University of Delaware

Department of
Mechanical Engineering

2017 News
AND ANNUAL REPORT

College of Engineering
DEPARTMENT OF MECHANICAL ENGINEERING

INSIDE

FACULTY RESEARCH | SPOTLIGHTS ON OUR HIGH-IMPACT, MULTIDISCIPLINARY RESEARCH
Biomedical Engineering | Composites and Advanced Materials | Clean Energy and Environment
Nanotechnology Advanced Materials | Robotics and Controls

MAKER SPACE | UNDERGRADUATE LABORATORY SPACE STREAMLINED

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University of Delaware | Department of Mechanical Engineering

Message from the Chair

As we near the end of our ME125 Celebration, I am also nearing the end of my tenure as chair. It has been a privilege to serve the department, especially during this special anniversary, and it has been gratifying to see the progress we have made in so many areas.

Our design program continues to attract national attention, and we are very grateful for the financial support we received from the Unidel Foundation, as well as from alumni and friends, that has made our updated Design Studio possible.

To complement the physical facility, we have modified the undergraduate curriculum to introduce hands-on design experience in every semester—for all 600+ of our mechanical engineering students from freshmen to seniors.

We have also expanded our senior design program to include students in other engineering majors, enabling our teams to address their projects from a truly interdisciplinary perspective.

In the area of undergraduate research, we are now hosting a multi-year NSF Research Experiences for Undergraduates (REU) program through our Center for Biomechanical Engineering Research (CBER). This prestigious program enables us to bring in talented students from universities across the country for an intensive summer program in bioengineering.

All of our core research areas have received funding from agencies including the Federal Transit Administration, the Department of Defense, the National Science Foundation, and the National Institutes of Health.

Funded projects, some of which are covered in this magazine, range from self healing membranes for fuel cell applications and robot-assisted locomotor learning to functional fabrics for performance monitoring and robot-assisted radiation detection. And we continue to be proud of our faculty and the recognition they have received for their teaching, research, and lifetime achievements. You can read more about some of the recent awards won by ME faculty in this publication.

I would like to thank everyone—alumni, students, faculty, staff, and friends—who joined us at one of our anniversary events during the past year.

We have had much to celebrate, and I look forward to the continued growth and development of our department.

Best regards,

Suresh Advani

George W. Laird Professor and Chair

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High-impact, multidisciplinary research

The broadest of the engineering disciplines, mechanical engineering offers a wide range of research and career opportunities for those committed to advancing innovations to enhance quality of life.

The department is recognized for our solid technical curriculum, internationally recognized faculty and world-class, high-impact research in nearly every aspect of modern mechanical engineering.

Focusing on critical areas ranging from sustainable energy to human health and national security, our faculty and students are making bold steps toward new technologies and better solutions to contemporary problems.

The Department of Mechanical Engineering houses the Center for Biomechanical Engineering Research (CBER) and the Center for Fuel Cell Research (CFCR). Other affiliated research centers and institutes include the Center for Composite Materials (CCM), the Delaware Rehabilitation Institute (DRI) and the University of Delaware Energy Institute (UDEI). Several critical college and university-wide academic programs and research centers originated in our department.

Reflecting the interdisciplinary nature of our research, many of our faculty members hold joint or affiliated appointments in other departments.

Research expenditures of more than $7 million allow us to constantly strive to expand knowledge of the world around us in our five core research areas:

- Biomedical Engineering
- Clean Energy and Environment
- Composites and Advanced Materials
- Nanotechnology
- Robotics and Controls

Enrollment (Spring 2017)

568 ME Undergraduate
80 ME Graduate
648 ME Total

Degrees Awarded (AY 2016)

93 Bachelor's
11 Master's
9 Ph.D.

Faculty (Current)

5 Named/Chaired Professorships
9 Full Professors
10 Associate Professors
6 Assistant Professors

Faculty Publications

135 Journal Articles
222 Conference Proceedings/Presentations
5 Journal Editors

DRI DELAWARE REHABILITATION INSTITUTE

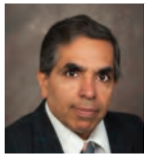
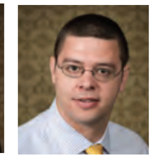
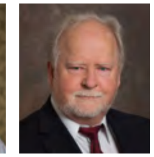
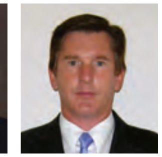
Center for Composite Materials

CFCR Center for Fuel Cell Research

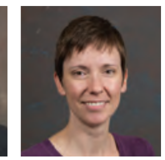
udei UNIVERSITY OF DELAWARE ENERGY INSTITUTE

CENTER FOR BIOMECHANICAL ENGINEERING RESEARCH

Mechanical Engineering Faculty Research

	Suresh Advani	Dennis Assanis	Thomas Buchanan	Jenni Buckley	David Burris	Tsu-Wei Chou	Heather Doty	Joseph Feser	Jack Gillespie	James Glancey
Biomedical Engineering			■	■	■				■	
Clean Energy and Environment	■	■			■			■	■	
Composites and Advanced Materials	■				■	■	■	■	■	■
Nanotechnology					■	■	■	■	■	
Robotics and Controls										

	Jill Higginson	Zubaer Hossain	Guoquan Huang	Michael Keefe	X. Lucas Lu	Andreas Malikopoulos	Kurt Manal	Ioannis Poulakakis	Ajay Prasad	Dustyn Roberts
Biomedical Engineering	■				■		■		■	■
Clean Energy and Environment		■							■	
Composites and Advanced Materials		■		■						
Nanotechnology		■							■	
Robotics and Controls			■			■		■		■

	Valery Roy	Michael Santare	Leonard Schwartz	Herbert Tanner	Erik Thostenson	Lian-Ping Wang	Liyun Wang	Bingqing Wei
Biomedical Engineering		■				■	■	
Clean Energy and Environment	■	■	■			■		■
Composites and Advanced Materials		■			■			■
Nanotechnology					■	■		■
Robotics and Controls				■				

Biomedical Engineering

Christopher Price and David Burris receive to shed light on how cartilage works

Cartilage, a connective tissue found throughout the body, is critical to the function of our joints. Tough yet flexible, it supports load and enables frictionless motion between joint surfaces.

Popular thinking is that cartilage degrades as we use it, much like bearings in an engine wearing down over time, but recent research has shown that activities like walking and running actually decrease the risk of joint failure.

"During loading, interstitial fluid, which comprises about 80 percent of cartilage, is automatically pressurized to support load and lubricate the joint," says **CHRISTOPHER PRICE**, assistant professor of biomedical engineering. "But pressurization also leads to fluid exuding, or oozing out, from the tissue. Thus, inactivity is likely a risk factor for joint disease because it defeats the biological, mechanical, and friction-related, or tribological, functions of cartilage. Static loading of a joint by standing or sitting for just 30 minutes causes joint spaces to thin considerably, a detrimental process that reverses itself during movement."

But the fact that activity prevents the otherwise inevitable collapse of cartilage does little to explain the underlying mechanism of cartilage recovery.

Now, with support from a National Science Foundation grant, Price is partnering with ME professor **DAVID BURRIS** to provide evidence of an alternative recovery mechanism and to fill some of the gaps in understanding of joint mechanics.

Based on previous findings, they have evidence that the joint functions like a self-pressurizing hydrostatic bearing.

"The matrix of the tissue effectively acts as a reservoir of pressurized fluid and can maintain reasonable interstitial pressures and lubrication over hours of inactivity in a typical joint — but it can't do this indefinitely," Price explains.

"Eventually, activity is required to replace the fluid lost to compression-induced fluid exudation," he continues. "At that point, sliding action hydrodynamically forces fluid from the joint space through the porous surface of articular cartilage and into the tissue, thereby restoring mechanical stiffness and lubricity, while preparing the tissue for the next round of inactivity."

Of most immediate interest to the public is the possibility that, in addition to weight control and overall health, physical activity may represent a prescription for promoting joint health.

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Biomedical Engineering at a glance

Biomedical engineering integrates engineering design and problem-solving strategies with medicine and the biological sciences to help improve human health and quality of life. Research within the department applies engineering principles and techniques to the human body and medical field.

Areas of Expertise

- Cartilage biomechanics for osteoarthritis
- Cell mechanobiology for osteoporosis treatment and prevention
- Musculoskeletal modeling and simulation for healthy and impaired movement
- Neuromuscular control for stroke patients
- Sports medicine

Affiliated Research Centers

- Center for Biomechanical Engineering Research (CBER)
- Delaware Rehabilitation Institute (DRI)

Clean Energy and Environment

Bingqing Wei's lab develops new approach to improve lithium-sulfur batteries

Rechargeable lithium-ion batteries are the power behind most modern portable electronics, including cell phones, tablets, laptops, fitness trackers, and smart watches. However, their energy density — that is, the amount of energy stored within a given amount of physical space, or mass — will need to be improved for these batteries to see widespread use in smart grid and electric transport applications.

In contrast, the energy density of lithium-sulfur (Li-S) batteries is five times higher than that of Li-ion batteries. That advantage, combined with low cost, suggests that this alternative technology shows promise for high-energy storage applications.

But the use of Li-S batteries is limited by a different problem: rapid capacity fade, which means that the amount of charge these batteries can deliver at the rated voltage decreases significantly with use.

Prof. **BINGQING WEI** explains that this problem stems from a phenomenon known as the polysulfide shuttle effect, in which the spontaneous formation of polysulfides inhibits performance.

Now, Wei and colleagues have demonstrated a new polysulfide entrapping strategy that greatly improves the cycle stability of Li-S batteries.

The work is reported in the scientific article "Ferroelectric-Enhanced Polysulfide Trapping for Lithium-Sulfur Battery Improvement" published recently in Advanced Materials. The authors include researchers from Northwestern Polytechnical University, Shenzhen University and Hong Kong Polytechnic University in China.

Wei explains that the addition of ferroelectric nanoparticles into the battery cathode anchors the polysulfides, preventing them from dissolving and causing the loss of active materials at the cathode.

While the mechanism underlying the trapping of polysulfieds is unclear at this point, we're optimistic about the potential of this approach to enable high-performance lithium-sulfur battery applications, as it not only solves the problem of the polysulfide shuttle effect but also can be seamlessly coupled to current industrial battery manufacturing processes," Wei says.

Based on article "Ferroelectric-Enhanced "Ferroelectric-Enhanced Polysulfide Trapping for Lithium–Sulfur Battery Improvement," Advanced Materials, 2016, vol. 29, issue 6, 1604724.

The research was funded by the National Natural Science Foundation of China (51674202, 51302219, 51521061, 51302172, and 51472204), the Natural Science Foundation of Shannxi Province (2015JM2045), the Specialized Research Fund for the Doctoral Program of Higher Education of China (No. 20136102120024), the Fundamental Research Funds for the Central Universities (3102014JCQ01019 and 3102015BJ(II)MYZ02) and the Shenzhen Key Laboratory of Special Functional Materials, Shenzhen University, China.

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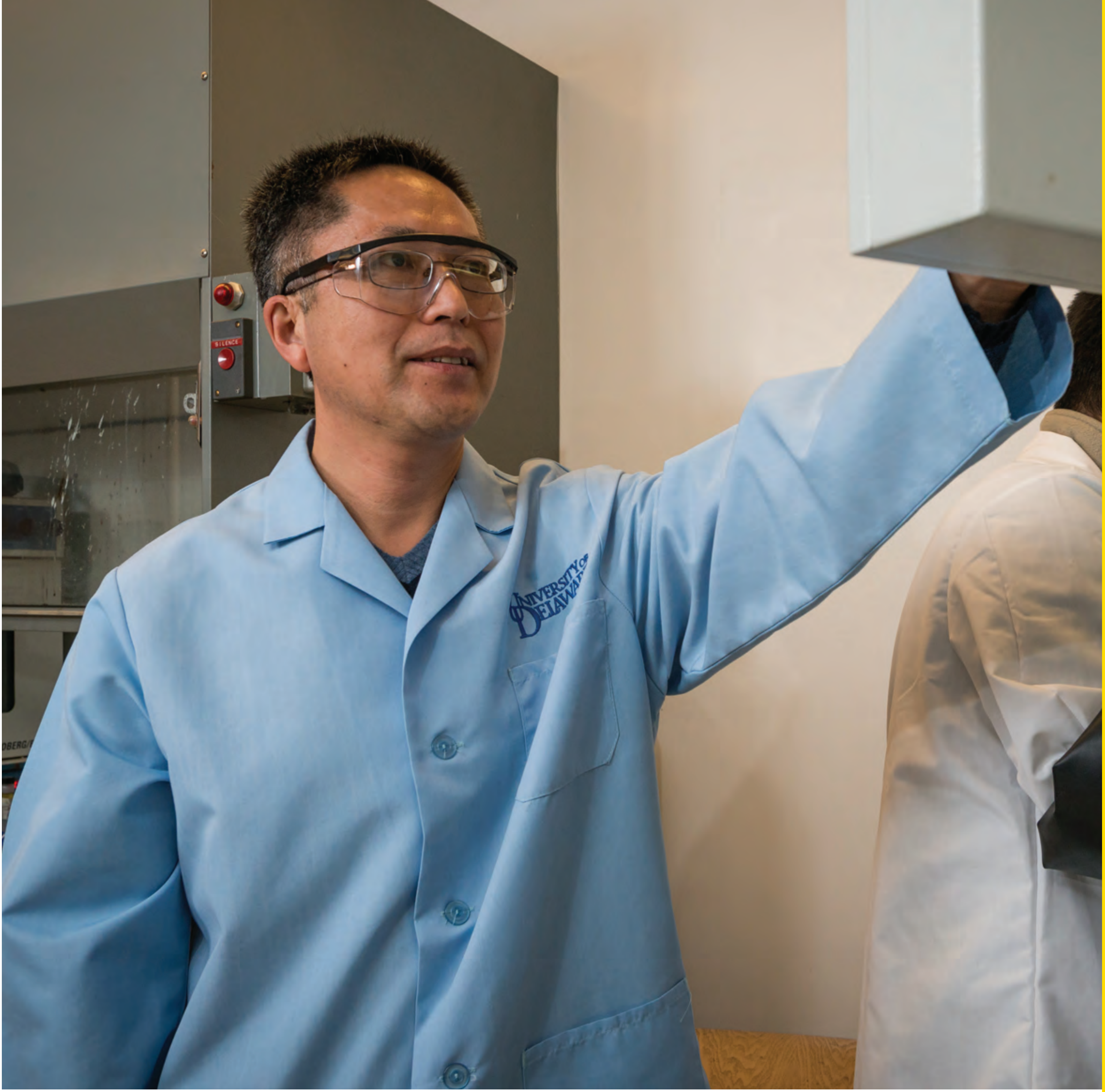

Clean Energy and Environment at a glance

One of the biggest challenges in today's world is sustainably generating, converting, transporting, storing and using energy. The department, with its traditional focus on thermodynamics, heat transfer and machine design, is well poised to respond to these concerns.

