UNIVERSITY OF DELAWARE | College of Engineering

Department of

Mechanical Engineering

2016 News
AND ANNUAL REPORT

INSIDE

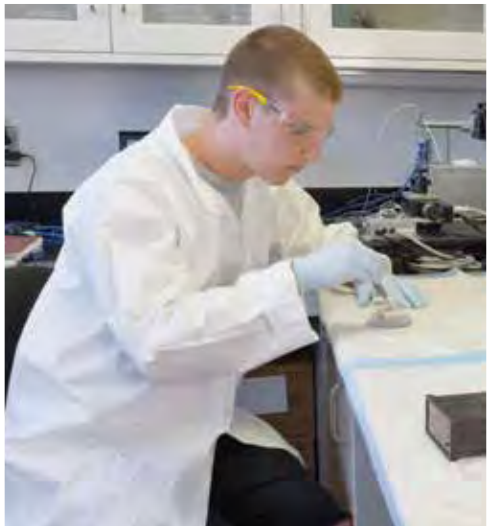
Spotlights on our High-Impact, Multidisciplinary Research:

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

Women in Engineering

Department *of* Mechanical Engineering

125th ANNIVERSARY



UNIVERSITY OF DELAWARE | Department of Mechanical Engineering

Message from the Chair

Have you ever wondered what the field of mechanical engineering will be like 125 years from now? At the rate engineering researchers are advancing scientific discovery today, we can't even begin to fathom what our successors will introduce to the world by 2141.

I imagine that's how those who founded our department back in 1891 might feel if they were to read about the advances highlighted in this year's report. From suppressing osteocytes' secretion of proteins to help build stronger bones, to investigating the limits of heat transport with an eye toward creating more thermoelectrically efficient materials, ME faculty are researching, designing and finessing innovations to enhance quality of life through nearly every aspect of modern mechanical engineering.

So much has changed from the early days of our department and profession. Back in 1892, our earliest students worked in a 30' x 50' frame woodshop. That "maker space" of old is a far cry from today's 5,900 square foot Design Studio equipped for interdisciplinary group projects, computer-aided design, prototyping and design validation. Students are already busy at work conceptualizing how we should upgrade to Design Studio version 2.0. Imagine the facilities and equipment students and faculty will have at their disposal in the next century!

Our facilities have evolved, and so too, have our student body and our faculty. Prior to 1957, ME was a man's profession, at least on our class rosters. That year, **CONSTANCE V. DARBY** (now Lieb) broke the gender barrier, becoming the first female to earn a bachelor's degree in mechanical engineering from the University of Delaware. And in the 1980s, **JANE DAVIDSON** and **AZAR PARVIZI-MAJIDI** were the first women to join our faculty. Today, about 20 percent of our students are women, and a number of the nation's brightest female engineering faculty are actively leading department programs in ways that can only enrich our future success. Read more about women in engineering at UD on page 31.

As we kick off our observation of the department's Quasquicentennial (a pseudo Latin lesson here—Quasqui = one and a quarter), and reflect on progress we've made since those earliest days, we are grateful to our faculty, the administration, major funding sources—you'll read more work funded by NSF, ARL and DARPA, as well as other major sources in this report—and industry friends. Their support has helped us create a solid technical curriculum, prepare 21st century leaders, and nurture renowned faculty of distinction whose teaching and high-impact research have placed us among the nation's preeminent ME programs.

Most importantly, we are grateful for the now more than 4,600 alumni of our program who have entrusted their engineering education and preparation for their very careers to our program. It is a privilege to stand alongside all of you as products of this incredible 125-year journey, and to look ahead with you as we imagine all that is to come for future generations of mechanical engineers at the University of Delaware.

Someone who knows a thing or two about the history of and vision for mechanical engineering is our newest ME faculty member, incoming UD President **DENNIS ASSANIS**. We welcome his leadership and are honored to have one of our own at the helm for this next great journey. Read more about Dr. Assanis on our back cover.

On pages 4 and 5, and at the back of this book, you'll find more about our 125th. Also, be sure to visit www.me.udel.edu/125 and join in the celebration throughout the coming year. Thank you for your ongoing encouragement and generosity.

Best regards,

Suresh Advani
George W. Laird Professor and Chair

IN THIS ISSUE

Content Direction: Department of Mechanical Engineering
Writing & Design: College of Engineering Communications Team
Photography: Communications & Public Affairs

Department *of* Mechanical Engineering

125th ANNIVERSARY

Building engineers *since 1891*

me.udel.edu/125

Mechanical Engineering kicks off its Anniversary Celebration

125 YEARS STEEPED IN TRADITION, PROPELLED BY DISCOVERY

This fall, as mechanical engineering students in the class of 2020 take their first enthusiastic steps through the hallowed halls of Spencer Lab, Dupont and Evans halls, these young women and men will begin their journey at a milestone place in our department's history. Joining the ranks of the 4,600+ undergraduate and graduate ME alumni who have taken those very same steps before them, not only are they heirs to history, but the forefathers—and mothers—of the department's next 125 years.

From rudimentary beginnings in a 30' x 50' wooden shop equipped with just three engine lathes, a small planer, a milling machine and a drill press operated by an 8-horsepower gasoline engine to today's meticulously equipped 5,900 square-foot Design Studio fostering interdisciplinary collaboration and hands-on learning, ME has crafted a solid century-and-a-quarter reputation for preparing the engineers of tomorrow in world-class, high-impact, multidisciplinary research.

The history of mechanical engineering as a profession dates to ancient Greece and China, where mechanisms like screw pumps, steam engines, clocks, seismometers and even differential gears were invented. Our history here at the University of Delaware, while much younger, likewise is steeped in tradition and accomplishment. Our journey through the next 125 years is certain to be equally full of advancement and discovery!

DID YOU KNOW?

- When the Department of Mechanical Engineering was established in 1891, one professor was assigned to the program. We now have 26 full-time and another 18 supplemental, emeritus and affiliated faculty connected with the department.
- According to a 1945 issue of UD News, Dean Robert L. Spencer (dean from 1928 to 1945, for whom Spencer Lab is named) himself built all the classroom desks and bulletin boards in the new Evans Hall building, dedicated in 1930.
- In 1965, all ME students were required to take two semesters of "military science" and a course in the "History and Government of Delaware."

1947

$2,700

Mechanical Engineer (BS)
Average Starting Salary

2016

$59,700

Mechanical Engineer (BS)
Average Starting Salary

Source: Forbes

See back cover for our 125th Anniversary events listing.

"The department has NEVER BEEN STRONGER, MORE PRODUCTIVE AND MORE SUCCESSFUL than it is now under the direction of Suresh Advani."

–Jack Vinson, H. Fletcher Brown Professor Emeritus of Mechanical and Aerospace Engineering, Founding Director, Center for Composite Materials, and former ME chair from 1965 to 1979, in a 2014 interview

#UDME125

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 regarded 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 $9 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

528 ME Undergraduate
84 ME Graduate
612 ME Total

Degrees Awarded

107 Bachelor's
12 Master's
9 Ph.D.

Faculty

5 Named/Chaired Professorships
5 Full Professors
7 Associate Professors
9 Assistant Professors

Faculty Publications

150 Journal Articles
217 Conference Publications/ Presentations
5 Journal Editors

DELAWARE REHABILITATION INSTITUTE

Center for Composite Materials

Center for Fuel Cell Research

udei UNIVERSITY OF DELAWARE ENERGY INSTITUTE

CENTER FOR BIOMECHANICAL ENGINEERING RESEARCH

Mechanical Engineering Faculty Research

	 Suresh Advani	 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 Hossein	 Guoquan Huang	 Michael Keefe	 X. Lucas Lu	 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 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)

Biomedical Engineering

High blood sugar may inhibit positive effects of exercise on bone health in people with diabetes

Diabetes, which now affects almost 30 million Americans, can cause serious health complications, including heart disease, blindness, kidney failure and lower-extremity amputations.

A lesser-known, but equally grave complication is the effect of diabetes on bone health.

"Clinical trials have revealed a startling elevation in fracture risk in diabetic patients," said **LIYUN WANG**, associate professor of mechanical engineering. "Bone fractures can be life threatening—nearly one in six hip fracture patients die within a year of injury."

Because physical exercise is proven to improve bone properties and reduce fracture risk in non-diabetic people, Wang and her research group decided to test its efficacy in Type 1 diabetes.

According to Wang, osteocytes, or bone cells, are critical to maintenance of the tissue quality and mechanical integrity of bone. As the primary "mechanosensing" cells, osteocytes orchestrate bone's adaptation processes under mechanical cues, such as exercise.

"We suspected that the response of diabetic bone to mechanical loading would be compromised due to impaired mechanosensing of osteocytes under hyperglycemic, or high blood sugar conditions," she said.

A study by Wang, along with **X. LUCAS LU**, assistant professor of mechanical engineering from UD, and Lidan You of the University of Toronto, demonstrated that exercise-induced bone formation was maintained in mildly diabetic mice at a similar level as non-diabetic controls, while the positive effects of exercise were nearly abolished in severely diabetic mice. At the cellular level, the researchers found that hyperglycemia reduced the sensitivity of osteocytes to mechanical stimulation and suppressed osteocytes' secretion of proteins and signaling molecules that help build stronger bone. The team published their findings last summer in the online version of the journal *Bone*.

To translate the study's findings to patient care, Wang's team is now collaborating with Christiana Care Health System in Wilmington, Delaware, to evaluate these findings in humans and expand the research to include other complications of diabetes, such as cardiovascular disease.

Bone 81 (2015) 152-160. http://dx.doi.org/10.1016/j.bone.2015.07.012 | Funded by the National Institutes of Health, the Department of Defense and the Natural Sciences and Engineering Research Council.

- Osteocytes, the primary "mechanosensing" cells, orchestrate bone's adaptation processes in exercise.
- Hyperglycemia reduces osteocytes' sensitivity to mechanical stimulation and suppresses osteocytes' secretion of proteins that help build stronger bone.

Clean Energy and Environment

Study investigates use of solar power on hybrid fuel cell shuttle buses

UD researchers are investigating the use of solar power on the fuel cell bus fleet as a way to reduce operating costs without increasing greenhouse gas emissions.

The program currently includes two 22-foot, 22-seat transit buses equipped with nickel-cadmium batteries to meet the power demand of the buses, and hydrogen-fueled proton exchange membrane fuel cells to maintain the state of charge of the batteries.

"The additional power produced by the roof-installed photovoltaic array can supplement the battery in meeting power demand and the fuel cell in charging the battery," said **BABATUNDE OGUNNAIKE**, the William L. Friend Professor of Chemical and Biomolecular Engineering and dean of the College of Engineering at UD.

Hybrid systems require satisfying bus power demand instantly at all times while maintaining the battery state of charge at an optimal 65 percent—under varying environmental and driving conditions.

Ogunnaike teamed with **AJAY PRASAD**, Engineering Alumni Distinguished Professor of Mechanical Engineering and director of UD's Center for Fuel Cell Research, to demonstrate the design, implementation and performance of the three-way hybrid system via simulation of real shuttle runs under various operating conditions.

The team considered two separate control strategies: an "algebraic" control strategy and standard proportional-integral (PI) control.

The performance and effectiveness of the two strategies were evaluated under three operating conditions: under typical operating conditions in terms of solar irradiance, vehicle speed and ambient temperature during summer and winter; during sudden changes in cloud cover; and with a sustained increase in bus speed.

"What we found is that the two control strategies perform equally well under typical operating conditions and under sudden cloud cover conditions," said Ogunnaike. "However, at consistently high bus speeds, battery state-of-charge maintenance is better and the system consumes less hydrogen with PI control."

