

The Department of Mechanical and Aerospace Engineering has produced 16 Presidential Fellows over the past five years, evidencing the achievements and performance of faculty and graduate students.

Arif Hossain | *PHD MECHANICAL ENGINEERING*

Doctoral student honored with Young Engineer Award from American Society of Mechanical Engineers

Arif Hossain, mechanical engineering PhD candidate in the Department of Mechanical and Aerospace Engineering, was recently awarded the American Society of Mechanical Engineers (ASME) International Gas Turbine Institute (IGTI) Young Engineer Award.

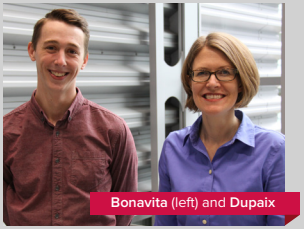
The prestigious recognition for graduate students was given at the ASME IGTI Turbomachinery Technical Conference & Exposition in Oslo, Norway. While attending the conference, Hossain presented work done in conjunction with his advisor, **Jeffrey Bons**, in the Turbine Aerothermodynamics Laboratory at the university's Aerospace Research Center.

The lab is developing innovative cooling architectures for next-generation gas turbine engines, using additive manufacturing techniques. According to Hossain, the team is particularly interested in the topics of sweeping jet film cooling and impingement cooling for gas turbine cooling applications. Hossain's work has led to new cooling strategies that can be enabled by additive manufacturing techniques.

Associate Professor **REBECCA DUPAIX** *and Graduate Student* **PETER BONAVITA**

Duo recipient of AFRL/DAGSI Ohio Student-Faculty Research Fellowship

Associate Professor **Rebecca Dupaix** and mechanical engineering graduate student **Peter Bonavita** were recently selected to receive one of 2018's Southwestern Ohio Council for Higher Education (SOCHE) fellowship awards to support their research in aerospace technology.



Bonavita (left) and **Dupaix**

The program—officially known as the Air Force Research Laboratory (AFRL)/Dayton Area Graduate Studies Institute (DAGSI) Ohio Student-Faculty Research Fellowship—is funded primarily through DAGSI by the Ohio Board of Regents. It aims to support graduate science and engineering students and faculty who conduct research in areas targeted by the AFRL at Wright Patterson Air Force Base. Target areas include a "sensors" category, under which Dupaix and Bonavita will complete their work.

Dupaix and Bonavita's project, "Thermal Management for Heterogeneous Integration to Enable Reconfigurable Radio Frequency (RF) Technology (MS)," will develop simulations to investigate thermal effects in electrical circuits, in order to better predict the heat output of various circuitry components during operation. This will ultimately inform circuit designers with thermal management information, enabling thermal management to be an integral part of the increasingly-complex design process.

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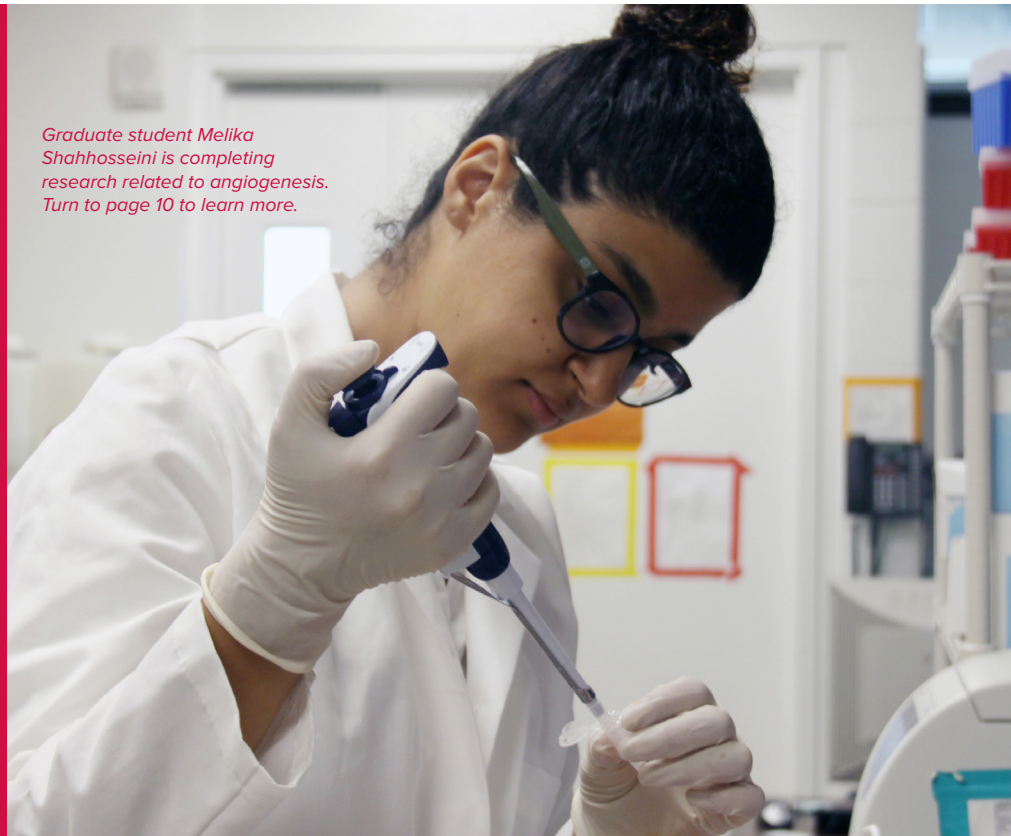

Graduate student Melika Shahhosseini is completing research related to angiogenesis. *Turn to page 10 to learn more.*