Areas of Expertise

- Wind energy
- Fuel cells, batteries, ultracapacitors, thermoelectrics and other energy-conversion devices
- Hybrid vehicle design and demonstration under intelligent control with real-time traffic feedback
- Computational fluid dynamics of warm rain, coal combustion and environmental-pollutant transport

Affiliated Research Centers

- Center for Fuel Cell Research (CFCR)
- Institute for Energy Conversion (IEC)
- University of Delaware Energy Institute (UDEI)

Composites and Advanced Materials

Professors Thostenson and Schumacher engineer new structural health monitoring technique

Aging, deterioration and extreme events like earthquakes and hurricanes can take a toll on roads, bridges and other structures. With damage and defects often invisible, the search is on for systems that can monitor the health of structures and alert their owners to potential problems and even impending catastrophic failure.

Several years ago, **ERIK THOSTENSON** and **THOMAS SCHUMACHER**, both affiliated faculty members in UD's Center for Composite Materials, began to explore the use of carbon nanotube composites as a kind of "smart skin" for structures.

Now, they have improved on this approach with the addition of another technique called electrical impedance tomography (EIT), which uses surface electrode measurements to create an image of the conductivity of a material or structure. While EIT has been used as a noninvasive medical imaging technique since the 1980s, it has largely been overlooked by the structural health monitoring community.

The UD team's development of the new approach, which applies EIT to a distributed carbon-nanotube-based sensor, is documented in a paper published in the *Journal of Nondestructive Evaluation* in June 2016. The paper was named one of the most cited, downloaded and shared papers of 2016.

"While the feasibility of employing carbon-nanotube-based composites as sensors has been validated, the typical approach is to use a series of one-dimensional measurements collected from a two-dimensional sensing area," says Thostenson, whose expertise lies in processing and characterization of composites for sensor applications. "The problem is that this confines the possible damage locations to the grid points of the measurements. EIT, on the other hand, is a true 2-D algorithm."

The nanotube composite sensor can be adhered to virtually any shape to detect damage and to show its location within the material or structure. Other advantages are that it is mechanically robust and that its electrical properties are isotropic, or the same in all directions. For Schumacher, a structural engineering researcher who envisions using the technique on in-service structures, major benefits of the new sensing technique are that it can be scaled up and that it is relatively inexpensive, as it doesn't require a large quantity of carbon nanotubes.

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Based on article "A Novel Methodology for Spatial Damage Detection and Imaging Using a Distributed Carbon Nanotube-Based Composite Sensor Combined with Electrical Impedance Tomography", Journal of Nondestructive Evaluation *(2016) 35: 26.*

The research was supported by the National Science Foundation through the CMMI Division, Award # 1234830

Composites and Advanced Materials at a glance

Research in advanced materials aims to accelerate the pace of discovery, deployment and recyclability of material systems. Composites—hybrids formed by combining two or more materials—can be tailored to optimize their properties to suit desired applications, offer performance advantages (e.g., stronger and/or lighter) and incorporate multiple functionalities in contrast to traditional materials.

Areas of Expertise

- Stronger, more durable composite membranes for fuel cell hybrid vehicles and stationary power production
- Modeling and simulation for virtual composite manufacturing and process optimization for large-scale structures
- Multi-scale modeling of composite structure and performance (e.g., airplane fuselages, automotive hoods)
- Multifunctional composites for damage detection and structural health monitoring (e.g., pressurized tanks and bridges)

Affiliated Research Centers

- Center for Composite Materials (CCM)

Nanotechnology

Professors Prasad and Advani invent self-healing membrane for fuel cell applicationss

Fuel cells, which offer a cleaner, more efficient alternative to the combustion of gasoline and other fossil fuels, are an important enabling technology for the nation's energy portfolio.

"Hydrogen-powered polymer electrolyte membrane fuel cells have already demonstrated the potential to replace internal-combustion engines in vehicles and to provide power in stationary and portable applications," says **AJAY PRASAD**, director of the Center for Fuel Cell Research.

Fuel cells are energy efficient and clean, and the hydrogen fuel can be generated from a variety of domestic sources. However, a major challenge to commercialization of this technology is the durability of the membrane, which is typically made from a polymer called Nafion®. During fuel cell operation, the membrane undergoes chemical and mechanical degradation, leading to cracks and pinholes that shorten its life.

To address this issue, Prasad, **LIANG WANG**, and **SURESH ADVANI** have developed a self-healing membrane incorporating microcapsules prefilled with a Nafion® solution. The work is reported in a paper published in the Journal of The Electrochemical Society. A patent application has also been filed.

"The microcapsules are designed to rupture when they encounter defects in the membrane and then release the prefilled Nafion® solution to heal the defects in place," Wang explains.

Durability testing of the developed membrane has confirmed that the self-healing functionality could greatly extend its useful life.

"Membrane defects are impossible to detect and repair in an operating fuel cell," Advani says. "The only solution currently is to replace the entire membrane electrode assembly, which is prohibitively expensive."

"The possibility of employing self-healing polymeric materials that can heal cracks and pinholes in place is an exciting prospect for extending the working life and safety of such systems while also reducing the life-cycle cost," he adds.

Based on article "Self-Healing Composite Membrane for Proton Electrolyte Membrane Fuel Cell Applications," Journal of the Electrochemical Society, (2016) volume 163, issue 10, F1267-F1271

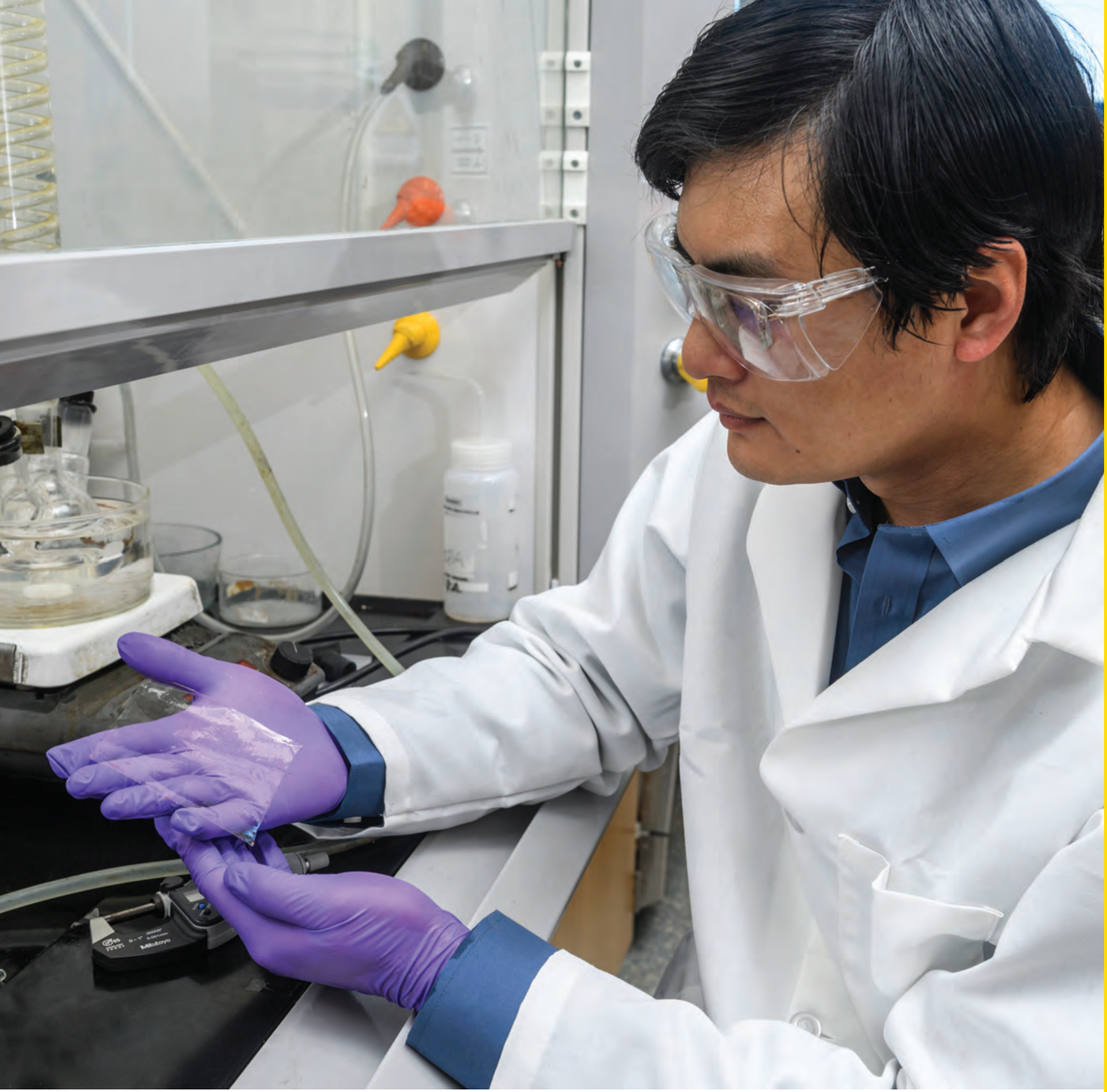
The research was supported by the University of Delaware's Fuel Cell Bus Program, which is funded by the Federal Transit Administration.

Liang Wang is an associate scientist in the Department of Mechanical Engineering.

Suresh Advani is George W. Laird Professor and chair of the Department of Mechanical Engineering.

Ajay Prasad is Engineering Alumni Distinguished Professor in the Department of Mechanical Engineering and director of the Center for Fuel Cell Research.

- The researchers have developed a self-healing membrane incorporating microcapsules prefilled with a Nafion® solution
- Durability testing of the developed membrane has confirmed that the self-healing functionality could greatly extend its useful life.



Nanotechnology at a glance

Nanotechnology is an emerging field that encompasses the manipulation of materials at the atomic and molecular scales (1–100 nanometers). This capability has enabled the development of new materials and devices that exhibit novel properties. Research in the department spans a wide range of topics, including processing, characterization and predictive modeling.

Areas of Expertise

- Synthesis and characterization of nanoscale materials (nanoparticles, carbon nanotubes, graphene) for durability, damage sensing and structural health monitoring
- Processing and characterization for manufacturing of flexible electronics and digital displays
- Scalable nanomanufacturing for battery and sensor applications
- Nanoscale transport phenomena to modify electrical and thermal properties of structures and components

Robotics and Controls

Team explores use of mobile robots to detect radiation

The department's three robotics experts—**BERT TANNER**, **PAUL HUANG**, and **IOANNIS POULAKAKIS**—have received a grant from the Defense Threat Reduction Agency to study how teams of autonomous robots can help detect radioactive materials. The DTRA is an agency within the Department of Defense focused on combating weapons of mass destruction.

Working in collaboration with Los Alamos National Laboratory, the UD team is using off-the-shelf hardware but new state-of-the-art algorithms to improve detection performance. Funding for the three-year project totals almost $700,000.

Tanner explains that mobile radiation detection networks can offer an additional layer of safety and security against the release and/or proliferation of radiological agents.

"For these detector networks to scale, the sensors themselves have to be relatively inexpensive, so that they can be deployed in numbers," he says. "Using commercial detection technology, we are investigating how controlled sensor mobility and judicious networking can help to boost the detection performance of such networks."

There are a number of challenges associated with this effort. Signals may be weak and comparable to background noise, and the sources of those signals can be in transit, therefore offering only a limited detection time window. Also, the environments where the robots are deployed may not allow for accurate localization.

The UD researchers will focus on perception and localization, navigation and target tracking, and networked decision-making, while Los Alamos will address radiation sensor configuration and signal processing.

"Our hope is that this work will help to reduce the threat of clandestine attacks involving fissile materials and contribute an additional layer of security and prevention," Tanner says.

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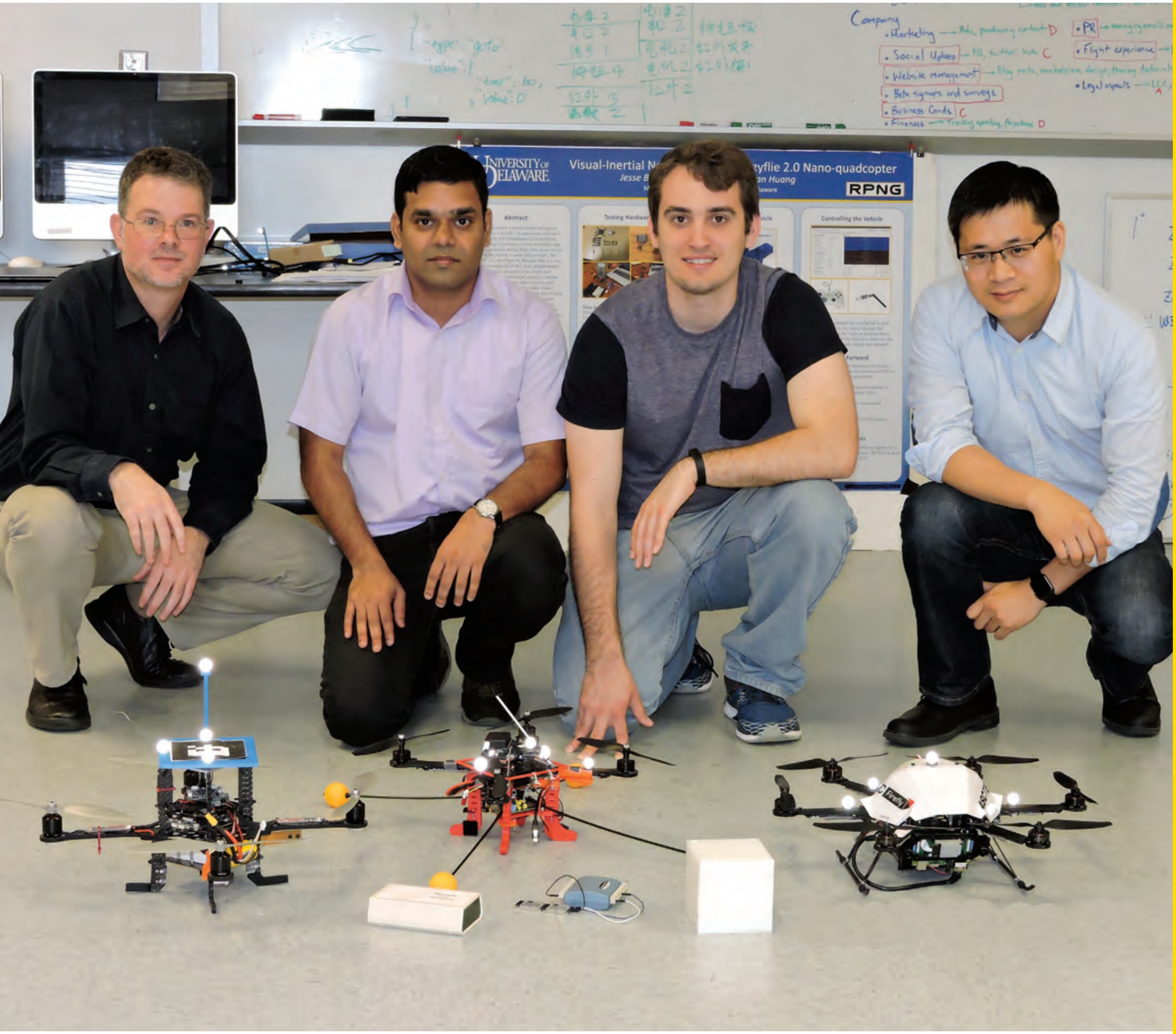
- The department's three robotics experts are studying how teams of autonomous robots can help detect radioactive materials.