Their findings were reported in June 2015 the journal *Processes*.

Economic analysis indicates that the photovoltaic array modification to the bus will pay for itself while producing zero harmful emissions.

One new advanced fuel cell hybrid bus was recently added to the UD fleet, now in its 9th year of operation on the Newark campus.

Processes 2015, 3, 452-470. http://dx.doi.org/10.3390/pr3020452 | The Fuel Cell Bus program is funded by the Federal Transit Administration at the Center for Fuel Cell Research at the University of Delaware.

- At consistently high bus speeds, battery state-of-charge maintenance is better and the system consumes less hydrogen with proportional-integral control.
- The photovoltaic array modification pays for itself while producing zero harmful emissions.

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 at a glance

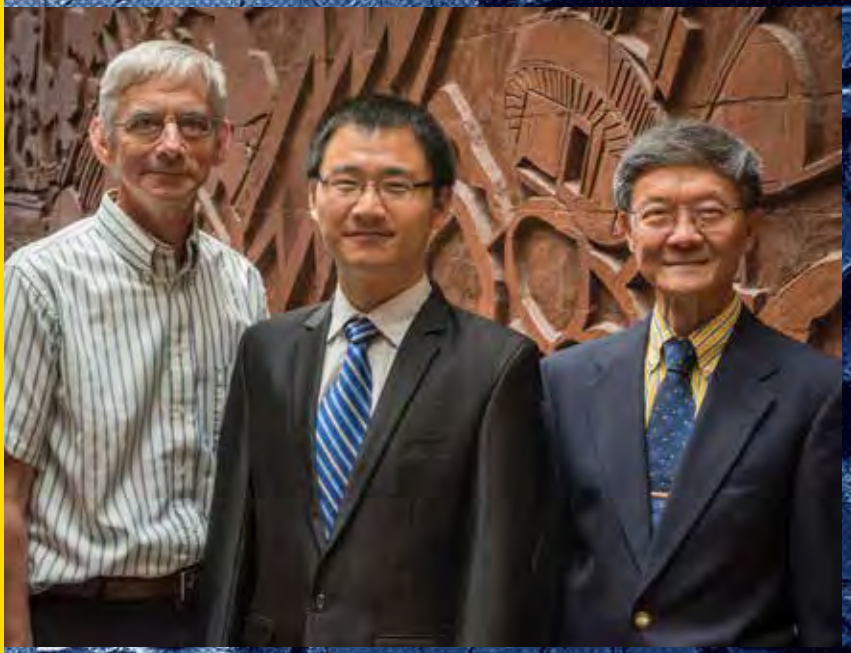
Research in advanced materials aims to accelerate the pace of discovery, deployment and recyclability of material systems. Composites—hybrids formed by combining two or more materials—can be tailored to optimize their properties to suit desired applications, offer performance advantages (e.g., stronger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



This cross-section of a fiber composite textile, or preform, is part of a 10 by 25.5-foot terra cotta mural in Spencer Lab created in 1983 by art alumnus Bernard Felch, MFA '68, celebrating the history of 20th century aeronautics. Composites are widely used in aircraft—from the coated fabrics on the Wright Brothers' plane to the all-composite Boeing 787—and their representation in this mural pays homage to the transformative work being advanced by UD researchers in the Center for Composite Materials. The transverse lines on the right depict fibers, while the circular pattern in the upper right-hand corner are a cross section of a fiber bundle—images holding particular significance to UD composites experts Tsu- Wei Chou (right), Michael Keefe (left) and Zhenzhen Quan (middle), first author of the additive manufacturing article published in Materials Today.

Composites and Advanced Materials

Research team explores a novel way to fabricate preforms for composites

Additive manufacturing, also broadly known as "rapid prototyping" and "freeform fabrication," is a process in which an object is built up layer by layer from a computerized model. The technique enables direct fabrication of complex-shaped objects without tooling and machining, and it eliminates the need to join a number of single parts into a single complex one.

TSU-WEI CHOU, the Pierre S. du Pont Chair of Engineering at the University of Delaware, is a pioneer in advanced composites, working over the years with a wide variety of materials and processes. Now he is part of an international team of researchers examining the feasibility of using additive manufacturing to produce 3D preforms.

His latest breakthrough builds on work he did in the 1980s and '90s on textile structural composites. This technology applies braiding, weaving, knitting and stitching techniques to produce 3D reinforcements, which are then combined with a binder, or matrix, to make complex shapes.

While textile structural composites offer many advantages, some fundamental technological barriers remain in their manufacture, which can lead to inconsistencies in performance. Complex parts are usually built by assembling separate simple parts, which can lead to premature structural failure at material joints.

With additive manufacturing, material composition can be changed at specified locations within a part at the processing stage, enabling various functions and graded properties to be incorporated directly during manufacturing.

The process also shortens lead time and makes small-lot-size customization—even a run of just a single part—economical. The material can also be placed just where it is needed, and the residual material can often be readily recycled or reused, reducing material waste.

"All of these features make additive manufacturing an attractive option for composite materials development," Chou said.

In a paper published in the web version of *Materials Today*, Chou's team reviews the state of the art within the scope of composites development and discusses challenges facing the broad adoption of additive manufacturing for directionally reinforced composites processing.

Those challenges include the need for new CAD tools and engineering standards, difficulties in process monitoring, and limitations in part size, printing accuracy, layer thickness and surface smoothness.

Materials Today. Vol. 18. No. 9. Nov 2015. http://dx.doi.org/10.1016/j.mattod.2015.05.001 | Funded by the National Research Foundation of Korea through the Korean Ministry of Science and Technology (MEST) and the State Scholarship Fund of the China Scholarship Council.

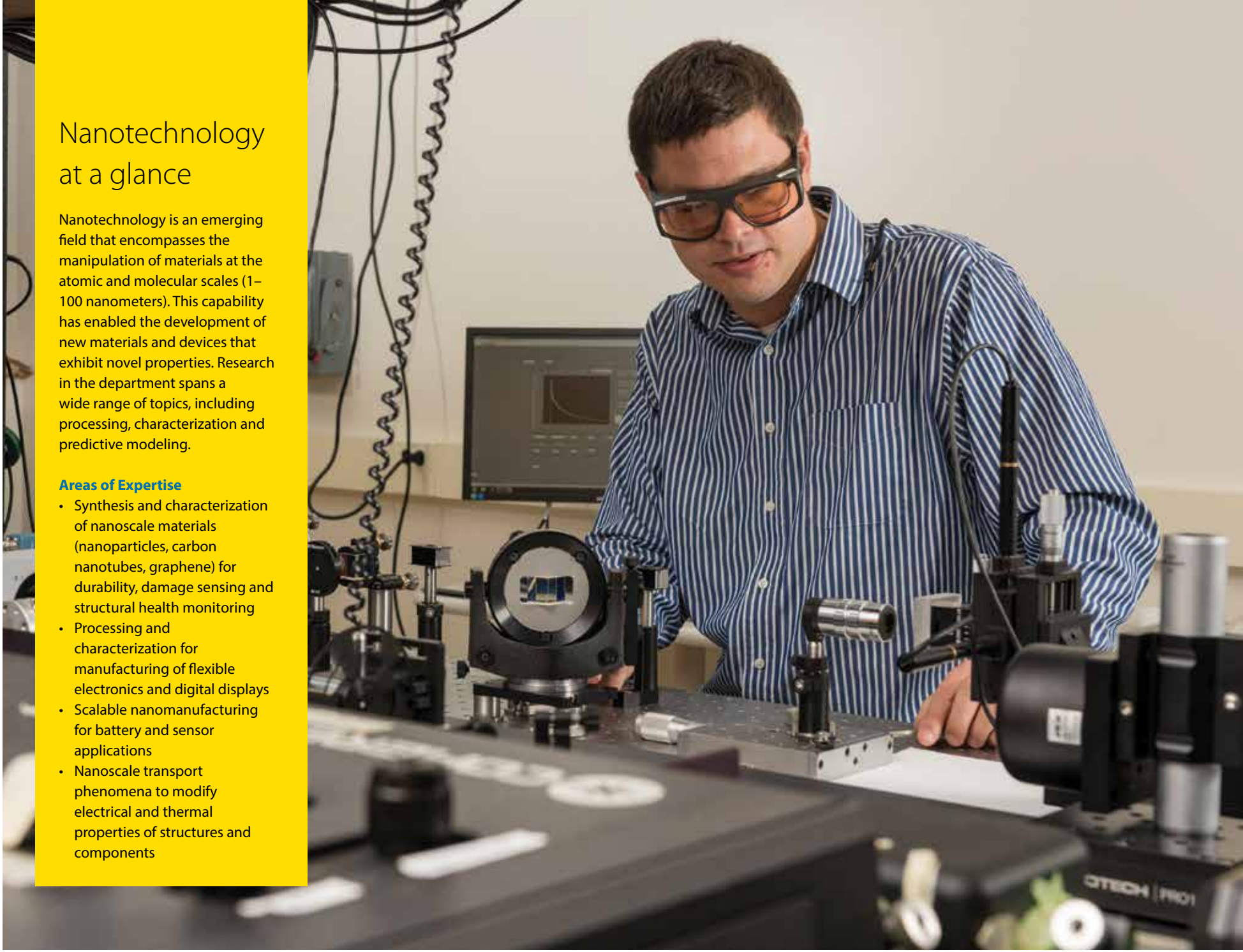
- The additive manufacturing process shortens lead time, makes small-lot-size customization economical, and residual material can be readily recycled or reused.
- Fiber-reinforced preforms are especially desirable for composite parts in aerospace and biomedical applications.

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



Nanotechnology

Research team reports new approach to simulating nanoscale heat transfer

A research group led by **JOE FESER**, assistant professor of mechanical engineering, is investigating the limits of heat transport using a suite of new tools for nanoscale thermal measurement and simulation, with an eye toward creating more thermoelectrically efficient materials.

One common strategy employed by his group is the use of nanoparticles to scatter heat-carrying vibrations, known as phonons. The team is developing tools to study phonon scattering so that the size, shape, and composition of nanoparticles can be optimized for thermoelectric applications.

Feser and doctoral student **ROHIT KAKODKAR** recently reported on their work in the *Journal of Applied Physics*.

The new framework significantly reduces the amount of computational power needed to simulate phonon scattering and greatly increases the maximum size of the systems that can be studied using computers.

While continuum mechanics models are accurate enough on length scales greater than the distance between atoms, Feser explains the approach may not be effective in characterizing the behavior of nanometer-length waves, which are often the wavelengths involved in heat transport.

The obvious solution is to have simulations that include an equation for each individual atom and track the behavior over an extended period of time, but that's where the computational logjam occurs. Traditional techniques like molecular dynamics are too slow to simulate scattering for every heat-carrying vibration separately, and other existing techniques are limited in their ability to simulate large systems.

Feser and Kakodkar's atomistic model can solve for a large number of atoms at a time.

"Basically what we've done is remove the unnecessary physics and embed facts we already know about the solutions into the solution procedure," Feser said.

The new tool helps researchers settle longstanding controversies about how to describe the physics of phonons encountering interfaces—that is, whether they travel across coherently or scatter diffusely—and especially how disorder changes that. It can be scaled up for use with supercomputers, which are seeing increased use for complex simulations.

Ultimately, the goal is to have precise control over the design of new materials at the level of their tiniest constituents.

Journal of Applied Physics. 118, 094301 (2015). http://dx.doi.org/10.1063/1.4929780 | Funded by the University of Delaware Research Foundation.

- This new approach significantly reduces the amount of computational power needed to simulate phonon scattering.
- The design of new materials that push the limits of achievable transport properties will enable the development of new device technologies.

Robotics and Controls

New tool guides planning and control of robots working in uncertain environments

Controlling robots in uncertain environments, such as over rough terrain or in changing ocean currents, is a challenge in itself, but it's an even greater challenge when the work involves not just one robot, but an entire team whose actions need to be coordinated.

Mathematical models can be a valuable tool for controlling robot behavior, but they need to be robust enough to account for the stuff that happens in real life.

To address this problem, a group of UD researchers has created a framework to extend traditional deterministic models, where the output is determined solely by the initial conditions and the applied inputs into the stochastic regime, where the inherent randomness of the real world can be considered.

In effect, they've created a method to predict how well models work.

Their work, co-authored by **KONSTANTINOS KARYDIS**, PhDME'15, **IOANNIS POULAKAKIS**, assistant professor of mechanical engineering, **JIANXIN SUN**, PhDME'16 and **HERBERT TANNER**, associate professor of mechanical engineering, is reported in the September 2015 issue of *The International Journal of Robotics Research*.

"Essentially, our method involves the use of data statistics to quantify the amount of uncertainty that the model parameters need to have to capture the variability observed in experimental data," said lead researcher Poulakakis.

"The methodology is general enough to accommodate different robot platforms and types of systems, and it can be applied to a variety of deterministic and stochastic models," he said.

To demonstrate the method, the research team applied it to miniature legged robots that crawl at low speeds, as well as to small quadcopters that hover.

The two chosen cases—leg-ground interaction in the legged vehicle case and aerodynamic effects in the aerial vehicle case—demonstrate that there are multiple ways to infuse stochasticity, or uncertainty, into the underlying deterministic model.

"We're hopeful that this method will help us to quantify the effect of uncertainty on individual robots so we can build functional robot teams of different morphologies and capabilities for a variety of applications."

The International Journal of Robotics Research, 1 - 18. (2015). http://dx.doi.org/10.1177/0278364915576336 | Funded by the National Science Foundation and the Army Research Laboratory.

- Extends traditional deterministic models into the stochastic regime—considers inherent randomness of real world.
- Data statistics quantify amount of uncertainty needed to capture observed variability.
- Teams of robots are more fault tolerant than are individual robots.

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

Interactive robot promotes rehabilitation for children with special needs

Robotics expert **HERBERT TANNER**, associate professor of mechanical engineering, is leading an interdisciplinary team exploring the use of a 22-inch humanoid robot named NAO in a new approach to pediatric rehabilitation based on social interaction between robots and humans.

Tanner and team members **COLE GALLOWAY**, a mobility researcher and UD physical therapy professor, and computational linguist **JEFFREY HEINZ**, associate professor of linguistics and cognitive science, received a National Institutes of Health grant through the Eunice Kennedy Shriver National Institute of Child Health and Human Development to develop the project known as GEAR (Grounded Early Adaptive Rehabilitation).

"NAO will interact socially with children and engage with them," said Tanner. "But, even more importantly, the robot will be programmed to react to the behaviors of individual children and deliver personalized interventions."

Heinz, whose expertise lies in machine learning, works with Tanner on the programming by developing new algorithms that enable the robot to devise plans on its own based on its environment.

This capability is what enables NAO not only to lead kids through a prescribed sequence of steps in a choreographed training routine but also to know when enough is enough.

NAO is used in conjunction with a portable harness system that partially supports the weight of special-needs kids and allows them to move freely in an 80-square-foot space, as well as with a network of cameras, sensors and accelerometers that record motion and type of activity.

The UD team is collaborating with researchers at the Johns Hopkins University Center for Imaging Science, who are developing activity recognition algorithms to help NAO discern fine distinctions in the types of movements the children make.

The data collected will enable the researchers to evaluate the effectiveness of the robotic intervention. Once the system has proven its efficacy through clinical testing in the Robotics and Control Lab at Spencer Lab, the door will be open to develop versions of the setup for use in community homes and area schools.

"Pediatric rehabilitation equipment and training currently do not meet the needs of kids with motor disabilities," said Galloway. "Young children's overall knowledge depends on their ability to be mobile with peers—once they start moving, they begin to learn about the world in fundamentally different ways."

NAO, a humanoid robot described by his creators as a "little character with a unique combination of hardware and software," can read your moods, recognize your family members, and learn your preferences in music, movies and food. He resembles a toy, but he is really a sophisticated research tool.

Buckley honored for advancing women's equity

JENNI BUCKLEY, assistant professor, senior design adviser and co-adviser of the Society of Women Engineers at UD, received the university's 2016 E. Arthur Trabant Award for Women's Equity.

Buckley is co-founder of the Perry Initiative, aimed at inspiring young women to be leaders in engineering and orthopaedic surgery. The nonprofit runs some 30 day-long outreach programs nationwide, with participants performing mock orthopaedic surgeries and conducting biomechanical engineering experiments.

"When it comes to women's equity, Jenni's work with the Perry Initiative is the obvious example," said colleague **DUSTYN ROBERTS**, also an assistant professor of mechanical engineering. "What started as a weekend project has turned into a legitimate nonprofit that reaches thousands of girls a year. She is selfless and giving of her time, more so than anyone I have ever met."

Buckley's approach to engineering education is to apply nationally what she learns locally for the greatest impact.

"If I visit a couple of middle school classrooms a year, I can affect maybe 60 girls, but through programs like The Perry Initiative, we can reach thousands," she said. "We have to think more broadly if we want to increase the number of women enrolling in engineering programs."

Buckley also won the university's 2016 Excellence in Teaching Award.

ENGINEERING A BETTER HEAT PUMP

Prasad's fuel cell knowledge could transform HVAC systems

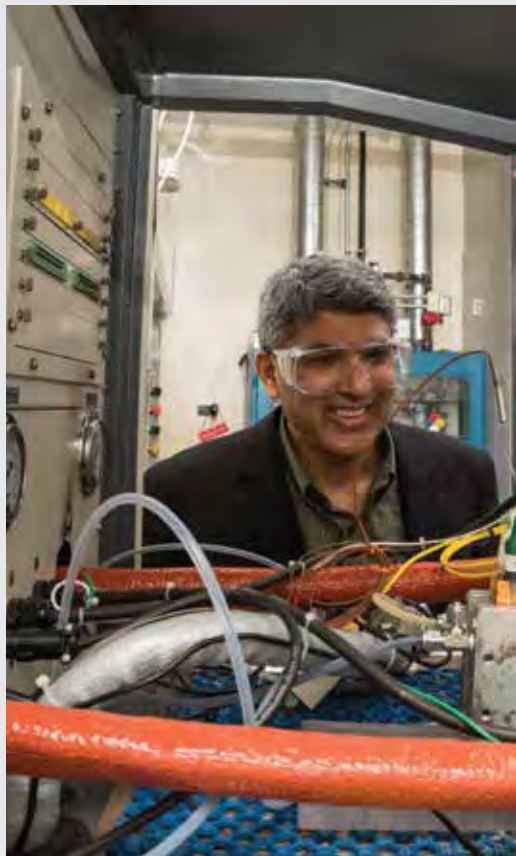
The same technology attracting attention for its potential to revolutionize the transportation sector by decreasing the use of fossil fuels and reducing emissions that contribute to climate change is now also being used in heating, ventilation and air conditioning (HVAC) applications, which account for about half of the energy use in a typical U.S. home.

A team led by **AJAY PRASAD**, the College of Engineering Alumni Distinguished Professor in the Department of Mechanical Engineering and director of UD's Center for Fuel Cell Research, is helping Delaware high-tech startup Xergy Inc. develop an innovative refrigeration system based on an electrochemical compressor to replace the conventional mechanical vapor compression systems found in typical heat pump units.

"Electrochemical compressors [ECCs] are very similar to fuel cells," said Prasad. "They employ many of the same components, including an ion-exchange membrane, gas diffusion layers, bipolar plates and catalysts."

Initial applications for the technology include hybrid water heaters and air conditioners. ECCs are extremely efficient and quiet because they have no moving parts, and, even more important, they allow the use of environmentally friendly refrigerants.

"This technology has the potential to transform refrigeration systems worldwide and bring about significant environmental benefits," said Prasad. "Improvements in HVAC system efficiencies will greatly reduce the electricity demand from power plants leading to reductions in greenhouse gas emissions."



Widespread adoption of ECCs will reduce our dependence on critical raw materials that go into electric motors, and help protect and preserve the ozone layer since ECCs do not require CFC-based refrigerants.

NIH grant supports continuing research on exercise and bone quality

Research by a multidisciplinary team led by **LIYUN WANG** may pave the way to identifying new molecular targets for preventing and slowing the onset of osteoporosis.

The work, which is funded through a five-year $1.9-million grant from the National Institutes of Health (NIH), may also help in the development of patient-specific exercise regimens to improve bone health.

Wang, associate professor of mechanical engineering, is partnering on the work with **X. LUCAS LU**, assistant professor of mechanical engineering and **CATHERINE KIRN-SAFRAN** from UD Biological Sciences, as well as colleagues from Rice University and the University of Pennsylvania. The award for their research on osteocyte mechanosensing is a competitive renewal of Wang's previous NIH grant on transport mechanisms in mineralized bone.

The research group has successfully developed and validated a novel method to study the fluid-flow-based delivery of various types of nutrients to osteocytes, the most abundant bone cells buried in bone.

"Specifically, we want to know how perlecan, an extracellular protein that comprises part of the suspension cables, facilitates bone cell responses to mechanical loading," Wang said.

In Wang's previous research, she and her collaborators discovered that perlecan is needed to maintain the normal density of the suspension cables and to ensure positive responses to exercise. These preliminary studies formed the basis for their hypothesis that the osteocytic pericellular matrix of the cables regulates bone adaptation to exercise and other mechanical cues.

They now plan to test that hypothesis at the tissue, cellular and molecular levels.

The work has the potential to improve the prevention and treatment of osteoporosis and advance fundamental knowledge about the pericellular matrix, a uniquely functioning but often overlooked structure found in nearly all mammalian cells.

ASC Outstanding Research Award

Department Chair **SURESH ADVANI**, the George W. Laird Professor of Mechanical Engineering, received the American Society for Composites (ASC) Outstanding Research Award for his contributions to the field of composites manufacturing through his research on modeling and simulation of various liquid molding processes.

"When I joined the University in 1987, most of the industry treated composites manufacturing as a black art," said Advani, who is also associate director of UD's Center for Composite Materials. "It was a lot of trial and error without a real science base. My mission since then has been to help create a science underpinning and then use that to develop predictive tools for composites manufacturing."

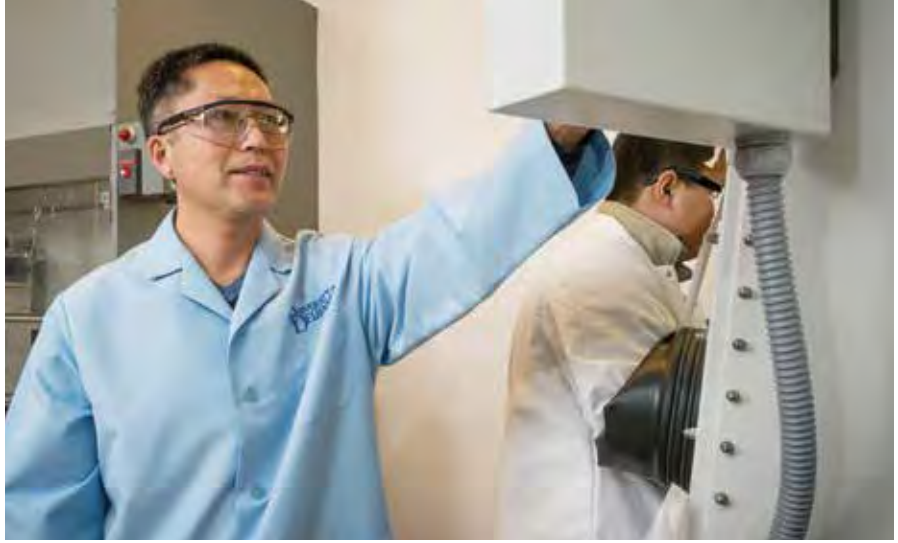
Slowly but surely the use of process modeling tools has been adopted in industrial practice—tools that are now considered a crucial component to address the challenges and gaps in the advancement of composites.