Robotics and Controls at a glance

From the deepest oceans to outer space, robotic devices have been used in search-and-rescue missions, in environmental exploration and inspection, and in a host of other applications. Among the main motivations for designing, controlling and deploying robots is to replace humans in "dull, dirty and dangerous" jobs.

Areas of Expertise

- Robotic navigation and mapping for exploration and intelligence gathering
- Human-assistive technologies for the visually or mobility-impaired
- Robotic networks for cooperative active sensing in environmental monitoring and intelligent transportation
- New bio-inspired mobile robotic designs and control algorithms for emergency response and defense

Healthy Knees

NIH grant supports investigation of connection between ACL surgery and osteoarthritis

Every year, about 250,000 people in the U.S. sustain injuries to the anterior cruciate ligament (ACL), and about half of these individuals end up having reconstructive surgery.

But even more disturbing is that some 30 to 60 percent of those who undergo surgery develop osteoarthritis (OA) within five years.

"ACL injury typically affects active young adults participating in sports like basketball, football, skiing and soccer, which means that this population is developing OA in their 20s and 30s," says **THOMAS BUCHANAN**, George W. Laird Professor and director of the Delaware Rehabilitation Institute.

"Although they're not experiencing symptoms at this point, X-rays show evidence of early-stage OA," he adds. "And chances are that within another five to 10 years, they're going to need knee replacement surgery, which is not an option for people that young."

Buchanan is collaborating with **LYNN SNYDER-MACKLER**, Alumni Distinguished Professor of Physical Therapy, to shed light on the ACL-OA connection, so that therapeutic interventions can be developed to prevent it.

They recently received a grant from the National Institutes of Health to examine both the biochemical and biomechanical bases for the development of OA after ACL surgery.

The two have been working together for more than 15 years, with Buchanan bringing knowledge of biomechanical modeling and Snyder-Mackler providing expertise in clinical treatment approaches.

Data collected during their previous studies showed that some patients displayed unusual gait mechanics within the first six months after surgery.

"Biomechanical analysis from our lab showed that the injured knee undergoes unloading — that is, the joint contact force is less in the involved knee than in the uninvolved knee when the patient walks," Buchanan says. "The unloading occurs immediately after injury and is still quite pronounced at six months."

"However, even though loading typically returns to normal at about the two-year point, we found that those people who had evidenced a difference in loading right after surgery were more likely to develop OA five years out," he adds. "This finding suggests that there may be a window of opportunity for treatment if we can figure out what happens within the first two years that sets some knees up for OA."

Under the new NIH grant, the researchers plan to study people at three months, six months and two years following ACL surgery, with three aims.

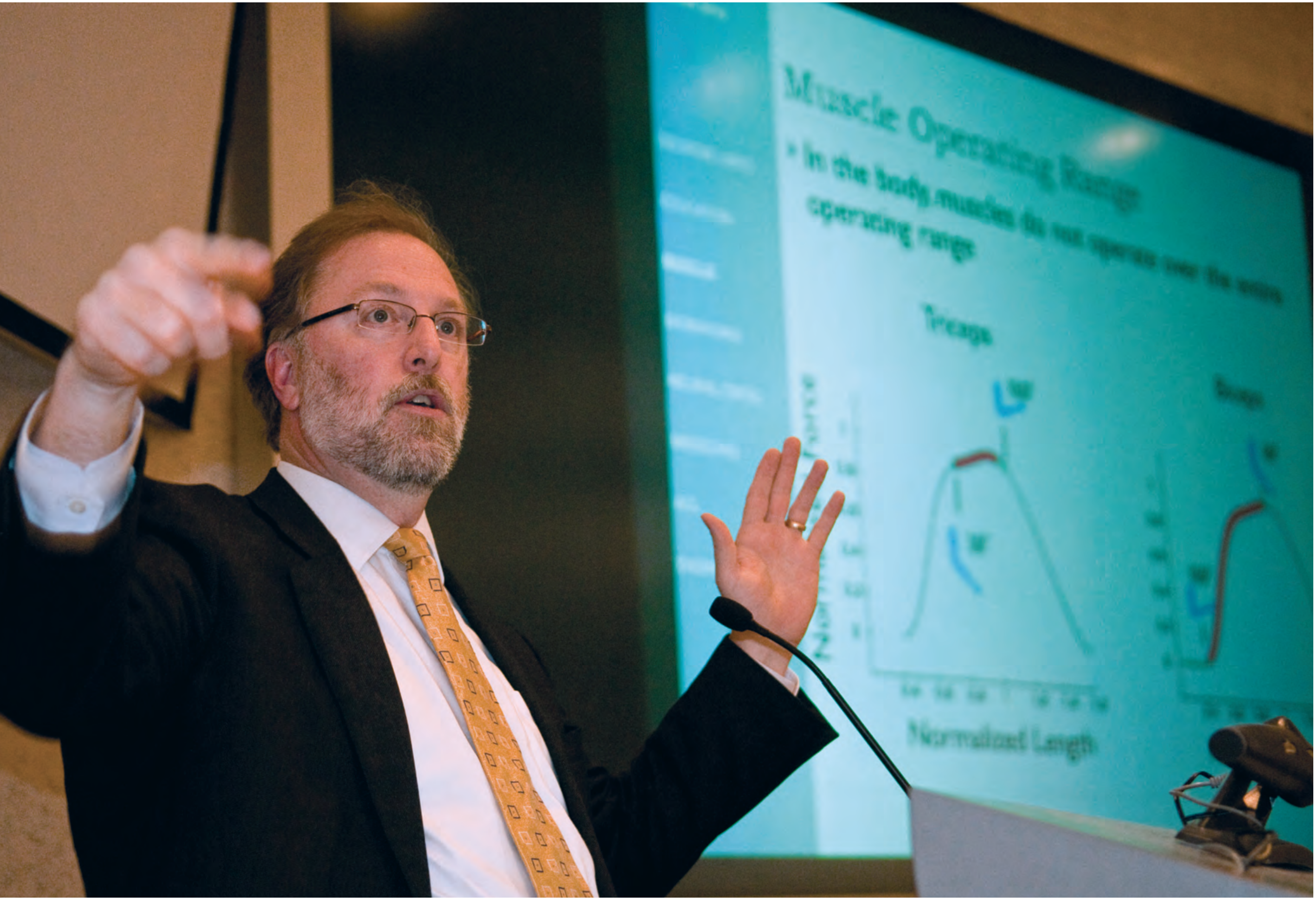
The first is to explore the biomechanical basis of the observed unloading using gait analysis and electromyography, a procedure to assess the health of muscles and the nerve cells that control them.

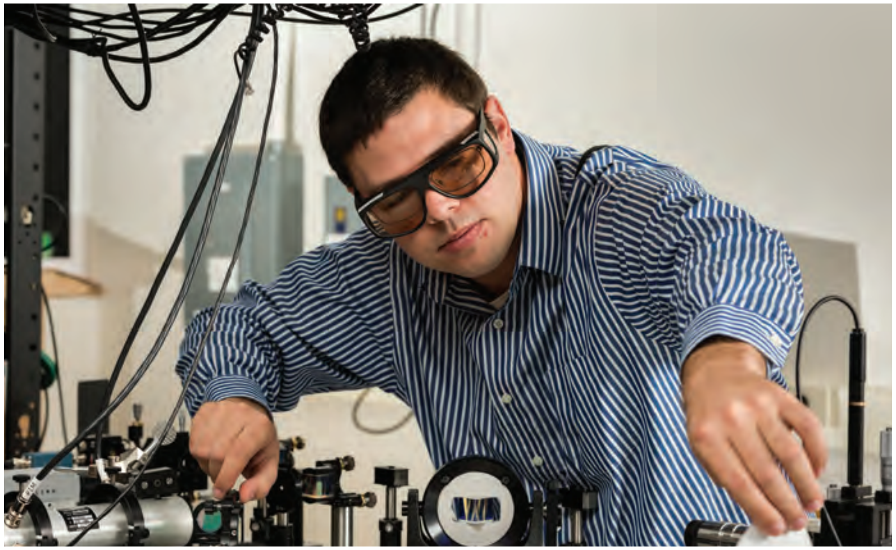
Second, they will use quantitative magnetic resonance imaging (qMRI) to detect biochemical changes in the cartilage at the same three points in the post-surgery period. This part of the work will be carried out in UD's new Center for Biomedical and Brain Imaging, which houses a state-of-the-art functional MRI (fMRI) scanner. The NIH funding will support the software upgrades needed to carry out the qMRI planned for the knee study.

Finally, the team will examine the effect of knee loading differences on knee cartilage stress distribution using a finite element model, which will enable them to determine precisely how the loading and biochemical changes influence the pressure in the cartilage.

"We believe this approach will allow us to understand the mechanisms governing knee unloading following ACL reconstruction and enable us to make recommendations for clinical treatment paths to avoid the development of OA in this population," Buchanan says.

The grant, "ACL Reconstructed Knee: qMRI and Biomechanical Modeling," totals $357,234 and was awarded through the Eunice Kennedy Shriver National Institute of Child Health and Human Development.


Muscle Operating Range
Triceps
Normalized Length



NSF Career Award

Feser's research to focus on engineering of materials with improved thermal properties

At a microscopic level, heat flow in many materials occurs through random vibrations, called phonons, that transport energy in a wave-like manner.

Recently, assistant professor **JOE FESER** received a National Science Foundation Faculty Early Career Development Award to explore the physics of thermal energy transport in materials with embedded nanoparticles. The five-year, $500,000 grant will enable research on how to manipulate heat transfer by phonons, using embedded nanoparticles.

"Phonons interact with any impurities they encounter, including particles, leading to energy scattering that impedes the flow of heat," Feser explains. "Our goal is to leverage new theoretical, computational, and experimental techniques to understand how phonons interact with nanoparticles and to use that information to engineer materials with improved thermal properties."

The scientific findings from the project could lead to nanostructured electronic and optical materials with improved heat dissipation capabilities as well as to thermoelectric materials that directly convert heat to electricity and vice versa with unprecedented efficiency.

Thermoelectric materials, which generate electrical energy from a heat source or remove heat when an electric current is passed through them, are seeing increased use in a variety of power generation and cooling applications.

One particular advantage of these materials is that they can convert waste heat — from, for example, solar radiation, automotive exhaust, and industrial processes — to electricity.

Feser will explores two scientific hypotheses in the NSF project.

"The first is that a phenomenon known as Mie scattering is far more important to transport than previously recognized, and this changes the geometric and materials design rules for thermal control of nanocomposites," he says.

"We're also keen to understand whether localization governs the physics of long-wavelength phonons important to thermal transport in dense nanoparticle-in-alloy materials, and whether that can be exploited to create materials with extraordinary insulating properties."

In addition to research, the project includes two educational outreach programs, one for at-risk K-8 children in Wilmington, Delaware, and the other targeted to industrial users with the goal of transferring ultrafast thermal measurement technology to nonacademic end users.

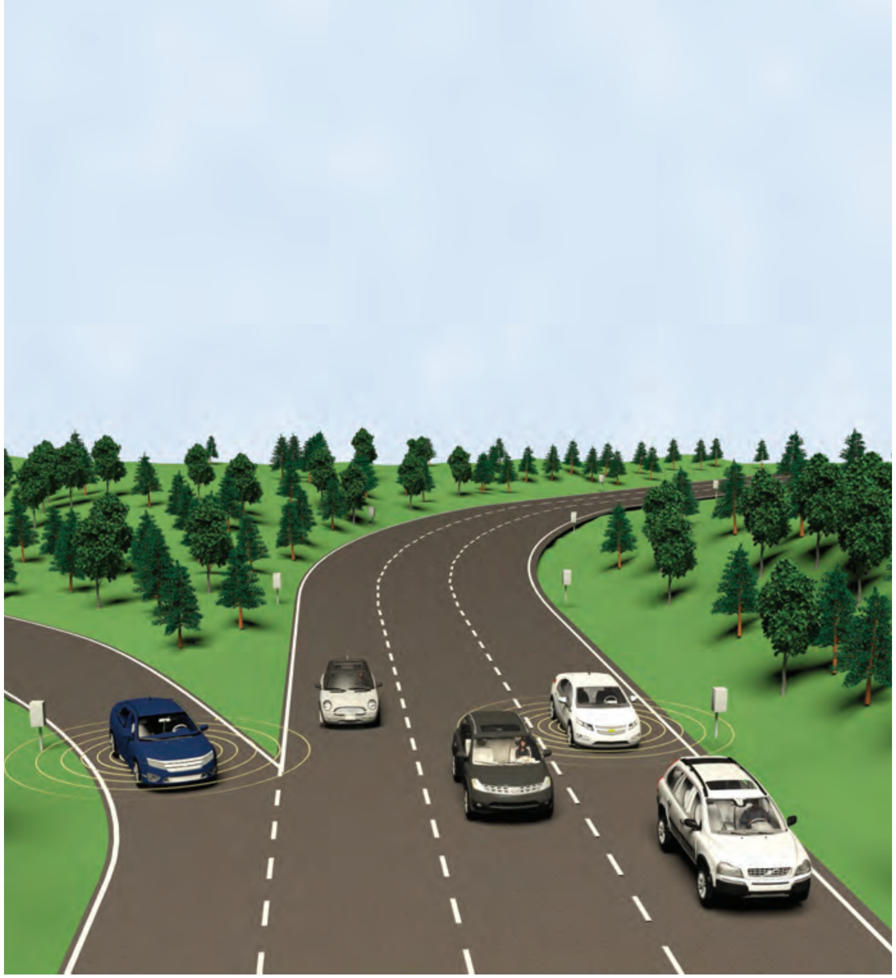
The grant was awarded through NSF's Division of Chemical, Bioengineering, Environmental, and Transport Systems.