One of Advani's major contributions to the field is the development of LIMS (Liquid Injection Molding Simulation), a software tool that simulates the mold filling stage of liquid composite molding processes.

LIMS provides a simple and cost-effective way to verify and optimize filling process design by providing a "virtual" mold filling process, enabling the user to avoid or reduce costly physical trial-and-error processing. The software has been continuously updated and made more robust since its initial development in the early 1990s.

"If you change the way you look at things, the things you look at change."

–favorite quote of Suresh Advani by Wayne Dyer



IAMM Medal

BINGQING WEI, professor of mechanical engineering, received the 2015 International Association of Advanced Materials (IAMM) Medal at a ceremony in Stockholm, Sweden, for his "notable and outstanding contribution in the field of materials science and technology." Wei's research focuses on nanomaterials and nanotechnology, with applications in supercapacitors, batteries, hydrogen generation, fuel cells and solar cells.

Honorary professorship

TSU-WEI CHOU, Pierre S. du Pont Chair of Engineering, was awarded an honorary professorship by the president of Southwest Jiaotong University in Chengdu, China. Chou received the award at the 23rd International Conference on Composites and Nano Engineering, where he delivered a plenary lecture on nanocarbon-based composites and energy storage devices. Chou is also an honorary professor of Beijing University of Aeronautics and Astronautics, Northwestern Polytechnical University and Tongji University in China.

NSF GRANT SUPPORTS DESIGN OF ATTACK-RESILIENT MICRO AERIAL VEHICLES

Drones are seeing increased use in a wide array of applications, including delivery and inspection services, aerial photography, mapping and surveying, and search and rescue missions. The economic impact of their integration into the national airspace is predicted to be significant, but their use exposes the public to unprecedented vulnerabilities due to ever-increasing malicious attacks.

Integrating these unmanned aircraft systems, known more technically as micro aerial vehicles (MAVs), is expected to have a significant economic impact, with a predicted investment of $91 billion over the next decade.

"It is conceivable that hundreds of thousands of MAVs will be tearing across the sky every day largely under their own automated control," said **GUOQUAN HUANG**, assistant professor of mechanical engineering.

"Each of these vehicles, however, could be hijacked or deliberately controlled for malicious purposes, exposing us to unprecedented vulnerabilities."

Huang was recently awarded a two-year grant from the National Science Foundation (NSF) to design resource-aware, attack-resilient, consistent MAV navigation.

The $166K award will enable Huang, whose expertise lies in robotics, to develop consistent state estimation algorithms that will enable drones to detect abnormalities in their sensing and react to them to compensate for malicious attacks.

Huang's work focuses on protecting the sensing systems that drive navigation—not on the communication systems embedded in MAVs.

"As MAVs become integral to our economy and national security, we face ever-more frequent and threatening attacks," he said. "By enabling secure MAV navigation in the presence of malicious attacks, this research will add one more layer of protection to our society."

The research will also foster novel MAV-based applications, such as providing aerial transportation during humanitarian aid and delivering supplies in hard-to-reach areas during and after disasters.

The project will create graduate and undergraduate research opportunities and an integrated outreach program offering innovative hands-on lessons in robotics programming for K–12 students.

Thostenson addresses MATCOMP in Madrid

ERIK T. THOSTENSON, associate professor of mechanical engineering and affiliated faculty of UD's Center for Composite Materials, gave an invited plenary address at MATCOMP'15's ninth National Congress on Composite Materials in Madrid, Spain. Thostenson's plenary address highlighted his pioneering research in utilizing carbon nanotubes as *in situ* sensors for detecting damage in advanced composites and for use in structural health monitoring.

ASME Burt L. Newkirk Award

DAVID BURRIS, associate professor of mechanical engineering, is the 2016 recipient of the Burt L. Newkirk Award from the American Society of Mechanical Engineers (ASME), recognizing researchers under 40 who have made notable contributions to the filed of tribology. Burris was cited for "exceptional contributions," particularly in the area of cartilage tribology.

Burris began working in the area of osteoarthritis in 2009 with seed funding from the National Institutes of Health to investigate the disruption of lubrication in damaged cartilage and its contribution to progressive failure.

"For nearly a century, articular cartilage has been known for its exceptional tribological properties," said Burris. "It helps our joints resist wear, bear load and absorb shock, and if all goes well, it performs all of these functions for 70 or 80 years. But we shouldn't be surprised that a material capable of performing all of these functions would be complex and challenging to create artificially."

To develop hydrogels for cartilage replacement, Burris said that materials scientists will need to reinforce them with a fibrous scaffold that is stiff in tension but collapsible in compression, while maintaining a strong bond at the scaffold-hydrogel interface.

"This won't be easy," he said, "but there is no reason it can't be done in the next five years with the right people working on the solution."

SAMPE Fellow

JOHN W. (JACK) GILLESPIE JR., director of UD's Center for Composite Materials (CCM), has been named a fellow of the Society for the Advancement of Material and Process Engineering (SAMPE).

He is one of just 147 SAMPE members honored with the distinction since its inception in 1982. Gillespie was cited for his "lifelong contributions to the advancement of the science and engineering of composite materials through the education of students and development and transition of composites technology to industry."

"Jack has had a significant impact on furthering the insertion of composite materials in various applications by addressing the technological hurdles in a systematic and scientific way," said Suresh Advani, CCM associate director, chair of the Department of Mechanical Engineering and George W. Laird Professor of Mechanical Engineering.

"He has made a tremendous commitment to supporting student groups who have competed successfully in SAMPE design competitions, and his graduate students have also done well in research competitions, with four of his doctoral students winning the Ph.D. competition and presenting at meetings in Europe and Japan," said Advani.

Gillespie will also be honored this fall by the American Society for Testing and Materials with the 2016 Wayne W. Stinchcomb Memorial Award.

Lu named Outstanding Junior Faculty Member

X. LUCAS LU is the College of Engineering's 2016 Outstanding Junior Faculty Member. An assistant professor and head of the Cartilage Bioengineering Lab, Lu's research focuses on biomedical engineering, biomechanics, solid mechanics and life and health sciences.

Roberts honored for robotics research

DUSTYN ROBERTS, assistant professor in the Department of Mechanical Engineering and the Biomechanics and Movement Science Program, is part of a team recognized for advancing the study of energy expenditure in robotic systems. Roberts co-authored a paper with her graduate adviser, Joo Kim, assistant professor of mechanical engineering at the New York University Polytechnic School of Engineering, outlining the development of an instrumentation system and program that enables energy expenditure to be measured, processed and analyzed in robotic systems with an unprecedented level of accuracy. For their work, Zoo was recently honored with the 2015 Freudenstein/General Motors Young Investigator Award from the Design Engineering Division of the American Society of Mechanical Engineers.

Meet some of our
MECHANICAL ENGINEERING FACULTY

Jennifer Buckley **Assistant Professor**

Core Research Area: Biomedical Engineering

JENNI BUCKLEY's research focuses on the development and mechanical evaluation of orthopaedic, neurosurgical and pediatric devices. She is also interested in mechanical testing standards, academic-industry research partnerships, and mentoring practices in engineering.

A graduate of the University of Delaware, she went on to earn master's and doctoral degrees in mechanical engineering from the University of California, Berkeley, where she worked on computational and experimental methods in spinal biomechanics.

She joined the UD faculty in 2011 and now teaches a range of courses as part of the undergraduate curriculum, including the senior design capstone course, in which students collaborate across disciplines to solve a broad range of real problems.

Buckley received UD's Excellence in Advising and Mentoring Award in 2013, an Excellence in Teaching Award in 2016, and she is the Delaware state leader for Project Lead the Way, which provides hands-on, project-based STEM curricula and high-quality teacher professional development through a network of corporate and community partners.

Buckley is very involved in issues of gender diversity in engineering. She is co-founder and president of The Perry Initiative, a nonprofit outreach sponsor encouraging women to pursue careers in engineering and orthopaedic surgery. In 2015, she was awarded the E. Arthur Trabant Award for Women's Equity for her work with The Perry Initiative, which was founded in 2009 and now reaches 1,700 young women nationwide annually.

David Burris **Associate Professor**

Core Research Areas: Biomedical Engineering, Clean Energy and Environment, Composites and Advanced Materials, Nanotechnology, Robotics and Controls

DAVID BURRIS, who joined UD in 2008, now directs the Materials Tribology Laboratory, where the overarching research mission is to better understand how material properties can be tailored to control friction and wear.

Lack of access to the buried tribological interface is one of the primary barriers to progress in this area, and his group specializes in the development of *in situ* methods to gain more direct access to interfacial processes and phenomena. Their research activities involve instrument design, software developments, materials synthesis, materials characterization and surface analysis. Current areas of interest have applications in health care, national security and energy sustainability.

In 2015, Burris received the American Society of Mechanical Engineer's Burt L. Newkirk Award, which is given to a person under 40 who has made notable contributions to research or development in the field of tribology. He was cited for "exceptional contributions to his field, particularly in the area of cartilage tribology." For the past several years, he has investigated the disruption of lubrication in damaged cartilage and its contribution to progressive failure.

Burris, who studied solid mechanics, design and manufacturing at the University of Florida and received his Ph.D. in mechanical engineering in 2007, has several patents in the areas of polymer nanocomposites, wear-resistant solid lubricants and *in situ* lubrication strategies.

Meet some of our FACULTY

John W. Gillespie Jr.

Donald C. Phillips Professor and Director, Center for Composite Materials

Core Research Areas: Composites and Advanced Materials, Biomedical Engineering, Nanotechnology, Clean Energy and Environment

JACK GILLESPIE is director of the Center for Composite Materials (CCM), which now involves more than 60 companies and some 200 researchers, including faculty, undergraduate and graduate students, research professionals, visiting scholars and postdoctoral fellows. Under his leadership, CCM has been designated a Center of Excellence by several federal agencies over the past three decades.

Gillespie's 35-year career at UD is marked by a number of major accomplishments, including the creation and commercialization of new processes, automated equipment, materials and composite structures—leading to $187M in funding as PI/Co-PI, 19 patents and more than 800 co-authored publications.

Research in Gillespie's lab has addressed a broad array of areas as composites science and technology have evolved since the mid 80s. Currently, he is the principal investigator on a new award from the Defense Advanced Research Projects Agency (DARPA) to create affordable materials and processes with the potential to provide aerospace performance at automotive rates. He also leads a program funded by the Army Research Lab focused on materials in extreme dynamic environments, as well as two Department of Energy programs focused on lightweight vehicle technologies.

Gillespie is a fellow of the Society of Manufacturing Engineers, the American Society for Composites and the Society for the Advancement of Material and Process Engineering, and he was recently elected to the board of directors of the Composites Division of the Society of Plastics Engineers.