ABOUT THE RESEARCHER

Joe Feser received his bachelor's and master's degrees in mechanical engineering at the University of Delaware in 2003 and 2005, respectively, and his doctorate from the University of California, Berkeley, in 2010. He served as a postdoctoral researcher at the University of Illinois, Urbana-Champaign from 2011-13 and then joined the UD faculty.

Feser leads the Microscale Thermal Transport Lab (MuTT Lab) at UD, which focuses on developing tools to study microscale thermal transport phenomena, new materials that push the limits of achievable transport properties, and new device technologies based on these materials.

Application areas include the cooling of electronic devices, energy efficiency, thermoelectric energy conversion, and next-generation magnetic recording devices.



ANDREAS MALIKOPOULOS ***is developing and implementing control technologies aimed at maximizing the energy efficiency of plug-in hybrid electric vehicles.***

ARPA-E NEXTCAR Program

Principal Investigator: Professor Andreas Malikopoulos

Simultaneous Optimization of Vehicle and Powertrain Operation Using Connectivity and Automation

Total Award: $4,196,480; Period of Performance: 36 months

The overarching goal of this project is to develop and implement control technologies aimed at maximizing the energy efficiency of a plug-in hybrid electric vehicle (PHEV) without degradation in tailpipe out exhaust emission levels, and without sacrificing the vehicle's drivability, performance, and safety. The technologies will exploit connectivity between vehicles and the infrastructure to optimize concurrently vehicle-level and powertrain-level operations. It will be applied to the operation of the vehicle over a range of real-world driving scenarios deemed characteristic of typical commutes. The project will deliver control technologies with the capabilities to achieve the following: 1) compute optimal routing for any desired origin-destination to bypass bottlenecks, accidents, special events, and other conditions that affect traffic flow, 2) accelerate/decelerate optimally based on traffic conditions and the state of the surrounding roads to avoid getting into congestion so that the vehicle will not have to come to a full stop, thereby conserving momentum and improving efficiency, and 3) realize online the optimal efficiency of the powertrain. The long-term potential impact of this project is substantial. Energy efficiency will be increased, and thus the market penetration of hybrid electric vehicles and PHEVs will be boosted dramatically with significant implications in reducing oil displacement and greenhouse gas emissions. The expected outcome of this project will promote scientific and technological innovations that will eventually advance the economic and energy security of the US, and decrease the dependence on foreign energy sources.

The other partners of this project are Bosch, Boston University, University of Michigan, and Oak Ridge National Laboratory.

Best Paper

Mechanical engineering faculty share importance of integrating makerspace into curriculum

Makerspaces and design centers are springing up on college campuses across the country, providing students with fabrication resources for hands-on learning.

But **DUSTYN ROBERTS** and **JENNI BUCKLEY** believe that the people affiliated with these spaces matter as much as, if not more than, the machines.

The two assistant professors recently shared their "recipe" for integrating a design studio into the curriculum with attendees at the First International Symposium on Academic Makerspaces (ISAM), held from Nov. 13-16 at MIT.

The pair received a best paper award for their submission, "The Role of a Design Studio in a Mechanical Engineering Department." They were recognized for "demonstrated impact of an academic makerspace."

"We highlighted the fact that our space grew organically in response to student curricular and programming needs," Buckley says. "This makes us very different from a lot of programs that have state-of-the-art makerspaces but no connection to the curriculum. A culture that encourages informal interactions between the communities the makerspace serves is what distinguishes it from a facility used only for fabrication."

The 5,500-square-foot Design Studio is actually a set of interconnected rooms located in Spencer Laboratory. The facility includes equipment ranging from digital fabrication equipment, electronics workstations, testing rigs, and rapid prototyping equipment to such low-tech tools as drills, sanders, wrenches, and even sewing machines.

The suite also includes a student machine shop managed by full-time machinist Scott Nelson, who provides safety training, equipment demonstrations, operating procedures, and general oversight of student work.

"The studio isn't fancy, but that's a good thing because the students are not intimidated by working there," says Roberts. "They can try things and they can break things and that's OK."

The facility is used extensively to support the curriculum, with 80 percent of mechanical engineering courses having some involvement in the space.

On a recent day in early December, the studio was especially busy, with the senior design project deadline looming.

"Some schools are trying to figure out how to get students into their makerspaces," Buckley says. "We have the opposite problem here."

Teaching Award

Buckley honored for excellence in teaching

"I think that students learn best by doing. Now, that 'doing' needs to be guided, especially in the early years, both in terms of performance expectations and how the hands-on exercise meshes with the theory that they're learning through lecture and reading. My goal as a teacher is to be relevant to the intellectual and career development of my students. I see my students as my future colleagues. I want them to have the knowledge base, the enthusiasm and the self-motivation for excellence that will allow them to be strong engineers." –Jenni Buckley

JENNIFER BUCKLEY, ***assistant professor of mechanical engineering, received the University of Delaware's 2016 Excellence in Teaching Award.***

Trabant Award

Doty honored for improving women's equity at UD

Assistant professor **HEATHER DOTY** has been awarded the 2017 E. Arthur Trabant Award for Women's Equity at the University of Delaware. Doty was honored at the 2017 Women of Honor dinner for her work with a number of organizations geared toward enhancing diversity and inclusion for faculty, students, and staff at UD.

Doty is co-PI on UD's NSF ADVANCE Institutional Transformation grant, which aims to increase the number of women faculty in STEM and the social sciences. In this role, Doty leads initiatives that provide professional-development opportunities to faculty, e.g., formal mentoring, promotion and tenure panels, networking lunches.

Doty is also faculty advisor to the College of Engineering's Women in Engineering Graduate Student Steering Committee. The committee, which comprises two women graduate students from each engineering department, organizes networking and career-development programs for graduate students, postdocs, and faculty.

Doty was an elected member of the Executive Board of Directors of UD's Women's Caucus from 2013-2017, serving as faculty co-chair from June 2016 - January 2017. The Caucus advocates for positive change on issues of importance to women employees at UD. As a board member Doty advocated for a proposed policy revision that would provide staff members paid time off for the birth or adoption of a child.

Sauveur Award

Chou recognized by ASM International for seminal work in composites, energy storage

TSU-WEI CHOU, Unidel Pierre S. du Pont Chair of Engineering, has been selected to receive the 2017 Albert Sauveur Achievement Award from ASM International, a professional organization for materials scientists and engineers.

Chou was recognized for seminal theoretical and experimental work on the processing-microstructure-property relationship essential to the engineering of advanced fiber composites, nanocomposites, and energy storage devices.

The award, which was established in 1934, recognizes "pioneering materials science and engineering achievements that have stimulated organized work along similar lines to such an extent that a marked basic advance has been made in materials knowledge."

The award presentation will be made at the MS&T '17 - Materials Science and Technology Conference and Exhibition in Pittsburgh, Pennsylvania.

A composites pioneer who launched his career 47 years ago, Chou has worked with a wide variety of materials and geometries, including hybrid composites, textile structural composites, flexible composites, and most recently nanocomposites. He and his research team have demonstrated unique applications of carbon nanotube-based continuous fibers in multifunctional composites and energy storage devices.

In 2011, Times Higher Education ranked him 34th on its list of the top 100 materials scientists of the past decade.

Chou joined the UD faculty in 1969 and was a founding member of the Center for Composite Materials (CCM). In addition to his technical achievements, he is credited with pioneering and sustaining many of the international collaborations that have made CCM recognized throughout the world.

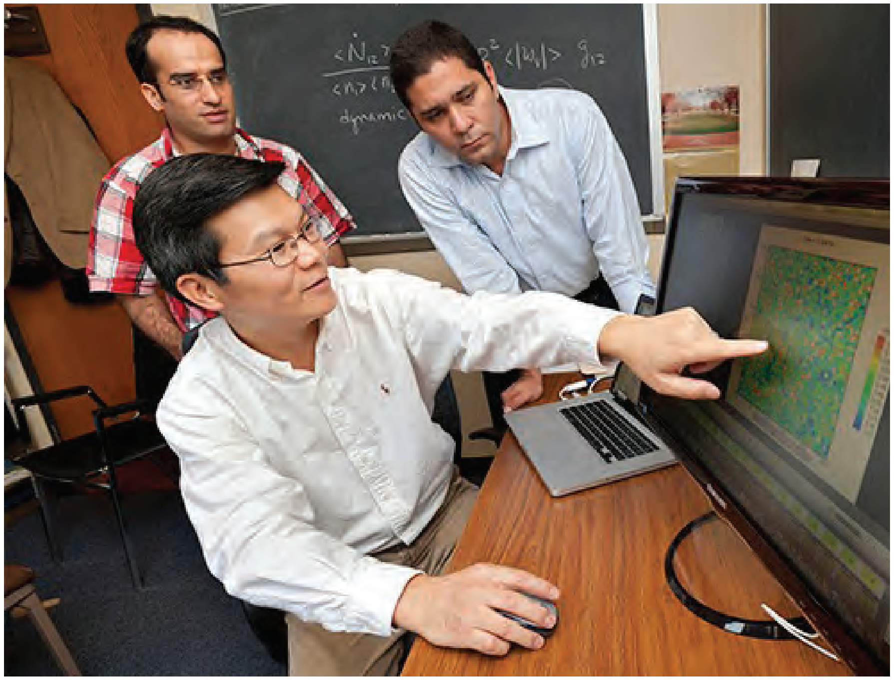
The author of some 350 journal articles and several books, Chou is editor-in-chief of Composites Science and Technology.

A fellow of six professional societies, he has received the Charles Russ Richards Memorial Award, the Worcester Reed Warner Medal, and the Nadai Medal from ASME; the Distinguished Research Award from the American Society for Composites; and the Medal of Excellence in Composite Materials and the Francis Alison Award from the University of Delaware.

Born in Shanghai, China, Chou earned his undergraduate degree at National Taiwan University, his master's at Northwestern University, and his doctorate at Stanford University.

He is an honorary professor of four universities in China, and he has lectured and conducted research at a number of institutions around the world, including Argonne National Laboratory, British Science Research Council, University of Witwatersrand in South Africa, National Commission for the Investigation of Space in Argentina, U.S. Office of Naval Research in London, German Aerospace Research Establishment, Tongji University in China, Tokyo Science University and Industrial Research Institute in Japan.

Chou joins other giants of modern engineering in winning this honor, including Geoffrey Taylor, a major figure in fluid dynamics; George Irwin, internationally known for his study of fracture mechanics; Merton Flemings, recognized for his expertise in metal forming; and Frank Spedding, a renowned expert on rare earth elements and on the extraction of metals from minerals.



ASME FELLOW

UD's Lian-Ping Wang recognized for work in multiphase turbulent flows

Prof. **LIAN-PING WANG** has been elected a fellow of the American Society of Mechanical Engineers (ASME) for "pioneering contributions to multiphase turbulent flows," work that has generated innovative computational methods, led to new predictive tools for multiphase flow, and laid the foundation for the development of next-generation weather and climate models.

Fewer than 3,500 of ASME's 113,000-plus members have been recognized as fellows.

Wang, who is also affiliated with UD's College of Earth, Ocean, and Environment, studies how finite-size particles interact with fluid turbulence, a fundamental process for many industrial and environmental applications such as fluidized bed reactor, spray atomization, plankton life cycle in ocean water, sediment transport, warm rain initiation, volcanic ash eruption, dust storm, and sea spray.

He develops rigorous computational methods to probe and quantify particle-turbulence interactions and delivers physical models based on his numerical experiments. As a specific example, he recently investigated how air turbulence influences collision-coalescence of cloud droplets, a key process leading to precipitation formation. His parameterization of turbulent collision rate of cloud droplets has attracted attention from the international cloud physics community.

He has published over 100 journal papers covering computational methods, fluid mechanics, and atmospheric sciences.

Since 2003, Wang has been a regular visiting scientist to the National Center for Atmospheric Research (NCAR), a federally funded research and development center devoted to service, research and education in the atmospheric and related sciences.

In 2005, Wang was named an NCAR Faculty Fellow; and in 2014, he became an NCAR Affiliate Scientist.

In 2012, he was appointed Chang Jiang Visiting Professor at Huazhong University of Science and Technology in China, and he began to develop new computational methods for complex flows that he is using to address transport processes in a wider range of turbulent multiphase flows than he could previously explore. In 2016, he was named an Invitation Fellow by the Japan Society for the Promotion of Science, which provides an opportunity for him to interact with Japanese researchers on multi-scale simulation and modeling of complex flows.

Wang earned his bachelor's degree in applied mathematics and engineering mechanics at Zhejiang University in Hangzhou, China, and his doctorate in mechanical engineering from Washington State University in Pullman, Washington. He joined the UD faculty in 1994.

His research was listed among the top 50 most-cited articles in the Atmospheric Research journal in 2010 and 2011. His career honors include the Distinguished Overseas Scholar Award from China, UD's Francis Alison Young Scholars Award and UD's junior-faculty Outstanding Teaching Award. In 2011, he was named a fellow of the American Physical Society (APS).

Composites Honor

Gillespie receives Wayne W. Stinchcomb Memorial Award from ASTM

JOHN W. GILLESPIE JR., director of the Center for Composite Materials, received the 2016 Wayne W. Stinchcomb Memorial Award from the American Society for Testing and Materials. The award was established in memory of Wayne W. Stinchcomb, a fellow of ASTM and past chair of Committee D30 on Composite Materials.

Criteria include outstanding contributions in research, engineering, or teaching the technology of composite materials, as well as service and other contributions in the area of composites.

Gillespie was recognized in particular for playing a key role in mentoring his students in his "career engagement in the academic world."

Erik Thostenson who interacted with many of Gillespie's students while working on his Ph.D. in the 1990s, wrote, "His students were always extremely well prepared and had tremendous breadth and depth of knowledge in their research. He has high expectations of his students, and many of them have gone on to be leaders in industry, government, and academia."

John Gangloff, who served as president of UD's SAMPE student chapter several years ago, expressed gratitude for Gillespie's support of UD's participation in the SAMPE Student Composite Bridge Contest.

Kuang-Ting Hsiao, who completed his doctoral research at CCM, credits Gillespie with creating a very dynamic research environment and encouraging researchers, scholars, and students to communicate ideas and share results.

From left to right: Leonard Schwartz (right) receiving a Tallmadge Award; Eric Thostenson addresses BCCM-3, Brazil.

TALLMADGE AWARD

Schwartz honored for contributions to coating technology

The International Society of Coating Science and Technology presented its prestigious Tallmadge Award to professor **LEONARD SCHWARTZ** during the 18th International Coating Science and Technology Symposium in Pittsburgh on Sept. 20, 2016. The Tallmadge Award is the main award of the ISCST and is only presented once every 2 years. It honors broad and insightful fundamental contributions to the dynamics of thin liquid films along with their application to problems in coating science and technology. Prof. Schwartz has been a Director of the Society since 1998.

PLENARY LECTURE

Thostenseon addresses BCCM-3 in Brazil

ERIK T. THOSTENSON, associate professor of mechanical engineering and affiliated faculty of UD's Center for Composite Materials, gave an invited plenary address at the 3rd Brazilian Conference on Composite Materials (BCCM-3) in Gramado, Brazil, on Aug. 29. Thostenson's plenary address, "Novel Multi-Scale Carbon Nanotube Hybrid Composites: Processing, Characterization and Applications in Smart Sensing," and highlighted his pioneering research in processing of hybrid carbon nanotube/fiber composites and utilizing them as in-situ sensors for detecting damage in advanced composite materials and for use in structural health monitoring.

Meet some of our Mechanical Engineering Faculty

Suresh Advani

George W. Laird Professor and Department Chair

SURESH ADVANI has made significant scientific impact through a mixture of research, education, and leadership. Currently serving as the department's chair, he has mentored over 85 graduate students (41 Ph.D.s and 44 Masters). His leadership in in the Composites Manufacturing area in particular has helped Delaware earn a number of multi-million dollars grants over the last three decades, and has contributed to the success of UD's renowned Center for Composite Materials. Process modeling tools developed by Advani's lab are now considered a crucial component to address the challenges and gaps in the advancement of composites. In addition, starting in 2004 he helped establish a fuel cell bus program with Dr. Prasad which has resulted in contributions in fuel cells, batteries, hydrogen generation and storage in addition to testing with a fleet of fuel cell buses on the UD campus.

Advani is a Fellow of American Society of Mechanical Engineers and is the North American Editor for the journal Composites A: Applied Science and Manufacturing. He is also a prolific writer having co-authored nearly 300 refereed journal papers, co-authored or edited six books, and holding three patents. American Society of Composites recently presented him with the Outstanding Research Award for his exceptional contributions.

However, Advani has created an educational legacy as well. During his tenure as department chair, significant improvements have been made to undergraduate education including a renewed focus toward hands-on and interdisciplinary learning accomplished through the creation of the maker space (i.e. the Design Studio), increased department funding for undergraduate researchers, and the integration of other engineering majors alongside mechanical engineering students in our Senior Design capstone course. He was awarded the graduate Student Mentoring Award in 2008 and was recognized as the Educator of the year by the Society of Plastic Engineers in 2015.

Heather Doty

Assistant Professor

HEATHER DOTY earned her Ph.D. in physics at the University of California, Santa Barbara, where she studied the electronic properties of semiconductor heterostructures at low temperatures and high magnetic fields. She completed a postdoc at UCSB and then worked as a patent examiner specializing in semiconductor devices before coming to UD.

As co-PI on UD'S NSF ADVANCE Institutional Transformation grant, Doty's research explores the recruitment, retention, and advancement of women faculty in STEM fields. As a member of the UD ADVANCE leadership team, she oversees activities that directly impact faculty (e.g., faculty workshops, panels, mentoring programs).

Doty is faculty advisor to UD's Women in Engineering Graduate Student Steering Committee and is a member of the College of Engineering's Diversity Committee. She is the 2017 recipient of UD's Trabant Award for Women's Equity. In the mechanical engineering department, Dr. Doty teaches classes that apply physics concepts such as thermodynamics and classical mechanics to engineering applications.

Meet some of our Mechanical Engineering Faculty

Zubaer Hossain

Assistant Professor

ZUBAER HOSSAIN joined the ME faculty in Fall 2015. He received his PhD degree in 2011 from the University of Illinois at Urbana-Champaign. Prior to joining UD, he served as a postdoctoral scholar at the California Institute of Technology. His research interests include mechanics and physics of heterogeneous materials and structures with applications in electronics and composites.

Currently, Hossain's team is exploring new ways of designing toughness and strength in nanocomposites. By using material and structural heterogeneity as a set of engineering tools, their aim is to control various quantum and classical mechanical mechanisms that govern mechanical properties at multiple length scales under varied thermomechanical conditions.

Hossain is an active member of the American Society of Mechanical Engineers, the Materials Research Society, the American Physical Society, the American Society of Engineering Education, and the American Association for the Advancement of Science.

Dustyn Roberts

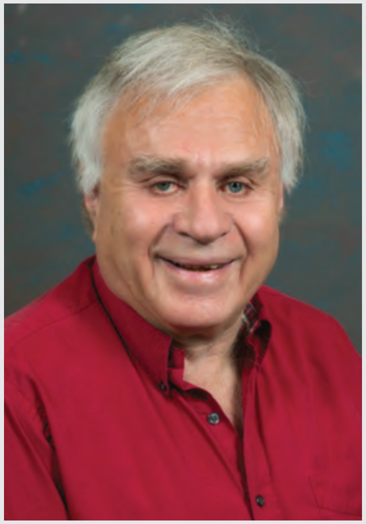
Assistant Professor

Since she joined UD in 2014, **DUSTYN ROBERTS** has helped reshape how students are taught basic engineering concepts through interactive, hands-on projects and courses. She has also brought students to the annual Maker Faire in New York, where they can showcase their projects and be exposed to engineering outside the university setting.

Roberts has acted as an advisor for students wishing to further their knowledge of controls and electronics. One of her groups created an automated guitar, the Guitarbot, which has served as an ongoing project for various students.

In addition to her ME appointment, Roberts is an affiliated faculty member in the Biomechanics and Movement Sciences Graduate Program as well as the Delaware Water Resources Center. She is also a member of the Center for Biomechanical Engineering Research and serves as co-director of the Design Studio.

Roberts won a three-year NSF Graduate Research Fellowship in 2011 and an NSF Career-Life Balance Supplemental Funding Award in 2014. She currently teaches a new course, Prototype to Product, which takes students through the process of generating a concept, testing it, perfecting it, and creating a viable prototype that can then be turned into a professional product.



Leonard Schwartz

Professor

LEONARD SCHWARTZ has been a faculty member at UD for the past 30 years. His research interests include fluid mechanics, applied mathematics, analytical mechanics, aerodynamics, and heat transfer. Most of his recent research has been in coating flows—that is, the flow and drying behavior of thin layers of viscous liquids on solid surfaces. A registered professional engineer in the State of Delaware in the fields of mechanical, civil, and aerospace engineering, Schwartz has consulted for industry for many years, including paint companies, makers of personal care products, and spectacle manufacturers, and he has served as an expert witness in legal proceedings.

Schwartz has been on the editorial board of the Journal of Engineering Mathematics as well as the board of directors for the International Society for Coating Science and Technology since 1996. In the past, he has also served as a member of both the NASA Microgravity Review panel and the NSF Fluid Dynamics Panel.

With strong ties to Melbourne University through his role as a visiting professor, he takes a group of junior mechanical and civil engineers to Australia every year for a Study Abroad program.

Liyun Wang

Associate Professor

LIYUN WANG, who joined the department in 2005, conducts research on how mechanical forces influence the health maintenance and disease development in the body. She focuses on osteoporosis, osteoarthritis, and diabetes, three diseases that inflict huge socioeconomic cost to the society. Supported by the National Institutes of Health, Wang is investigating how mechanical forces generated during physical activities are transferred to the tissue level and perceived by cells. This work may pave the way to identifying new molecular targets that could be used to improve bone's sensitivity to exercise, with the potentials of preventing and slowing the onset of osteoporosis.

Wang also works with clinicians at Christiana Care to investigate the effectiveness of exercise in improving bone health in Type 1 diabetic patients, who are at increased risk of sustaining fractures. Wang continues to investigate the effects of diabetes on the vascular health as well, and in particular, how the disease alters the way that the inner lining of the vessel responds to forces caused by blood flow.

Wang's research activities have provided rich training opportunities for undergraduates, graduates, and postdoctoral students. More than 50 undergraduates students have participated in undergraduate research in her laboratory. Wang also serves as Co-Director of the Cytomechanics Core, a shared facility to assist research in cell mechanics. She is a member of the Center for Biomechanical Engineering Research in UD, Orthopedic Research Society, American Society of Bone and Mineral, Biomedical Engineering Society, American Society of Engineering Education, and International Chinese Musculoskeletal Research Society.

Meet some of our Mechanical Engineering Faculty

Andreas Malikopoulos

Associate Professor

A 2017 addition to the ME faculty, **ANDREAS MALIKOPOULOS**. Before joining UD, Andreas was the Deputy Director and the Lead of the Sustainable Mobility Theme of the Urban Dynamics Institute at Oak Ridge National Laboratory, and a Senior Researcher with General Motors Global Research & Development.

The overarching goal of his research is to develop the theory and algorithms for making complex systems able to learn how to improve their performance over time while interacting with their environment. Current applications include connected and automated vehicles (CAVs) with the aim of (1) becoming eco-friendly, (2) realizing the optimum performance and efficiency based on consumer's needs and preferences, and (3) learning how traffic information can positively impact considerations of the environment, traffic safety and traffic congestion.

Within the capacity of his previous positions, Andreas has developed several initiatives with the goal to investigate how we can use scalable data and informatics to enhance understanding of the environmental implications of CAVs and improving transportation sustainability and accessibility.

Next year, Andreas will be teaching an undergraduate-level course, Vibration and Controls, which covers the fundamental principles of controls, and a new graduate-level course on Optimal Control.

Joseph P Feser

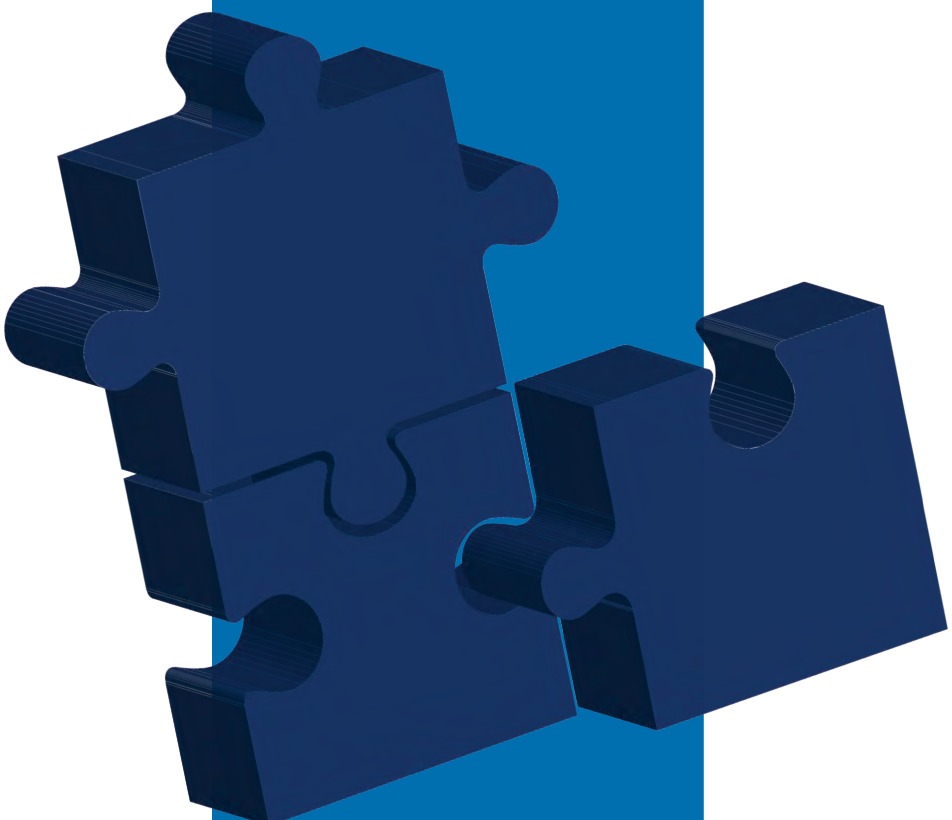
Assistant Professor

JOE FESER's MuTT (Microscale Thermal Transport) Lab focuses on understanding how heat propagates through materials at microscopic length scales. Using that information, he engineers new materials and interfaces that have extreme heat transfer abilities.

Using ultrafast lasers, Feser's lab characterizes heat transfer on femtosecond timescales—and, since heat can't move very far on short timescales, that also means that heat transfer can be confined to nanoscale distances, where much of the fundamental physics can be observed.

Ultrafast lasers can even be used to detect heat transfer resistance across a single atomic layer. Feser is currently using that capability to investigate how atomic vibrations—called "phonons" because of their similarity to light or "photon" properties—interact at abrupt interfaces between materials. Interfaces are common in high-tech devices like computer chips, next-generation hard drives, and military-grade amplifiers. In many cases, heat dissipation across interfaces represents a performance bottleneck, which Feser's lab works to address.

He is also developing computational tools to simulate atomic vibrations and their heat-carrying capabilities. These tools can be used to investigate scattering of vibrational energy from nanoparticles in composite materials, with the goal of raising the efficiency of thermoelectric devices.



NSF Grant Advances Women Faculty in STEM

UD's National Science Foundation ADVANCE Institutional Transformation grant aims to increase the number of women STEM faculty and the number of women faculty in leadership positions at UD. The five-year, $3.3 million grant is now in its third year. The grant team is led by PI **PAM COOK**, associate dean for faculty in the College of Engineering. Assistant professor **HEATHER DOTY** is a co-PI.

The grant team works at multiple levels to improve the climate for faculty. They partner with administrators and faculty groups to clarify, disseminate, and enhance policies that affect faculty careers. Activities have included:

- Working with the Faculty Senate and the provost's office to establish formal mentoring for junior faculty in all departments.
- Offering networking and professional development opportunities, including a leadership workshop for women STEM faculty, which was attended by all five mechanical engineering women faculty in Fall 2016.
- Conducting a faculty climate survey and disseminating the results every two years.

In addition, a team of ADVANCE Faculty Fellows – senior faculty who represent most UD colleges – offer workshops annually for search committee members and support formal mentoring for faculty within their colleges.