Jill Higginson **Associate Professor**

Core Research Area: Biomedical Engineering

JILL HIGGINSON leads research aimed at improving understanding of muscle coordination for normal and pathological movements through coupled experimental and simulation studies.

Higginson's group uses state-of-the-art modeling and optimization techniques to develop a cause-and-effect framework that relates muscle impairments to gait deviations. Current experiments involve three-dimensional kinematic and kinetic analysis and electromyography (EMG) recording during treadmill and overground gait. State-of-the-art modeling and optimization techniques are used to develop simulations based on experimental data.

Ongoing research projects are related to muscle deficits and subject-specific interventions for post-stroke hemiparetic gait, cartilage contact and compressive forces in progressive knee osteoarthritis, simulation-based analysis of muscle coordination in healthy and pathological gait, and interactions between cognitive function and gait performance.

The overarching goal of the work is to form a scientific rationale for therapeutic interventions to improve movement. Higginson, who earned her Ph.D. in mechanical engineering at Stanford University in 2005, recently collaborated with researchers in physical therapy on the design of an innovation called SmartBoot, an instrumented orthopaedic walking boot that enables clinicians to monitor patient compliance during daily life and provides patients with visual feedback to let them know if they are under- or overloading their limbs after an injury.

Guoquan Huang **Assistant Professor**

Core Research Area: Robotics and Controls

GUOQUAN HUANG leads the UD Robot Perception and Navigation Group, where the research efforts are driven by the desire to understand intelligence and develop robots that better serve people—for example, autonomous systems for search and rescue—and augment human capabilities, such as working in dangerous or inaccessible environments. The group's mission is to enable robots to understand their surroundings so as to navigate autonomously, safely and efficiently in any environment.

To this end, their research has been primarily focusing on probabilistic localization, mapping, estimation and control of autonomous ground, aerial and underwater vehicles. Theoretically, they seek to design and develop robust, efficient, consistent, secure state estimation and control algorithms for various perception and navigation problems.

Huang earned master's and doctoral degrees in computer science (robotics) from the University of Minnesota–Twin Cities in 2009 and 2012, respectively. He joined the UD faculty after serving as a postdoctoral associate with the Marine Robotics Group in MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL).

He received the 2006 Academic Excellence Fellowship from the University of Minnesota, the 2011 Chinese Government Award for Outstanding Self-Financed Students Abroad, and the 2013 MIT Postdoctoral Associate Travel Award. He recently received funding from the National Science Foundation and the University of Delaware Cybersecurity Initiative for research aimed at achieving attack-resilient, resource-aware, consistent drone navigation.

R. Valery Roy **Associate Professor**

Core Research Area: Clean Energy and Environment

Many natural and technological processes involve phenomena that take place over widely differing scales of time and space. Such multi-scale problems pose considerable difficulties. Porous media—which abound in modern technologies, such as drug delivery substrates, membrane reactors and chemical sensors, batteries and fuel cells—are a typical example. These heterogeneous systems involve multi-physics phenomena, such as diffusional or convective transport, and electrochemical conversion.

VALERY ROY's research focuses on the modeling and simulation of porous media and, more generally, on multi-scale systems. He uses a combination of mathematical modeling, continuum theories and advanced computational techniques. One such mathematical technique consists of devising pre-treatments of the multi-scale system so as to make the smallest scale vanish, leaving effective macroscopic, homogeneous models, which are much simpler to simulate.

Roy has also conducted research in the area of interfacial phenomena, nonlinear dynamics and stochastic dynamics. He teaches sophomore and graduate-level courses on engineering dynamics and an advanced course in applied mathematics. He recently published undergraduate and graduate textbooks in engineering dynamics and is working on a new book project on the modeling and simulation of multi-scale systems.

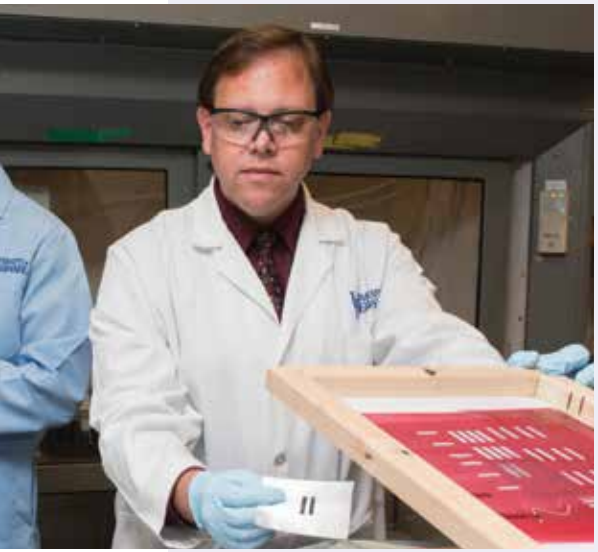
Roy joined the UD faculty in 1989 after earning his Ph.D. in mechanical engineering at Rice University.

Meet some of our FACULTY

Erik Thostenson **Associate Professor**

Core Research Areas: Composites and Advanced Materials, Nanotechnology

ERIK THOSTENSON heads the Multifunctional Composites Laboratory, which focuses on developing a fundamental understanding of the processing-structure-property relations in nanostructured materials and composites.



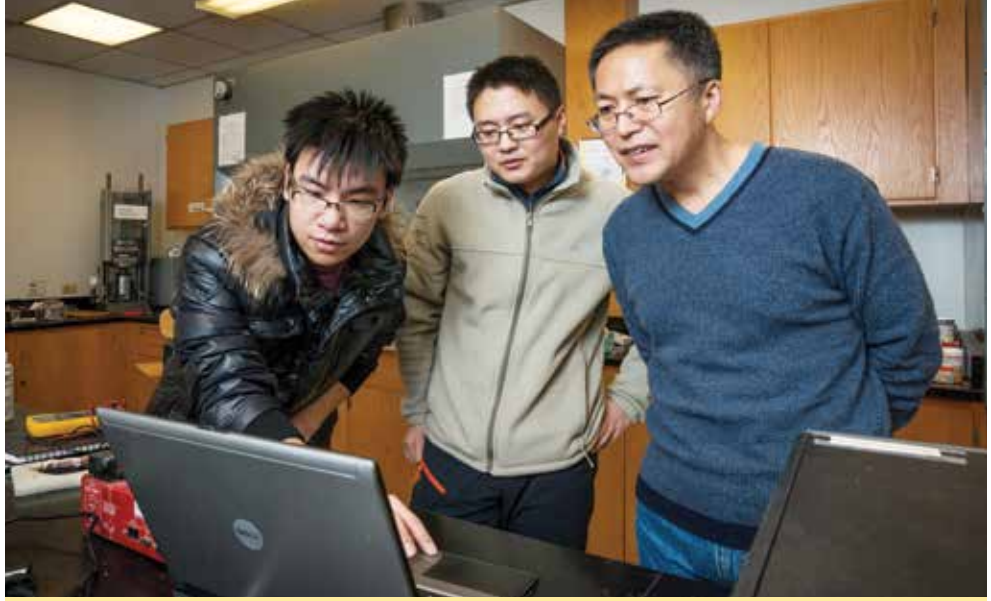
Key initiatives include experimental and theoretical research in processing, characterization and predictive modeling of nanocomposites. A major focus is on the development of novel and industrially scalable approaches for hybridizing nanostructures with traditional fiber reinforcements.

Working at the microscopic scale, his team is tailoring the local stiffness, strength, toughness and other properties through control of the fiber orientation, type and volume fraction. Recent advances in producing nanostructured materials with novel material properties have stimulated research to create macroscopic engineering materials by designing the structure at the nanoscale.

Thostenson's work is highly cited in the literature, and he has received a number of awards and honors, including a National Science Foundation Early Career Development Award and a Young Investigator Program Award from the Air Force Office of Scientific Research.

He is also the recipient of the Elsevier Young Composites Researcher Award from the American Society for Composites, which recognizes researchers who, early in their careers, have made a significant impact on the science and technology of composite materials through a sustained research effort.

Thostenson performed his master's (Mechanical Engineering) and Ph.D. (Materials Science) research at UD's Center for Composite Materials.



Bingqing Wei **Professor**

Core Research Areas: Clean Energy and Environment, Composites and Advanced Materials, Nanotechnology

BINGQING WEI's recent work focuses on the synthesis, processing, characterization and physical properties of carbon nanostructures and carbon nanotube nanocomposites. In particular, he has been exploring the feasibility of using carbon nanotubes for energy storage applications, such as supercapacitors.

He has achieved a tunable means to couple or decouple the mechanical, electrical and electrochemical properties of carbon nanotube macro-films through mechanical buckling. His current work focuses on further improving the energy density of these materials and enhancing charge/discharge cyclability.

This research offers significant potential to impact new energy technologies, such as deformable energy storage devices. Beyond traditional electronics, potential stretchable applications include biomedical, wearable, portable and sensory devices, such as cyber-skin for robotic devices and implantable electronics.

Wei and his team have also recently discovered a "sticky" conductive material that may eliminate the need for binders in lithium-ion batteries. Their discovery that fragmented carbon nanotube macrofilms can serve as adhesive conductors, combining two functions in one material, could reduce both the cost and the environmental impact of lithium-ion batteries.

Wei received his Ph.D. in mechanical engineering from Tsinghua University in Beijing and joined the University of Delaware in 2007 after spending four years at Louisiana State University.

2015–2016 MECHANICAL ENGINEERING LECTURE SERIES

Fall 2015

Fabrizio Sergi
Assistant Professor, Biomedical Engineering,
University of Delaware
"Advances in Mechatronics for Human-Robot Interaction: The Case of Neurorehabilitation"

Alberto Cuitino
Professor and Department Chair, Department of Mechanical and Aerospace Engineering, Rutgers University
"Reaction Front Propagation Modeling in Heterogeneous Condensed Systems"

NOWINSKI LECTURE
Guruswami Ravichandran
John E. Goode, Jr., Professor of Aerospace and Mechanical Engineering,
California Institute of Technology
"Mechanics of Cell-Matrix Interactions in Three-Dimensions"

Pradeep Sharma, M.D.
Anderson Chair Professor and Department Chair, Department of Mechanical Engineering, University of Houston
"Flexoelectricity"

Lawrence J. Bonassar
Professor, Departments of Biomedical Engineering and Mechanical & Aerospace Engineering, Cornell University
"New Insights on the Mechanics of the Surface of Articular Cartilage"

Louis L. Whitcomb
Professor and Chair; Louis M. Sardella Faculty Scholar,
Johns Hopkins University
"Nereid Under-Ice: A Remotely Operated Underwater Vehicle for Oceanographic Access under Ice"

Spring 2016

Stelios Kyriakides
Cockrell Family Chair Professor Department of Aerospace Engineering & Engineering Mechanics,
University of Texas at Austin
"Crushing and Energy Absorption of Open-Cell Foams"

W. Gregory Sawyer
N. C. Ebaugh Chair Professor, Department of Mechanical & Aerospace Engineering,
University of Florida
"Soft Matter Engineering for Biomedicine"

John J. Leonard
Samuel C. Collins Professor Department of Mechanical & Ocean Engineering,
Massachusetts Institute of Technology
"Mapping, Localization, and Self-Driving Vehicles"

VINSON LECTURE
Kenneth E. Goodson
Robert Bosch Chairman, Department of Mechanical Engineering,
Stanford University
"Electronics Thermal Management at the Extremes"

Gareth H. McKinley
Professor, Department of Mechanical Engineering,
Massachusetts Institute of Technology
"Fog, Feathers and Fluid Friction Reduction: Real-World Applications of Superhydrophobic Textured Surfaces"

JERZY L. NOWINSKI DISTINGUISHED LECTURE

The Nowinski Lecture Series honors the late Jerzy L. Nowinski, Professor Emeritus in Mechanical Engineering at the University of Delaware, for his contributions to the field of Applied Mechanics. Each year, one outstanding individual in Applied Mechanics is invited to present a lecture in the series. Dr. Nowinski was the H. Fletcher Brown Professor in the Department of Mechanical Engineering and subsequently the Department of Mechanical and Aerospace Engineering at the University of Delaware from 1961 to 1973.

JACK R. VINSON DISTINGUISHED LECTURE

The Vinson Lecture honors Jack R. Vinson, the H. Fletcher Brown Professor Emeritus of Mechanical and Aerospace Engineering at the University of Delaware. Vinson, who joined the UD faculty in 1964 and taught one of the first composites courses in the US in 1969, was the founding director of the University's Center for Composite Materials in 1974. He served as chairman of UD's Department of Mechanical and Aerospace Engineering from 1965 to 1979.

CCM leads major DARPA program to revolutionize the manufacturing of composite materials with aerospace properties at automotive prices

Researchers from UD's Center for Composite Materials (CCM) may help revolutionize the use of complex curvature composite structures for aerospace and automotive applications in the defense and commercial sectors with a newly awarded DARPA contract for the Tailorable Feedstock and Forming (TFF) Program.

Under the $14.9M three-year cooperative agreement with the Defense Advanced Research Projects Agency (DARPA), CCM will lead a team of composite experts from Clemson, Drexel and Virginia Tech to develop a novel low-cost carbon fiber composite feedstock and manufacturing process.

The new material, called TuFF (tailorable universal feedstock for forming) will consist of carbon fiber in a thermoplastic matrix with improved microstructural design, creating thin ply sheets that optimize formability of single and doubly curved parts with aerospace grade mechanical properties and damage tolerance.

Under the leadership of director **JOHN W. GILLESPIE JR.**, professor of mechanical engineering, materials science & engineering and the Donald C. Phillips Professor of Civil & Environmental Engineering, CCM will establish a semi-automated pilot plant to produce TuFF starting with carbon fiber precursors and ending with net-shape zero-waste formable feedstock blanks.

Said **ROB ADKINSON**, TuFF program manager, "Bypassing all of the manufacturing problems associated with advanced composites, our approach will allow us, for the first time, to make composite parts having aerospace properties at automotive prices."

TuFF
Tailored Universal Feedstock for Forming

DOE-FUNDED PARTNERSHIPS ADVANCE FUEL-EFFICIENT VEHICLE TECHNOLOGIES

Center for Composite Materials (CCM) researchers have formed industry and university partnerships in two recently funded programs to design, manufacture and demonstrate an ultra-light hybrid composite door through a Department of Energy (DOE) program aimed at advancing fuel-efficient vehicle technologies.

CCM is part of the Clemson University-led team where researchers will use carbon-fiber-reinforced thermoplastic composites to fabricate a driver's side front-door assembly for a large original equipment manufacturer. Their goal: to reduce the door's weight by 42.5 percent as automakers work to meet U.S. corporate average fuel economy (CAFE) standards. Fleets of vehicles are supposed to average 54.5 miles per gallon by 2025.

CCM is also part of the TPI Composites-led team where TPI's expertise in system design and as a Tier 1 supplier will be complemented by CCM's modeling and simulation capabilities for HP-RTM (high pressure resin transfer molding) of carbon fiber thermoset composites, material response and side impact crash modeling of composites.

According to **DIRK HEIDER**, assistant director of CCM, the new carbon-fiber-reinforced doors have to match the current steel models with regard to all fit, function and safety requirements. The new doors must also be producible at the required rate of 80,000–90,000 units per year.

CCM poster day highlights summer scholar research

Each summer, about two dozen undergraduates working in multidisciplinary teams address real problems in composites research—from microscopy to signal processing—

gaining invaluable laboratory experience that brings academic coursework to life. Summer internships often pave the way for internships with industry, continued research opportunities during the academic year, independent research, co-authoring of papers and the opportunity for students to present their work at conferences and symposia.

UDME training record numbers of female engineers

By Sarah Masters, BME '14, and Jenni Buckley, BME '01

Our department was 66 years old when Constance Darby became the first woman to earn a Bachelors of Mechanical Engineering degree in 1957. At the time, engineering was widely considered a masculine profession unsuitable for women. It wasn't until 1972 that the number of U.S. women receiving undergraduate degrees in engineering reached just 1 percent.

Now, universities across the country play an important role in diversifying the industry. From sponsoring summer camps for young girls to enlisting current female students and faculty as recruiting event ambassadors, they have spent decades working to recruit women into engineering. But despite these efforts, the rate has been stagnant at 20 percent since the 1990s.

At UD we are making great gains in terms of gender diversity in our undergraduate population. Furthermore, our efforts—and results—serve as a model for other mid-to-large state programs nationally.

In 2015, 20 percent of our graduating mechanical engineering undergraduate class was female, up from 12 percent in 2007. What's more, our undergraduate enrollment has increased 250 percent over the past decade, from 41 students in 2005 to 104 in 2015. We're not only increasing the rate of female graduates, but also the overall volume, which is essential for these gains to translate into the workforce.

UD ranks as one of the top 10 most gender-diverse ME programs in the country when compared to other programs with graduating classes larger than 100 students. Our percentage of female graduates far surpasses regional rivals for engineering recruits, such as Penn State (12 percent female), Drexel (8 percent), and Virginia Tech (8 percent). We are within striking distance of programs such as Carnegie Mellon (#5 at 27 percent female) and Cornell (#4 at 28 percent), which have hefty endowments and recruiting budgets to draw in top female talent nationally.

At UD, we have found success by approaching the diversity problem like mechanical engineers. We designed a comprehensive recruitment strategy and, to retain our female talent, we have adopted best practices from engineering education research.

We're increasing our department's visibility at regional high schools with pre-engineering programs like Project Lead The Way. We're providing more peer and faculty mentoring in students' first two years. And we're emphasizing the social impact of mechanical engineering, particularly in health care, sustainability and security.

We still have a lot of work left to accomplish. We've set our sights on 30 percent female enrollment by 2020. Not only would this put us in the top three programs nationally for gender diversity (alongside MIT and Notre Dame), but also 30 percent is the generally accepted threshold for self-sustaining diversification.

To reach this goal, we need involvement from the entire UD community—including current students, alumni and industry partners. You can help in this effort by spreading the word that UD is a great place for women to train to become mechanical engineers, by supporting women's scholarship funds, and by volunteering your time to mentor our female students.

Learn more about opportunities to help in the back of this magazine.

> UD ranks as one of the top 10 most gender-diverse ME programs in the country when compared to other programs with graduating classes larger than 100 students.

ME co-hosts conference emphasizing the 'E' in STEM

PAM LOTTERO-PERDUE, BME'95, M.ED.'99, PhD'05, worked briefly as a process engineer after earning a her Ph.D. in mechanical engineering, but she couldn't silence the voice in her head that said she should be a teacher.

Now an associate professor at Towson University, Lottero-Perdue shared her approach to science education in a keynote address at a conference, "Emphasizing the E in STEM," co-hosted at UD's Clayton Hall earlier this year by the departments of Mechanical Engineering and Education and Office of Admissions.

Sponsored by Project Lead The Way—a national provider of project-based curricula and teacher professional development in science, technology, engineering and mathematics (STEM)—the conference focused on bringing an integrated approach to K–12 engineering education.

JENNI BUCKLEY, assistant professor of mechanical engineering, was one of the lead organizers of the event, which attracted some 150 students, teachers, administrators and educational researchers. Workshop topics ranged from preparing students for an engineering education and supporting teacher learning in STEM, to attracting diverse and engaged students to engineering. A panel discussed strategies for partnering with industry in K–12 education.

"This conference was an important first step in building a community for pre-college engineering educators in the state," said Buckley. "The partnership between our colleges of education and engineering really positions UD to provide the necessary resources and support to K–12 teachers who are incorporating engineering practices in their classrooms."

Lottero-Perdue, who prepares education majors at Towson and K–12 educators in Maryland to teach engineering to children, believes that you have to "engineer" an engineering education.

"You have to design with what you have and then redesign in response to changes in standards," she said, of the importance of applying engineering principles to curriculum development and instructional design in this area. "Iteration is an inherent part of the process."

CBER to undergraduates: Dare to BE FIRST in biomechanical engineering

A team of 20 minority undergraduate students will have the unique opportunity to gain essential research skills for biomedical engineering through a comprehensive 10-week Research Experience for Undergraduates (REU) offered by UD's Center for Biomechanical Engineering Research (CBER). The **B**iomechanical **E**ngineering **F**oundations in **I**mpactful **R**esearch, **S**cience and **T**echnology—BE FIRST—program offers students hands-on experience in a research laboratory, scientific and professional development workshops, research lab and clinical site visits, networking opportunities, interdisciplinary communication with scientists from graduate students to orthopaedic surgeons, and the opportunity to attend a university-wide research symposium.

According to principal investigators **JILL HIGGINSON**, associate professor of mechanical engineering and biomedical engineering, and **X. LUCAS LU**, assistant professor, students who dare to BE FIRST are recruited for the REU from minority institutions and historically black colleges and universities around the U.S., as well as from other institutions with limited research resources. CBER's goal is to improve engineering and research skills and influence the academic pursuits of this group of talented and diverse young scientists.

Dare to BE FIRST participants receive:

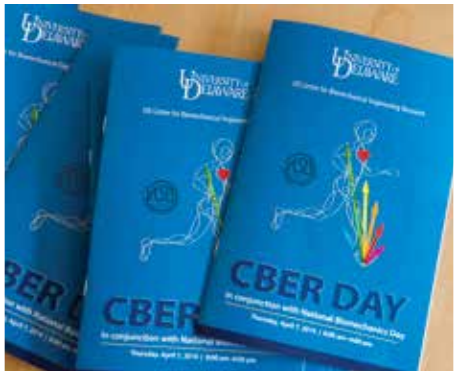
- 10-week full-time summer research experience.
- Research advisor and host bioengineering laboratory.
- $5,000 stipend.
- University housing supplement.

The program leverages CBER's strengths in cutting-edge osteoarthritis research to improve undergraduates' professional skills and quantitative analysis capabilities. Theory, modeling and simulation in molecular, cellular, tissue and joint-level biomechanics are emphasized.

For more information, visit www.cber.udel.edu/reu

CBER Day winning posters

- First Place, Session 1: "Lower Knee Flexor Muscle Forces During Gait Are Associated with 2nd ACL Injury In Young Female Athletes," Jacob Capin, Ashutosh Khandha, Ryan Zarzycki, Kurt Manal, Thomas Buchanan, Lynn Snyder-Mackler.
- First Place, Session 2: "Changes in Corticomotor Drive to Plantarflexor Muscles Induced by Gait Training with Functional Electrical Stimulation Positively Influence Post-Stroke Gait Mechanics," Jacqueline Palmer, HaoYuan Hsiao, Stuart Binder-Macleod.
- People's Choice: "Helical Versus Euler Angles for Describing Scapulothoracic Motion," Elizabeth Rapp, Tyler Richardson, James Richards.



CBER DAY SHOWCASES FACULTY, STUDENT WORK IN BIOMECHANICAL ENGINEERING

Nearly 100 middle and high school students learned about UD research at the Health Sciences Complex, joining peers across the country for a nationwide biomechanics open house marking National Biomechanics Day in April.