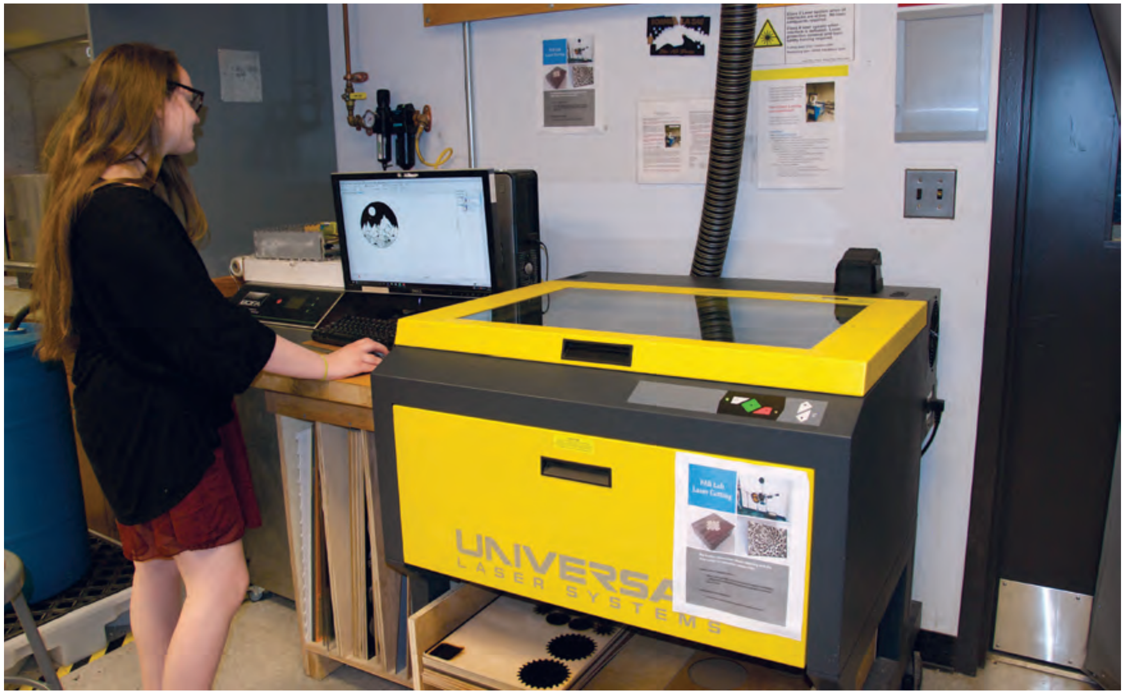

Mazak
SMOOTH
VCU-500C


PROTO TRAK SLX


AVALON

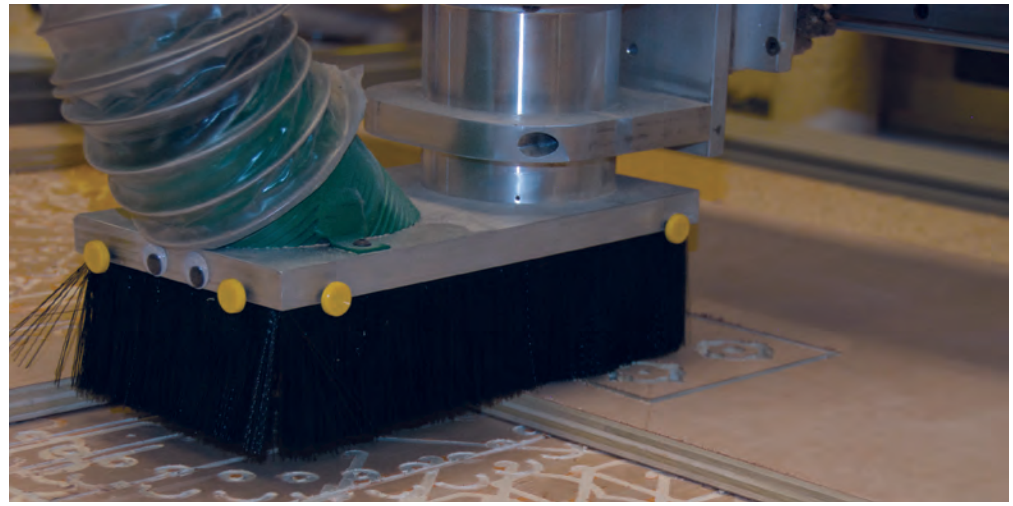
ME MAKERSPACE IMPROVEMENTS

With the help of a grant from the Unidel Foundation, the ME department made numerous equipment acquisitions and facilities upgrades to our student makerspaces.

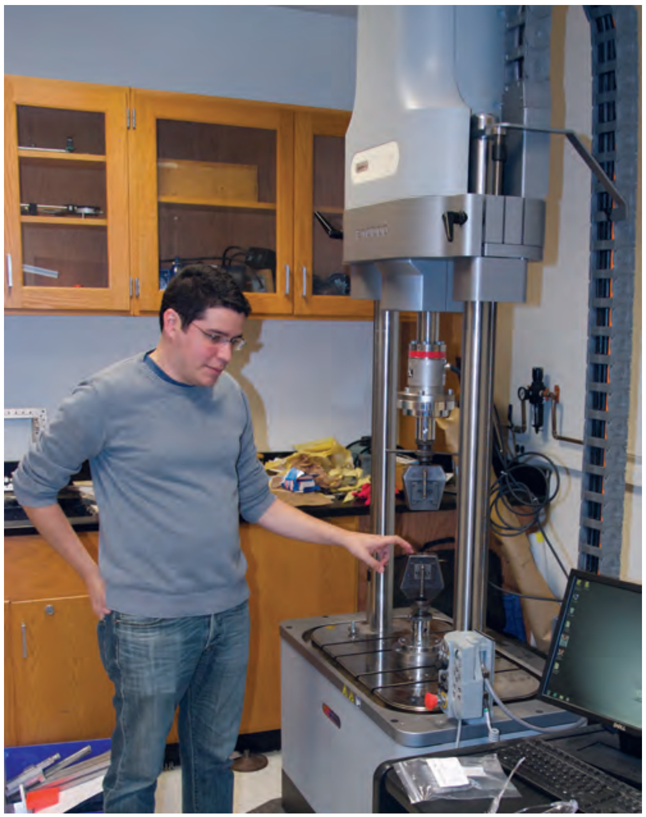


Opposite Page (clockwise from top left): A new 3-axis CNC mill with automated bit cycling; students working on one of four new mills; student working on our CNC lathe

This Page: The "Fab Lab" was renovated to include space for student electronic component assembly and testing, a bank of 3D printers, an automated laser cutting tool, and vaccum molding equipment



A space called the "the Pit" was installed as a makerspace for hand-made projects. The Pit includes a shared library of tools, including everything from drills to saws to sewing machines.



Two new Instron machines are housed in ME's "TESTLAB."

Above: Even after all the renovations, the ME department maintains a busy student space ("the Hive") for group study, homework, and teaching assistant office hours.

Below: Undergraduate laboratory space has been streamlined and expanded and now includes enough table space and equipment to teach all our solid mechanics, vibrations, fluids, and thermal laboratory classes.

Research Experiences for Undergrads

NSF-funded program supports diverse group of undergraduates in biomechanical engineering

Even accomplished researchers know that luck can play a role in scientific breakthroughs.

That was one important message shared by Dean Babatunde A. Ogunnaike in a special seminar for undergraduate researchers on July 5.

"When you do research, keep your eyes open," he said. "In many cases, researchers get lucky — that's how Teflon was discovered."

Five weeks later, the students in that audience were presenting the results of their own research at a one-day symposium highlighting the work of some 400 students from more than 40 institutions.

The group who heard Ogunnaike's message, participants in the Dare to BE FIRST Research Experiences for Undergraduates (REU), learned some lessons of their own along the way.

"I had hoped to present our preliminary data today, but I ran into some issues," said the University of Florida's Meggie Pires-Fernandes in a presentation she delivered halfway through the project.

"That's one of the most important things I've learned so far this summer — research involves a lot of waiting and dealing with technical difficulties, but it's worth it to get those good numbers."

UD's newest REU is aimed at creating independent research experiences in biomechanical engineering for undergraduate students with diverse backgrounds. Led by professors Jill Higginson and Lucas Lu, the program is housed within UD's Center for Biomechanical Engineering Research (CBER).

"The REU site leverages CBER's strengths in cutting-edge osteoarthritis research in order to expose students to the power of quantitative skills in solving biomedical problems from bench to bedside," says Lu.

Projects addressed topics ranging from cellular-level tissue mechanics to 3-D printing and characterization of a unique material that has potential application in athletic shoe insoles.

One student examined redistribution of backpack load, while another investigated a driving simulator to test post-surgical reaction time.

But all learned lessons beyond the data they collected using mathematical models, microscopes and mechanical testing.

They learned that poring through patient data is a painstaking time-consuming process and that finding qualified human subjects can be challenging.

They taught themselves new software, and they stayed up late at night babysitting a balky 3-D printer.

For some, like Takunda Masika, who attends Clark College, a community college in Vancouver, Washington, spending the summer at UD provided a window into not only the world of research but also the opportunities offered by graduate school.

For Higginson and Lu, the first year of the Dare to BE FIRST REU was a resounding success.

"The students were carefully selected, mostly from partner schools, and they were ambitious and motivated to get the job done," says Higginson. "The posters they presented at the symposium were of professional quality with content worthy of national and international scientific conferences – not bad for just 10 weeks at a new school."

And, while Ogunnaike's guest lecture early in the summer focused on optimizing in vitro fertilization treatment, his overall messages rang loud and clear for anyone doing scientific research.

"Don't try to predict the unpredictable, but you can talk about probability," he said.

"No mathematical model is perfect," he added. "If you're going to use a mathematical model, please validate it before you sell the farm."

ABOUT THE REU PROGRAM

The REU Program supports active research participation by undergraduate students in any of the areas of research funded by the National Science Foundation. REU projects involve students in meaningful ways in ongoing research programs or in research projects specifically designed for the REU program. UD's Dare to BE FIRST REU is funded for five years.

2016 REU program faculty, staff, and student participants.

**QUICK FACTS ABOUT
THE DARE TO BE FIRST REU**

- Student majors included biomedical engineering, materials science and engineering, bioengineering, mechanical engineering, biology, and applied physiology and kinesiology.
- Research advisers at UD included Dawn Elliott, Sergi Fabrizio, Megan Killian, Christopher Price, and John Slater (biomedical engineering); Tom Buchanan, Jill Higginson, Lucas Lu, Kurt Manal, and Liyun Wang (mechanical engineering); Chris Modlesky (kinesiology and applied physiology); and Darcy Reisman (physical therapy).
- Participants hailed from Boston University, Clark College, New Jersey Institute of Technology, Penn State University, Saint Joseph's University, University of Colorado-Boulder, University of Delaware, University of Florida, University of Pennsylvania, Washington University in St. Louis, and Worcester Polytechnic Institute.


Terri Kelly
125

Industry Partners Day

Gore CEO Terri Kelly, '83, shares lessons learned during successful career

Terri Kelly, president and CEO of W.L. Gore and Associates, shared some of her three decades of career wisdom with an audience of more than 150 students, faculty, alumni, and representatives of industry on Friday, February 17.

Her presentation, "Reaching Your Full Potential," was the keynote address at Industry Partners Day, part of the year-long ME125 anniversary celebration.

The event brought industry partners together with students for career presentations, panel discussions, and recruiting opportunities.

KEYNOTE ADDRESS

Kelly, a member of the class of 1983, said that an engineering degree "provides a foundation that can take you in any direction."

"Understand the values of an organization and ensure that they're aligned with your own," she said.

"Find your voice and appreciate different perspectives."

Kelly also encouraged students to be willing to take on challenges for which they don't think they're ready.

"The best learning opportunities happen when you're in your discomfort zone," she said.

In addition, Kelly told the students, "It doesn't matter how smart you are as an engineer—you need to be an effective leader."

"The 'hub-and-spoke model' of management doesn't scale up to large organizations," she added. "You have to lead by empowering others. You're not a leader if people don't want to follow you."

Kelly also pointed to Gore's enterprise strategy of "improving lives through advanced materials" when she told the students that success needs to be about more than achieving business and financial outcomes.

Other important lessons she shared included advising students to gravitate toward their passions, achieve balance between their work and personal lives, and give back.

PANEL DISCUSSIONS

Kelly's talk was followed by two panel discussions, "The 21st Century Engineer" and "Career Navigation: How Do You Find Your Place in the World?"

Panelists emphasized the importance of teamwork, the need for critical thinking skills, and the value of entering the workplace with extracurricular activities to augment classroom and laboratory experiences.

They also encouraged students to take electives that might not be "natural fits" for them, develop a global view, and never underestimate the value of networking.

In addition, students were advised to participate in cross-disciplinary projects to prepare themselves for the broad range of careers open to mechanical engineers in fields ranging from healthcare and aerospace to manufacturing and business.

"I think the perspectives and advice provided by the two panels were not only extremely valuable for the students, but also useful to the alumni, faculty and other attendees as well," said Michael Santare, professor of mechanical engineering and one of the organizers of the event. "I know I learned a lot."

A networking session between the two panels provided students the opportunity to talk with industry representatives while offering attendees the chance to view posters of award-winning senior design projects.

ABOUT THE PANEL

The following served as panelists for "The 21st Century Engineer":

- Edmund DeLussey—managing director, Technology Consulting at Accenture
- Kenneth Eland—H-47 chief engineer & AVT leader, Boeing Defense, Space & Security
- Florence Li—senior mechanical engineer, SpaceX
- Stephen Shuler—director, Automotive Marketing Asia and Innovative Plastics, SABIC
- Meg Smith—vice president, Quality Assurance/Post Market Regulatory, Stryker

The following served as panelists for "Career Navigation: How Do You Find Your Place in the World?":

- Maylene Hugh—key account manager, Ahlstrom Nonwovens
- Ravi Shanker—general manager, Lightweighting Platform, Dow Chemical
- Alexis Shupe—enterprise capabilities associate, W.L. Gore and Associates
- Stephen Shuler—director, Automotive Marketing Asia and Innovative Plastics, SABIC


WE BUILD
GINEERS.

Highly qualified, business-minded ENGINEERS

The Mechanical Engineering major at UD remains the most popular engineering major on campus, and it's little wonder why! With our hands-on learning philosophy, dedicated makerspaces, centralized student "Hive," and a modernized student machine shop, mechanical engineering students at UD have a lot of fun.

Our focus on engineering design starts in a student's first year and continues all the way to Senior Design, where students complete real-world, industry-sponsored engineering projects.

8th HIGHEST MAJOR

The mechanical engineering undergraduate program has the 8th highest enrollment of all UD majors.

54%

54% of Engineering Undeclared students become mechanical engineering majors after sampling different engineering disciplines as first-year students.

21.9%

21.9% of ME undergrads are women. This places UD in the 74th percentile nationally in terms of female representation in mechanical engineering.

96%

Our graduates currently achieve a 96% employment rate with a median starting salary of $63,000/yr ($69,000 for Honors Bachelor of Engineering students)

Engineering Solutions

Senior design students team up to solve a broad range of problems

A semester's worth of work by 161 senior engineering students culminated in a six-hour celebration on Wednesday, December 14. This year's UD capstone engineering design program featured 40 projects that were supported by 29 sponsors, supervised by 12 faculty advisors, and judged by 35 evaluators. Each team put in some 1200 hours of work over the 14-week semester. Building on the 25-year history of ME's senior design program, the program—which is coordinated by assistant professors Jenni Buckley, Jeannie Stephens and Sarah Rooney—now includes all of UD's biomedical engineering seniors as well as participants from electrical, civil and environmental engineering.

"We were lucky to have the opportunity to join in with the hugely successful mechanical engineering senior design course beginning with our first graduating class," says biomedical engineering chair Dawn Elliott.