ELISA ARCH, PhDME'12, assistant professor in kinesiology and applied physiology, led a team of volunteers from the colleges of Engineering and Health Sciences offering teen-friendly demonstrations in 10 labs at the facility on UD's Science, Technology, and Advanced Research (STAR) Campus.

The open house for teens was held in conjunction with CBER Day, an annual event showcasing faculty and student work in the Center for Biomechanical Engineering Research (CBER).

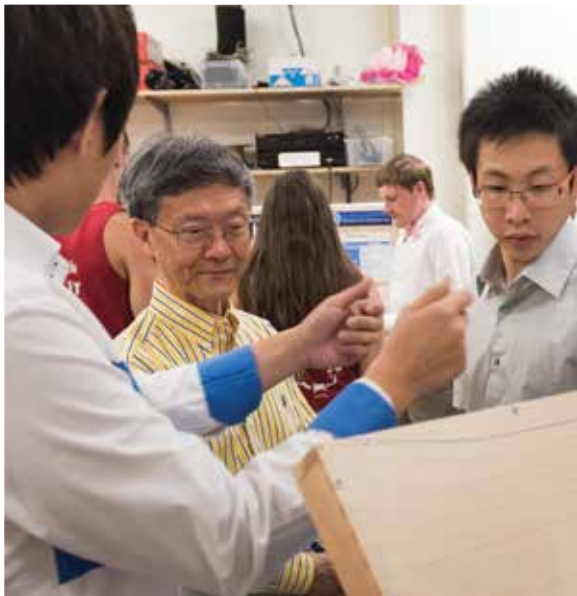
Later that day, the venue shifted to the Harker Interdisciplinary Science and Engineering Laboratory for the traditional CBER Day program.

Two sessions featured a total of 38 posters in five focus areas: assistive devices; bone, cell and cartilage; gait; motor control; and orthopaedics. Project topics ranged from helping amputees gain balance to the effect of surgical approach on gait mechanics after total hip arthroplasty, or surgery to restore the integrity and function of a joint.

"We tried something new this year by pairing CBER Day with National Biomechanics Day, and I think it was a great success," said **MIKE SANTARE**, CBER director and professor of mechanical engineering. "Our visitors had a chance to not only observe activities in our labs, but also try out some of the technologies and ask questions."

"We're known for training engineers to be great designers here at UD, and part of that training involves hands-on construction each and every year."

– Jenni Buckley, Assistant Professor and Design Expo Organizer



Design Expo SHOWCASING
STUDENT DESIGN SKILLS ATTRACTS HUNDREDS

UD's annual Design Expo has become a popular year-end showcase for student design projects at the freshman, sophomore, junior and senior levels.

"The Design Expo is a great opportunity for our younger students to show off their design skills," said **JENNI BUCKLEY**, assistant professor and organizer of the event hosted by the Department of Mechanical Engineering in the new Design Studio "maker space" in partnership with the departments of Art and Biomedical Engineering. "We're known for training engineers to be great designers here at UD, and part of that training involves hands-on construction each and every year."

"The challenges are a great way to encourage our freshmen to get creative and work together to solve an open-ended problem," said **DUSTYN ROBERTS**, assistant professor of instruction.

DANIELLE GERSTMANN and **CAROLYN HALL**, both sophomores in the Computer Aided Engineering Design (MEEG202) course at last year's event, created a shelving unit that used vertical space for over-the-bed storage and incorporated various attachments, such as a foldable desk and phone and cup holders, offering users the ability to customize the unit by placing any of the attachments on any of the rungs.

"Although I've been told many times that mechanical engineering is known for its rigorous academic schedule, I'm persistently intrigued by all the opportunities to put the work learned in the classroom to great use in real life," said Gerstman.

In the senior Integrated Design (MEEG467) course, mechanical engineering upperclassmen and visual communications students partner to study and design commercial products. A recent project involved envisioning the next generation of plumbing products for the Speakman Company, a major manufacturer of showerheads and plumbing fixtures.

About the Design Studio

The 5,900-square-foot Design Studio in Spencer Laboratory, UD's mechanical engineering building, includes workspaces for rapid prototyping, digital fabrication (e.g., 3D printing, laser cutter), electronics, health care-focused design (wet lab for tissue work and physiology stations), and design validation and testing.

The maker space was designed and built by students, with generous financial contributions from alumni, the College of Engineering and the University.

Senior Design

From guitar strings to intramedullary nailing devices—senior design students collaborate to solve problems

Someday soon, guitar aficionados may have a team of mechanical engineering students to thank for the fresh sounds resonating from their strings.

A team of mechanical engineering senior design students was challenged by industry sponsor W.L. Gore and Associates to develop an automated guitar string coating process for the Delaware-based company.

"Automating this process is a problem we've been struggling with for awhile," said Gore's **MIKE HAWLEY**, who completed his bachelor's degree in mechanical engineering at UD in 2001. "Senior design is a great way for us to get fresh ideas for concepts that our engineers can carry forward."

The senior design capstone course imitates challenges young engineers will experience in industry, from designing a more efficient hydroponic system for growing lettuce to creating a robot that aids in inspecting and measuring for roof replacement.

This year, the senior design students collaborated with faculty in five of UD's other colleges: Agriculture and Natural Resources, Arts and Sciences, Education and Human Development and Health Sciences, as well as the Alfred Lerner College of Business and Economics. They also received assistance from the Office of Economic Innovation and Partnerships.

UD's Multidisciplinary Senior Design Final Review in December showcased nearly 40 projects completed by teams of students in mechanical, biomedical, civil and environmental, electrical and computer engineering, including one to develop a proprietary concept to provide adequate nutritional support for critically ill patients served by a start-up company launched by UD alumna **JENNIFER LINTON**, a registered dietitian.

"It's very rewarding for our students to work with clinician entrepreneurs," said **JENNI BUCKLEY**, assistant professor of mechanical engineering and one of the team faculty advisers. "There's a lot on the line when you're the first engineering team working with a start-up company. Our senior design teams do a great job delivering for the startups, and they'll be able to use the students' work to build their business."

DePuy Synthes, a Johnson and Johnson company that develops a wide range of orthopaedic devices and trauma care products, worked with a team of mechanical and biomedical engineering students on a device to assist surgeons in intramedullary nailing, which is the standard of care on long bone fractures.

"You were asked some tough questions," said Tom Keyer, group manager at Synthes Trauma, in expressing his pleasure with the team's final product. "I was impressed with your ability to think on your feet."

"Senior design was an eye-opener about how open-ended engineering can be. There were so many possible solutions and nothing currently existed that solved such a problem. This made the project very challenging, but at the same time gave us the most creative freedom possible when designing."

– Erik Johnson, BME'16
Team W.L. Gore

Sponsor a senior design team

Companies, corporations and engineering firms: Start building relationships with some of brightest, most creative young minds in the industry by sponsoring a senior design team. If you need a "fresh look" at a new or improved product, process or quality control system, partnering with our Senior Design program could be your answer. Projects are executed, concept to prototype, in a single semester (September – December) by teams of students with diverse backgrounds and capabilities. Student teams are supported by a team of faculty members and industry consultants and have access to mechanical engineering's research facilities.

As a sponsor, you'll not only uncover the business potential of that "back burner" idea, but get an inside look at students' potential as prospective employees.

For more information on senior design sponsorship, contact Jenni Buckley, PhD, BME '01, Jbuckley@udel.edu

Senior design SmartBoot takes third at 2015 Summer Biomechanics, Bioengineering and Biotransport Conference

If you've ever sprained an ankle or had a stress fracture in your foot or lower leg, you've probably worn an orthopaedic walking boot.

The Velcro-strapped black devices are designed to force rest while allowing partial weight bearing. While experts agree that this combination is the best route to recovery, questions remain: How much weight should be kept off an injured limb? For how long? And how do patients know whether they're correctly following clinician's recommendations about weight bearing?

Enter SmartBoot, a device prototype designed by UD senior design students, which enables clinicians to monitor patient compliance during daily life and provides patients with visual feedback to let them know if they are under- or overloading their limbs after an injury.

Then ME seniors—now alumni—**MICHAEL SCHENK**, BME'15, and **MEG O'BRIEN**, BME'15, were part of the interdisciplinary engineering team that earned a third-place award for their project at the 2015 Summer Biomechanics, Bioengineering and Biotransport Conference in Snowbird, Utah.

"This device brings science to an established technique," said team sponsor **JILL HIGGINSON**, associate professor of mechanical engineering. "Patients are often trained in the clinic on a bathroom scale and then sent home with crutches, with the assumption that they can consistently perform partial weight bearing on their own."

Features incorporated into the boot include force sensors, data processing, data storage, wireless data transmission and sensory feedback.

Although the senior design class was over at the end of the fall 2014 semester, the team continued to work on the boot to prepare for the conference with support from the College of Health Sciences First Step. They implemented some critical improvements, including new force sensors, better switches, detachable wiring and a rechargeable battery.

Progress continues on the SmartBoot and a provisional patent is now in place with undergraduates working to take it to the next level.

UD's SmartBoot and the design team including two ME students was featured in the *Philadelphia Inquirer* and on philly.com in November 2015. Check it out at:

philly.com/philly/health/sportsmedicine/20151108_High-tech_boot_could_speed_healing.html

ME undergrad captains UD women's basketball

HANNAH JARDINE, an ME major and biomechanical engineering minor whose goal is to become a doctor, is co-captain of UD's Women's basketball team. This two-time letter winner has a .401 3-point shooting percentage—second in the program's history behind All-American Elena Delle Donne—and is on the Colonial Athletic Association's All-Academic Team.

2015–2016

Mechanical Engineering Dissertations and Theses

Joshua Bryson, Ph.D.
Dissertation: "The Optimal Design of Cable-Driven Robots"
Advisor: Sunil Agrawal

Qu Cao, Ph.D.
Dissertation: "A Modeling Hierarchy of Quadrupedal Running with Torso Compliance"
Advisor: Ioannis Poulakakis

Zeyuan Cao, Ph.D.
Dissertation: "Carbon Nanotube Macrofilm-Based Nanocomposite Electrodes for Energy Applications"
Advisor: Bingqing Wei

Cedric Jacob, Ph.D.
Dissertation: "Sub Percolation Threshold Carbon Nanotune Based Polyvinylidene Fluoride Polymer-Polymer Composites"
Advisor: Erik Thostenson

Konstantinos Karydis, Ph.D.
Dissertation: "A Data-Driven Hierarchical Framework for Planning, Navigation, and Control of Uncertain Mobile Robots: With Applications to Miniature Legged Robots"
Advisor: Herbert Tanner

Xiaohan Lai, Ph.D.
Dissertation: "Osteocytic Pericellular Matrix and Lacunar-Canalicular System in Mechanosensing"
Advisors: X. Lucas Lu and Liyun Wang

Xiaoqing Li, M.S.
Thesis: "A Study of Fiber Orientation in Particle-Loaded Suspensions Using a Direct Simulation Method with Collision Strategy"
Advisor: Suresh Advani

Yupeng Li, Ph.D.
Dissertation: "Mechanical Characteristics of Continuous Carbon Nanotube and Continuously Reinforced Carbon Nanotube Composite"
Advisors: Jonghwan Suhr and Bingqing Wei

Michael Minnicino II, Ph.D.
Dissertation: "Multiscale Mechanics Modeling of the Effect of Interface Topography Between the Fiber and Matrix"
Advisor: Michael Santare

Queming Qiu, Ph.D.
Dissertation: "Theoretical and Computational Study of Colloid Transport and Retention in Saturated Soil Porous Media"
Advisor: Lian-Ping Wang

Hatice Sas, Ph.D.
Dissertation: "Addressing Variability of Fiber Preform Permeability in rocess Design for Liquid Composite Molding"
Advisor: Suresh Advani

Jianxin Sun, Ph.D.
Dissertation: "Radiation Detection Using Mobile Sensor Networks"
Advisor: Herbert Tanner

Vineet Unni, M.S.
Thesis: "Optimized Design of Nanofibers for Low Thermal Conductivity in Nanocomposites"
Advisor: Joseph Feser

Wenjie Zhao, Ph.D.
Dissertation: "Mechanical Characterization and Modeling of Three-Dimensional Carbon Nanotube and Nanotube Reinforced Composite"
Advisors: Jonghwan Suhr and X. Lucas Lu

New nanofabrication facility garnering attention of students, faculty and industry

To help advance nanotechnology studies—a core research area for ME—UD opened a $30M "machine shop of the 21st century" this spring in the Harker Interdisciplinary Science and Engineering (ISE) Laboratory.