"I wanted to expose our students to real-life design problems initiated by industry. This interdisciplinary course has been a huge win for the students and all the participating departments. The addition of clinically motivated design needs has further strengthened the course."

Many of this year's projects addressed typical mechanical engineering processing challenges—including better ways to extrude, cool, heat, cure, and clean materials and production lines—while others tackled problems related to agriculture, health, veterinary medicine, environmental protection, art conservation, and sports.

Need a filtering system that keeps agricultural runoff out of streams? A way to measure heart rate that doesn't involve strapping a monitor to an athlete's chest? An underwater recorder for oceanographic research?

How about a device that deposits lawn waste from a vacuum system into municipally approved paper bags? A heated jacket for industrial safety wash stations? A solar roof tile that looks like an ordinary roof shingle?

UD engineering students are on the job, creating new approaches to these problems or modifying current technologies that need tweaking.

Sixteen students worked on the department's Formula SAE car, with individual teams dedicated to specific aspects of the car including the chassis, power train, suspension, and ergonomics.

A number of teams worked on devices to aid people with disabilities. Their projects ranged from a training device for wheelchair racing and a motorized assistive recumbent trike to a functional garment that promotes arm movement in children with arthrogryposis and a special chair for children with osteogenesis imperfecta.

Some projects present new opportunities for design teams year after year.

QuadCrew, which enables people with disabilities to participate in the sport of rowing, is now ready for field testing thanks to the work of a 2016 team.

In addition, the SimuCare line of devices for nursing education continues to expand. This year's development is a wearable colostomy simulator, designed to be worn by a live actor to provide a realistic experience for nursing students.

All of the senior design work is enabled by equipment housed in a maze of rooms, otherwise known as the Design Studio, that occupies more than 5,000 square feet in Spencer Laboratory as well as by expertise from machinist Scott Nelson, who runs the Student Machine Shop.

Over the course of the semester, the students' designs take shape with the help of not only such high-tech instruments as 3D printers, electronics workstations, and testing rigs but also ordinary tools like drills, sanders, wrenches, and sewing machines.

"Our Design Studio has provided a much-needed collaborative platform for our students to test ideas and concepts and to work together in teams to explore innovative and creative solutions," says ME chair Suresh Advani. "I was very proud to see them present these solutions, which will not only result in business improvements for our sponsors but may also lead to patents and new commercial products."

Buckley emphasizes that the sponsors are critical to the success of the program.

"We ask a lot of these industrial, clinical, and academic partners," she says. "The projects they provide have to not only reflect real-world challenges but also be limited enough in scope that the students can make reasonable progress toward a solution in just one semester."

Five of UD's academic colleges were involved in this year's senior design program.

1. Project: Undercarriage Decontamination for Poultry Farm Equipment

Problem Posed:
Reduce the spread of avian influenza
Team Members: Lucas Serge, Darian Abreu, Xiaolun Guo, and Dianna Kitt
Advisors: Jenni Buckley and Dyer Harris

2. Project: Floating Wetlands

Problem Posed: Create an approach to surface water treatment that is aesthetically appealing and educational
Team Members: Danielle Gerstman, Sarah Hartman, Erica Loudermilk, Mark White, and Megan Doyle
Advisors: Dustyn Roberts, Kurt Manal, Andrew Hayes, and Jules Bruck

3. Project: Simulated Colostomy Care

Problem Posed: Develop a wearable colostomy simulator that allows trainees to practice caring for a patient with a colostomy
Team Members: Christopher Bresette, El Grasso, Kevin MacMillan, and Olivia Smith
Advisors: Amy Bucha, Jenni Buckley, and Amy Cowperthwait

4. Project: Museum Display Case

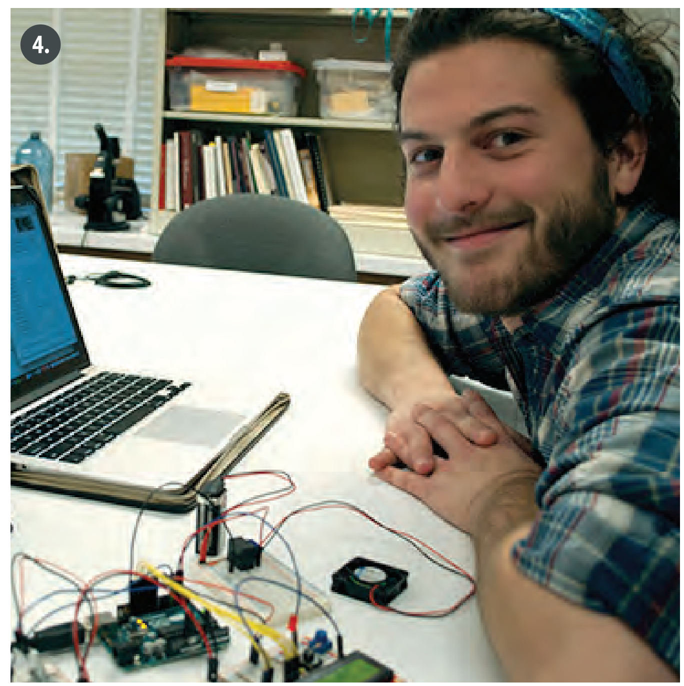
Problem Posed: Develop an inexpensive technology to protect rare and high-profile objects
Team Members: Matt Baker, Yan Ling Choi, Kevin Clark, Kelli Kearns, Marcos Miranda, and Dennis Palica
Advisors: Liyun Wang and Vicki Cassman

1.

2.

3.

4.



Engineering in Motorsports

Winter Session course gives students behind-the-scenes look at the world of auto racing

When Lan Tomasi signed up for a University of Delaware Winter Session course in mechanical engineering called Engineering in Motorsports, her understanding of the topic was equivalent to "a baby bear's knowledge about astrophysics."

But by the time the course was finished five weeks later, she had gained a great deal of knowledge about the technology behind modern racecars and how that technology has changed over time.

Course instructor Steve Timmins complemented his lectures with a slate of trips intended to bring the dense material to life, including visits to professional race shops in New Jersey and North Carolina. The course culminated with a week in Daytona, Florida, for the Rolex 24, a world-championship 24-hour endurance race.

"At the Rolex 24, our students had unprecedented access to the garages, pits, teams, and drivers," Timmins says. "Two teams, BodyMotion Racing and The Racer's Group, offered our students direct access to their facilities, and Roush Fenway Racing's lead engineer gave them a three-hour behind-the-scenes look at a professional NASCAR operation's engineering facility."

For senior Lexi Fader, who is a professional motorcycle coach, the best part of the trip was sitting in a Porsche 911 GT3 R, a race car valued at about $500,000.

"Seeing the engineers in action and how everything came together to produce top-performance cars was eye opening," she says. "I don't think many people fully understand how much time and thought is put into designing, manufacturing, validating, and testing each car. Whether you are interested in cars or not, I believe everyone needs to experience a race like the Daytona 24 at least once."

FIRST-HAND EXPERIENCE

I don't think many people fully understand how much time and thought is put into designing, manufacturing, validating, and testing each car

Sophomore Don Paolo Tiamson, who documented the various trips with hundreds of photos, came away from the course with new insight into fundamental vehicle dynamics, the engineering involved in vehicle design, and an insider perspective on working in the motorsports industry.

Timmins, who with his wife, Lydia, owns a company called Instant-G that builds Porsche engines and transmissions, shared his three decades of knowledge about the brand with the students, including how a Porsche designed for use exclusively on a racetrack differs from the ones driven on the road.

A tour of the Simeone Foundation Automotive Museum in Philadelphia showcased cars from the beginning of motorsports to the present day, demonstrating how vehicle design has evolved through history.

"The engineering is very different, depending on whether a car was meant to break a speed record, race in a hill climb, or complete a 1,000-mile circuit through Italy," Tiamson says.

Senior Tyler Gravatt found that the research and development facility at Roush Fenway Racing provided him with the best learning experience of the five-week class.

"During this tour, one thing in particular really stood out to me," he says. "NASCAR allows teams to uniquely design and change very few things relative to other forms of racing. However, the amount of time, money, and effort put into optimizing these small changes is truly extraordinary."

For Timmins, whose primary job at UD is IT professional, the course was a unique opportunity to share his love of cars.

He fell in love with Porsches in 1988 — after spending his college years as a "Triumph guy" — when a friend invited him to tag along on a test drive of a used 1984 Porsche 944.

Timmins bought the car, and he has since logged almost 30 years as a member of the Porsche Club of America, participated in a number of races, and repaired dozens of cars.

While he doesn't expect all of the students who took his Winter Session class to become "car nuts" like he is, he hopes to at least have ignited their interested in the engineering behind these machines designed for speed.

Steve Timmins earned his bachelor of science degree in mechanical engineering at the University of Delaware in 1989 and his doctorate in 1997. He is a staff member of IT-Client Support and Services and an instructor in the Department of Mechanical Engineering, where he has been teaching courses in Vehicle Dynamics of Race Cars, Powertrain Theory, and FSAE Senior Design since 2000.

"I don't think many people fully understand how much time and thought is put into designing, manufacturing, validating, and testing each car."

– Lexi Fader, UD Senior

Photos provided by Paolo Tiamson

Brooke Burris: Dream Job Achieved

Student spends Senior Spring Interning at Disney World

Brooke Burris thought she was afraid of roller coasters. But after riding Kingda Ka, the world's tallest roller coaster, she fell in love. By her senior year of high school she knew her dream job was to design and build roller coasters, so she enrolled in UD's mechanical engineering program with a minor in Integrated Design.

Burris spent Spring 2016 – the final semester of her senior year – working and networking with Disney engineers in Orlando as part of the Disney College Program. She also completed Disney's highly competitive DUEE (Disney's Ultimate Engineering Exploration) Day program, complete with a written engineering exam, a design challenge, and a chance to meet some 200 Disney Engineers. She was recently offered the opportunity to remain in Orlando as a "Walt Disney Imagineering Project Management Intern" – a six-month internship that Burris hopes will be the start of a full-time career with Disney.

Mechanical Engineering Dissertations and Theses

Sandipan Banerjee, M.S.
Thesis: "Turbulent collision statistics of cloud droplets at low dissipation rates"
Advisor: Lian-Ping Wang

Subramani Sockalingam, Ph.D.
Dissertation: "Transverse impact of ballistic fibers and yarns - fiber length scale finite element modeling and experiments"
Advisors: John Gillespie and Michael Keefe

Harish Opadrishta, M.S.
Thesis: "Multiple-relaxation-time lattice boltzmann simulations of turbulent pipe flows"
Advisor: Lian-Ping Wang

Guoliang Ding, Ph.D.
Dissertation: "On numerical modeling of fatigue crack growth in polymers using plastically dissipated energy"
Advisors: Michael Santare and Anette Karlsson

Xiaoyan Shi, Ph.D.
Dissertation: "Lattice boltzmann simulations of two-phase flow in a microchannel model and colloids transport with a study of electrostatic force for nanoparticles"
Advisor: Lian-Ping Wang

Prasanna Kannappan, Ph.D.
Dissertation: "Object recognition in noisy natural images"
Advisor: Herbert Tanner

Thomas Cender, Ph.D.
Dissertation: "Process analysis of manufacturing composites structures with vacuum-bag-only prepregs: quantifying partial resin impregnation and its effect on gas evacuation"
Advisor: Suresh Advani

Xin Liu, Ph.D.
Dissertation: "Harnessing compliance in the design and control of running robots"
Advisor: Ioannis Poulakakis

Michael Yeager, Ph.D.
Dissertation: "Multiscale modeling to describe free surface resin flow around fibers and within fiber bundles"
Advisor: Suresh Advani

Taoli Gu, Ph.D.
Dissertation: "Carbon nanotube film based nanocomposites for stretchable energy storage devices"
Advisor: Bingqing Wei

Matthew D. Lindemer, Ph.D.
Dissertation: "Heterogeneous hydrolysis with zinc vapor under a temperature gradient for efficient solar hydrogen production"
Advisors: Suresh Advani and Ajay Prasad

NSF Graduate Fellowship

Senior Nick Geneva is among a dozen University of Delaware students (undergraduate and graduate) and alumni who have won National Science Foundation Graduate Research Fellowships as the prestigious competition marks its 65th year. Hunter Bachman, now pursuing graduate studies at Duke University, is among fourteen others receiving honorable mention designations.

The awards—for which more than 13,000 applicants competed this year—include three years of funding at $34,000 per year, plus $12,000 in cost-of-education allowances to the school for study leading to a master's or doctoral degree in science and engineering. The total of these awards is almost $1.4 million – a significant boost for the students and their research.

Nationally, there were 2,000 winners (about 15 percent of all applicants), representing 449 different schools, all 50 states, the District of Columbia and other U.S. territories. Winners included 1,158 women, 498 individuals from underrepresented minority groups and 726 undergraduate seniors.

“Working with Professor Lian-Ping Wang and his graduate students is largely the reason why I decided to pursue a Ph.D. His work has shown me that the integration of state-of-the-art computer hardware and engineering is a very important challenge that is facing the scientific community today. Computing, whether through traditional CPUs or other hardware accelerators, is becoming ever more powerful, but exploiting this power effectively to solve the difficult engineering problem is by no means trivial.”

– Nick Geneva

SAMPE Award

Aris Mardirossian (right) won the SAMPE University Leader Experience Award, which sends student leaders to the SAMPE North America Conference and Exhibition to network with peers and industry professionals and increase their understanding of the Materials and Processes community.

Student Honors

Congratulations to the following ME students recognized for outstanding achievement in academics and research!

Undergraduate Awards

W. Francis Lindell Mechanical Engineering Award to the Distinguished Senior
Presented to **CONNOR B. BYDLON** & **ROBERT C. LOESCH**

W. Francis Lindell Mechanical Engineering Award to the Distinguished Junior
Presented to **JOSHUA A. GRAESSLE** & **ELIZABETH RACCA**

W. Francis Lindell Mechanical Engineering Achievement Award
Presented to **THOMAS J. CELENZA** & **KEIRSTIN E. HUGHES**

Mary and George Nowinski Award for Excellence in Undergraduate Research
Presented to **NICHOLAS E. GENEVA, PATRICK F. GENEVA,** & **JOHN G. PFREUNDSCHUH**

ASME Delaware Section Outstanding Senior Design | Final Presentation Award
Presented to **Team FSAE - Chassis**
CORWIN J. DODD
NICHOLAS E. GENEVA
PATRICK F. GENEVA
CORY J. MORRIS

ASME Delaware Section Outstanding Senior Design | Final Presentation Award
Presented to **Team Siemens Healthcare Diagnostics**
CONNOR B. BYDLON
GREGORY E. HORSKY
SHANNON N. RUSSELL
WENHAO ZHANG

ASME Delaware Section Outstanding Senior Design | Final Presentation Award
Presented to **Team Speakman**
ANDREW T. HAMILTON
ERIC R. JACKSON
JINCHENG LIU
RYAN J. SARROCCO

Delaware Section of the American Society of Mechanical Engineers Outstanding Student
Presented to **STEPHEN T. BUCHANAN**

American Society of Mechanical Engineers Student Section
Presented to **ERIN T. REZICH**

ME Alumni Award – Outstanding Senior
Presented to **DANIEL M. GRINDLE** & **CAROLYN A. HALL**

ME Alumni Award – Outstanding Junior
Presented to **MARISA R. BISRAM** & **MATTHEW J. BLASI**

ME Alumni Award – Outstanding Sophomore
Presented to **CHRISTOPHER E. BLACKWELL** & **REBECCA L. WILLIAMS**

ME Departmental Chairperson Award – Outstanding Student Leader
Presented to **DANIELLE R. GERSTMAN** & **TYLER C. GRAVATT**

ME Departmental Chairperson Award – Outstanding Student Service
Presented to **GRACE C. RUIZ COOPER**

Undergraduate Teaching Assistant Award
Presented to **MICHAEL B. DIMERCURIO, JESSE D. BLOECKER,** & **SHERIDAN S. WOOD**

Robert T. Bosworth Scholarship – 2016
Presented to **TREVOR OAKES**

Ralph M. Newman, Jr. and Sarah Joe Newman Fund – 2016
Presented to **TOMAS ELDER**

Redden Scholarship – 2016
Presented to **ARIS D. MARDIROSSIAN**

Graduate Awards

Graduate Teaching Assistant Award
Presented to **ARNAB BHATTACHARJEE** & **ELAHE GANJI**

Graduate Achievement Award
Presented to **SAGAR M. DOSHI**

Best Poster recipients at ME Research Day

Center for Composite Materials Awards

R. L. McCullough Scholars Award
Presented to **THOMAS CENDER**
Advisor: Suresh Advani

Progress Award
Presented to **RAJA H. GANESH**
Advisor: Jack Gillespie

Outstanding Senior Awards
Presented to **MICHAEL CZERWINSKI**
Advisors: Shashank Sharma and Shridhar Yarlagadda

Presented to **ANDREW KOSTER**
Advisor: Joseph Deitzel

Presented to **TESS CARELLA**
Advisor: Suresh G. Advani

Undergraduate Research Awards
Presented to **ARIS MARDIROSSIAN**
Advisor: Erik Thostenson

Directors' Award
Presented to **ALEX VANARELLI**

2017 Distinguished Career Alumni

Michael Seitel

BME 1987

Mike Seitel has built Norwalt, a small company founded by his father and others in 1971, into a widely known designer and builder of custom high-speed assembly lines. Norwalt machines are used for packaging a wide variety of products, including medical, pharmaceutical, and personal care items and toiletries. The company designs, builds, tests and then ships and re-assembles their products at the plants of customers, which include many major companies in the U.S. and abroad.

Mike is also very interested in mechanical engineering education, and Norwalt has been a sponsor of senior-design projects for the past several years. These projects have been highly successful due to Mike's responsiveness to the students and to the relevance of the work. Each project has been essential to the performance or improved performance of a current design, providing the students with the opportunity to work on actual equipment and the incentive needed for success. Every year, Norwalt-sponsored projects are highly ranked, and many have won senior design awards.

Ravi Shanker

PhD 1991

Ravi Shanker is currently global business advisor and general manager in lightweight and composite materials at the Dow Chemical Company, where he leads strategic corporate initiatives for the office of the CEO. His work includes leading and contributing on behalf of Dow on advancing manufacturing in the U.S. in addition to critical corporate initiatives on business portfolio restructuring. As general manager for lightweight and composite materials, he leads carbon fiber composite investment strategy and implementation.

Leading up to these most-recent appointments, Ravi held a variety of increasingly responsible positions, including the launch, in 2009, of Dow Kokam LLC, a joint venture between Dow Chemical Company and TK Advanced Battery LLC. Dow Kokam produces affordable batteries with lithium polymer technology aimed at the hybrid and electric vehicle markets. Ravi established the equipment and the capacity to manufacture the widest range of lithium polymer cells and to extend its offering to the electric mobility industry. He also co-led the technology development workgroup at the Advanced Manufacturing Partnership 2.0 project, aimed at reinventing U.S. advanced manufacturing.

Swaminathan Subbiah

PhD 1989

Subbiah is currently Vice President of Global Product Operations at ANSYS, Inc., a premier software company focused on simulation-based analysis in engineering. As the head of global operations, he works with ANSYS R&D and field organizations to ensure the achievement of global product sales and growth goals for their fluid dynamics and structural mechanics product lines, which account for approximately two-thirds of overall company sales. Prior to this, he led the corporate product and market strategy for ANSYS.

Shortly after graduating from UD, Subbiah joined Fluent Inc. when it was in its start-up days. He was a member of the early leadership team at Fluent and he was instrumental in helping make Fluent the global market leader for computational fluid dynamics software. His technical knowledge, business acumen, communication and leadership skills were essential to his success. He rose to lead Fluent's overall North American operations. After ANSYS acquired Fluent in 2006, he has risen to senior technical executive roles within ANSYS. He has been described as a strong, focused leader who is bright, thoughtful and insightful and who works across, and with, multiple functions and geographies to get things accomplished globally.

Jennifer (Jenni) Buckley

BME 2001

Jenni Buckley is co-founder of the Perry Initiative, whose goal is to inspire young women to be leaders in orthopaedic surgery and engineering. She was executive director from 2009-2016 and now is co-president of the board of directors. Her outreach into the broader community as well as into pre-college curricula is also evidenced by her leadership role in Project Lead the Way (PLTW), an organization that promotes transformative learning experiences for K-12 students.

As an assistant professor at UD, Jenni has developed the resources and created the physical space to expand the undergraduate design-build-test experience. She also developed design projects for freshmen in a required ME class. With that success, she was then asked by the College of Engineering to help revamp the required Introduction to Engineering course. In addition, she empowered student leaders by creating the the Mechanical Engineering Student Squad (MESS), who now actively organize the recruiting, retention and advancement aspects of the undergraduate experience.

Florence Li

BME 2001

After graduating from UD with her bachelor's degree, Florence obtained her master's degree in aeronautics and astronautics from Stanford University and then joined SpaceX. She started with structural design, testing and launch integration on the first four Falcon 1 rocket launch campaigns.

Afterwards she managed a group designing composite structures for the Falcon 9 rocket and supported the first several flights of Falcon 9 as lead structural integration engineer on site at Cape Canaveral. Florence then began managing the launch mechanical team where she led development of structural systems at a new launch site at Vandenberg for both the Falcon 9 and Falcon Heavy launch vehicles as well as an upgrade to the launch site at Cape Canaveral and the initial layout of the SpaceX site at the historic 39A launch pad at Kennedy Space Center. Florence currently works as a senior engineer in the Advanced Projects group.

Thank you to our donors!

We wish to thank the many ME friends and alumni who have made generous contributions between July 1, 2015 and June 30, 2016. Your gifts are used for many worthwhile purposes, including support of our fundamental interdisciplinary research and educational programs. To donate, visit **www.udconnection.com** and click Donate Today. To designate your gift to ME, select *other* and specify *Mechanical Engineering.* Or, to discuss a specific gift, contact Barbara Maylath, Director of Development, at bmaylath@udel.edu or (302) 831-7273.

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Special Thanks

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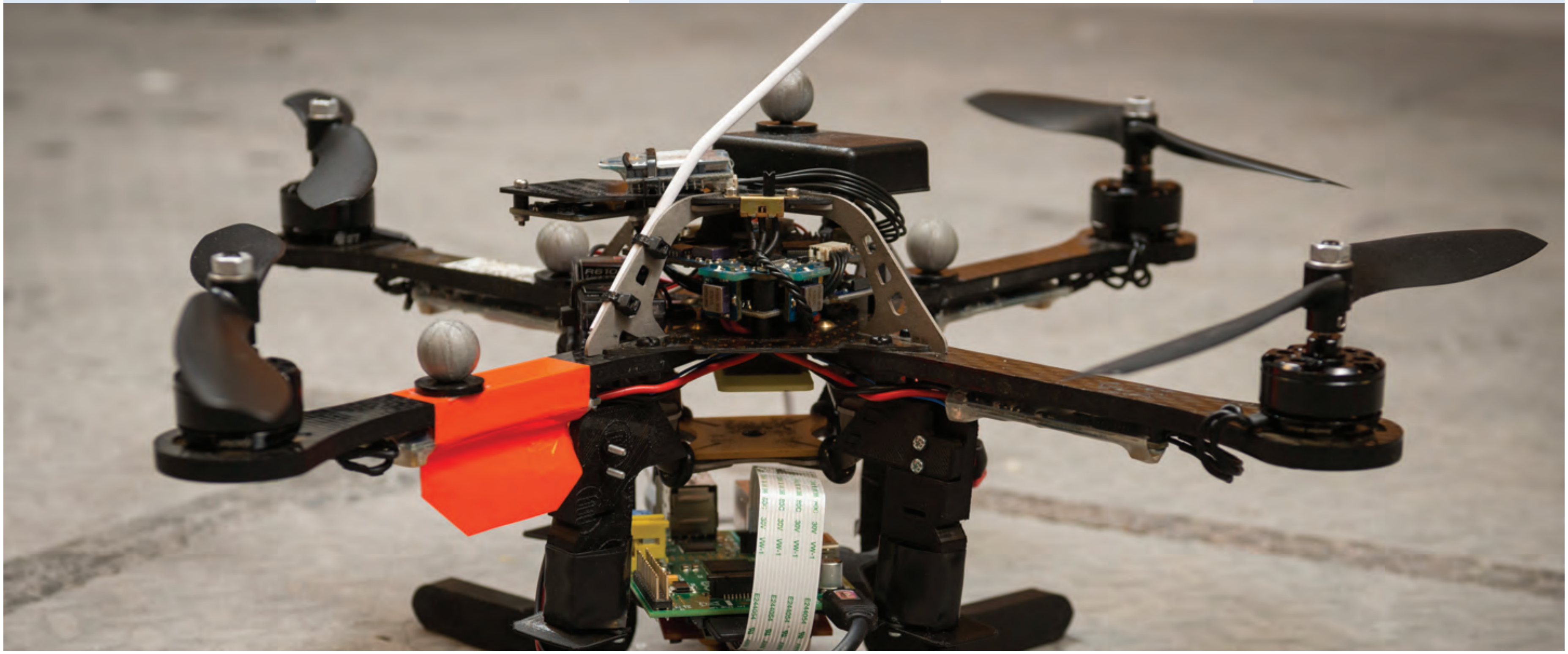

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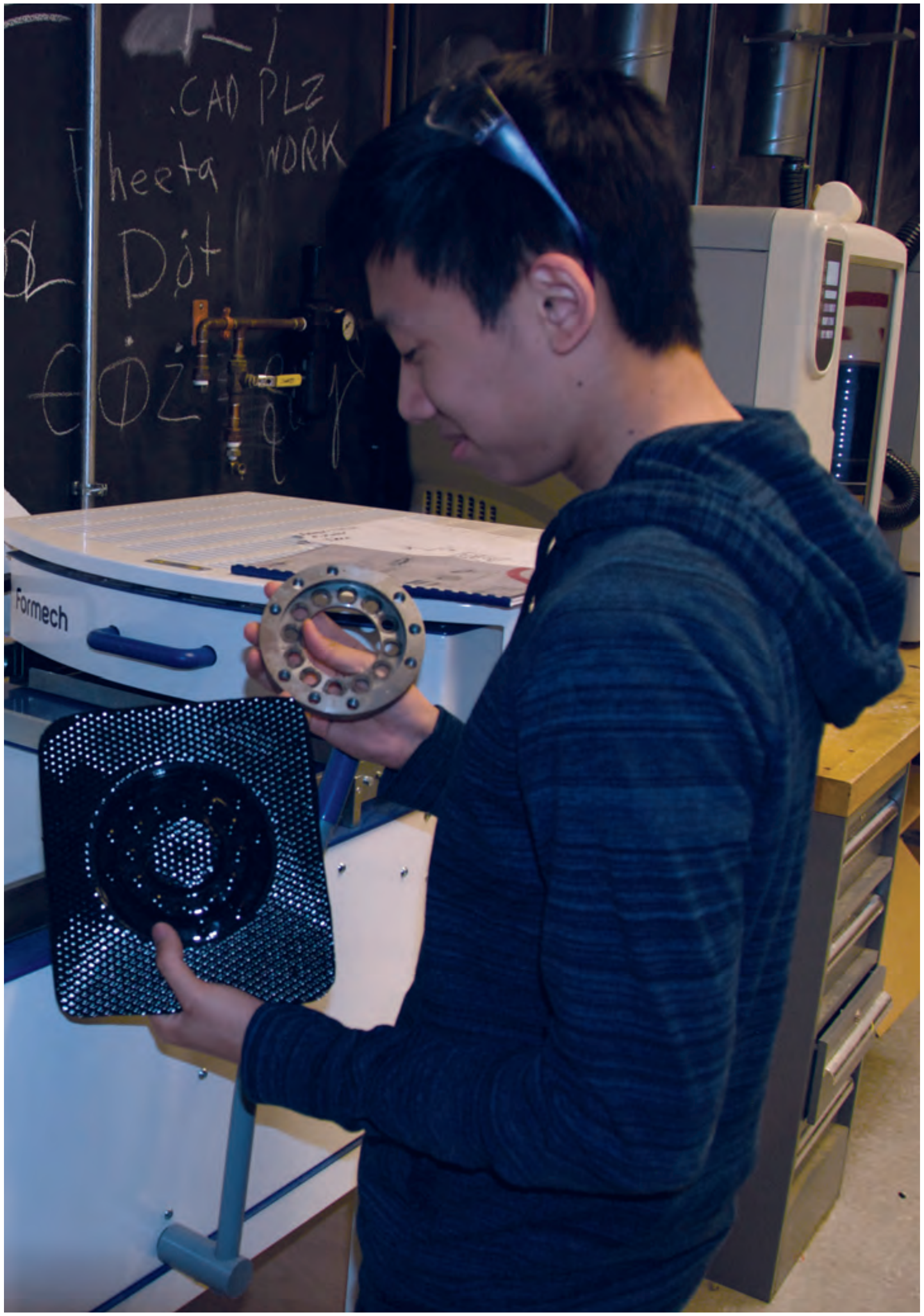

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125th
ANNIVERSARY

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EVENTS INCLUDED:

- BLUE TIE GALA
- HOMECOMING TAILGATE
- INDUSTRY PARTNERS DAY
- RESEARCH DAY
- ALUMNI
- 1ST ANNUAL ME GOLF-OUTING