The University of Delaware Nanofabrication Facility is equipped to produce devices that cannot be seen by the naked eye—materials used in a wide array of applications from medicine to environmental sciences to solar energy harvesting. The lab's equipment allows researchers to make devices as small as 10 nanometers.

Its cleanroom features four separate bays for processes, including lithography, deposition of thin films, etching and thermal processing.

Murray wins SPE scholarship and 4H Science Innovator Award

Mechanical engineering student **COLLEEN MURRAY**, an intern in the Center for Composite Materials (CCM) Summer Undergraduate Research Program, had a pretty impressive freshman year, reflecting on wins of both the 2015 Harold Giles Scholarship undergraduate award sponsored by the Society of Plastics Engineers (SPE) Composites Division and a 4H Science Innovator Award.

As a summer intern with CCM, Murray assisted in a grant-support project on the creation of protective gear for the military and worked as a counselor for an engineering summer program. Her work earned first and second place honors respectively at CCM's 2014 and 2013 annual research symposia.

"Having the opportunity to work at CCM allowed me to explore mechanical engineering and learn about the protocols in a collegiate laboratory," said Murray, who was selected for the SPE award among 17 candidates. "My mentors and the fellow interns were very accepting and offered great advice whether it came to the various projects or when talking about colleges."

Murray focused on science-related topics in her high school coursework, including environmental education and engineering. Her school's competitive robotics team mandated community outreach projects, including an Urban Promise program that assisted students with annual science fair projects.

From 2011 until she entered her freshman year, Murray was a fixture at various 4-H day and overnight camps. Her service as a volunteer camp counselor and instructor focused on environmental education, gardening, engineering, biotechnology and forensics studies modeled after *CSI: Crime Scene Investigation*.

Watching campers make a connection through science, engineering, technology and mathematics has had an impact on Murray. "Their joy and enthusiasm is why I want to continue with STEM outreach," she said. "Because of that camp, maybe one of them will decide to go into science, just like my camp activities helped me discover engineering."

University of Delaware

Mechanical Engineering Student Squad

MESSing around gives students valuable leadership experience

The Mechanical Engineering Student Squad is creating quite a MESS around campus—a good mess—helping to recruit, retain and advance mechanical engineering students at UD.

RECRUIT

This team of about 40 hardworking, talented sophomores, juniors and seniors meets bi-weekly to help out with department recruitment efforts by providing guided tours of Spencer Lab, mentoring select high school students through design projects and traveling to local K–12 STEM classes to spread interest in mechanical engineering.

RETAIN

To help incoming freshmen acclimate to college life, MESS members hold continuous office hours throughout the two-week registration period and are on-hand round-the-clock to answer questions about classes and the department. They also plan fun events for ME students and faculty, including the Build-a-thon design challenges, where teams constructed the tallest freestanding balloon tower possible with just tape, designed an aesthetically pleasing battery-powered toy vehicle and competed in the classic egg drop; monthly mechanical-themed movie nights; pizza and LEGOs; grad student poster sessions, organized in collaboration with the Mechanical Engineering Graduate Association (MEGA) to give undergrads a chance to see what grad school is like; and end-of-year celebrations. The group is heavily involved in planning and promoting activities for ME's 125th celebration throughout the coming year.

ADVANCE

MESS helps students make alumni connections and learn about internship opportunities and job postings. The group fosters networking opportunities through connections with alumni, professors and UD Career Services. The student leaders maintain the website www.mess.udel.edu and contribute to both the department's Facebook page, www.facebook.com/me.udel.edu, with more than 800 followers, and LinkedIn profile at https://www.linkedin.com/groups/5048775, with nearly 500 connections.

JENNI BUCKLEY, assistant professor, **MICHAEL KEEFE**, associate professor and associate chairman for undergraduate education, and **HEATHER DOTY**, assistant professor, provide professional guidance and connections for this student-run club. Senior **MATTHEW HERSH** is MESS president.

"MESS members are always thinking of innovative ways to improve the department and Spencer Lab—and department leadership looks to us to represent the student body when it comes to proposed departmental changes," said Hersh. "All the while, MESS not only helps the community, it also benefits the club members themselves. Being involved in such a club provides vast leadership skills, such as public speaking, communicating and connecting with others, working effectively as a team, making big decisions and working hard for what you are passionate about."

Vorontsova crowned Miss Delaware USA

Mechanical engineering major **ALEXANDRA VORONTSOVA** was crowned Miss Delaware USA 2016 and will compete in June at the 2016 Miss USA Pageant in Las Vegas.

Student Honors

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

Senior Awards

W. Francis Lindell Mechanical Engineering Award to the Distinguished Senior
Presented to **HUNTER L. BACHMAN** and **MATTHEW J. HERSH**

Mary and George Nowinski Award for Excellence in Undergraduate Research
Presented to **ROBERT S. MORGAN**

ME Alumni Award – Outstanding Senior
Presented to **THIEN-NAM DINH** and **MICHAEL A. TOWNSEND**

Junior Awards

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

W. Francis Lindell Mechanical Engineering Achievement Award
Presented to **CAROLYN A. HALL** and **NICHOLAS E. GENEVA**

ME Alumni Award – Outstanding Junior
Presented to **NICHOLAS P. KOPP** and **RISHAY NATHOO**

Departmental Awards

American Society of Mechanical Engineers Delaware Section Outstanding Student Award
Presented to **FRANCIS J. FISH**

Delaware Section of the American Society of Mechanical Engineers Outstanding Student
Presented to **ERIK R. JOHNSON**

ME Department Chairperson Award – Outstanding Student Leader
Presented to **FRANCIS J. FISH** and **ROBERT L. HEEBNER** and **MATTHEW J. HERSH**

ME Department Chairperson Award – Outstanding Student Service
Presented to **RYAN R. GALLAGHER** and **CINDY WENG**

ME Alumni Award – Outstanding Sophomore
Presented to **MATTHEW A. SEITEL** and **CHRISTOPHER C. KITSON**

Graduate Achievement Award
Presented to **ANDREW P. BOROWSKI**

Graduate Teaching Assistant Awards
Presented to **ANAHID EBRAHIMI** and **GALIP OZAN EROL**

Undergraduate Teaching Assistant Award
Presented to **ADAM A. BITAR** and **DANIELLE R. GERSTMAN** and **DANIEL M. GRINDLE**

Center for Composite Materials Awards (awarded to MEEG students)

R. L. McCullough Scholars Award
Presented to **MICHAEL YEAGER**

Progress Award
Presented to **JIAYIN WANG**

Outstanding Senior Award
Presented to **MICHAEL B. CARROLL, JR.** and **MATTHEW J. STEVENS**

Undergraduate Research Award
Presented to **FRANCIS G. KLINCEWICZ**

Directors' Award
Presented to **SAGAR DOSHI**

2014–2015 Scholarships

Bosworth Scholarship
Presented to **BRYAN P. DAMIANO**

Redden Scholarship
Presented to **RISHAY NATHOO**

Newman Scholarship
Presented to **TRAVIS E. SCHEMBRI**

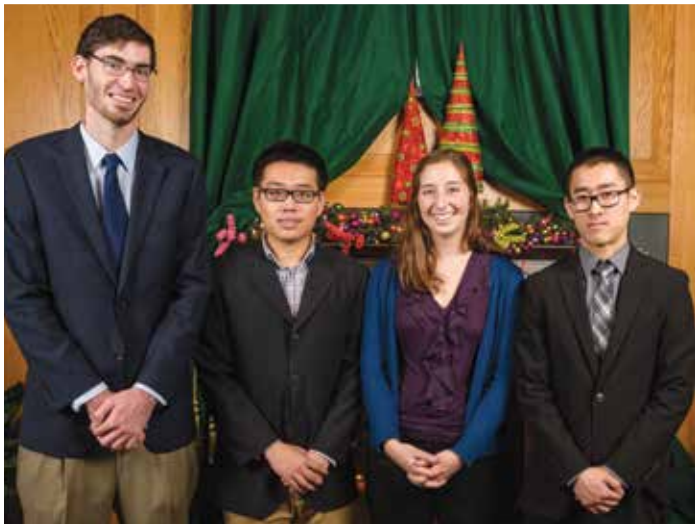
Senior Design

ASME Delaware Section Outstanding Senior Design Final Presentation Award

Team Norwalt
MICHAEL B. CARROLL, JR.
BRUCE E. MULRINE
THOMAS J. STARK
MICHAEL A. TOWNSEND

Team Speakman
NICHOLAS KUNZE
YINGDA PAN
DANIEL M. PIAZZA
TODD R. THORP

Team Agoge Automation
THIEN-NAM D. DINH
CHRISTOPHER D. FAIRCLOTH
YIYANG LIN
HALEY M. NORTHRUP



MILESTONES IN ME ALUMNI HISTORY

1895

First Bachelor's degrees (2) awarded

1948

First Master's degree awarded

1960s

First Ph.D. awarded (sometime between 1960 and 1968)

2005

First Distinguished Career Awards presented

2016

Alumni now number more than 4,600!

#UDME125

2015 DCA honoree featured for work on cutting edge of industrial recycling

ME alum, former Distinguished Career Award honoree and Senior Design industry sponsor **THOMAS C. EMBLEY**, BME'87, was featured in the *News Journal* last summer for his company's work on the cutting edge of industrial recycling.

"Everything we do is about making the manufacturing process a little greener," said the co-founder and chief executive officer of Newark, Delaware-based Precision AirConvey Systems in the June 2015 article.

Precision AirConvey designs and builds custom waste removal systems for companies in the food, consumer products, medical and pharmaceutical industries.

"It might be the film that's wrapped around the outside of your soda bottle, or the aluminum lid on the top of your yogurt cup," Embley said in the article. "Packing is something no one thinks about, but it's a huge industry in the United States."

Embley also said his company has gained national reputation as an industry leader by designing some of the most reliable and efficient systems on the market.

"The secret is in the cutters," he said.

Embley began his career as a staff engineer with Precision Cutters, Inc., co-owned by former UD professor **JACK BILLINGSLEY**, who offered then-recent ME graduate an engineering job and became his mentor. In 1995, he started Air Convey Systems, which merged four years later with Precision Cutters to become Precision AirConvey Systems.

Read the full article at www.delawareonline.com/story/money/business/2015/06/21/glasgow-company-cutting-edge-industrial-recycling/29070525/

> "Any award is an honor, but one coming from my alma mater is especially so."
>
> –Tom Embley, BME'87, on his 2015 Distinguished Career Award from the Department of Mechanical Engineering

Precision Air Convey at a glance

- $15M annual revenue
- 65 employees
- Headquarters in Delaware, metal factory in Pennsylvania and machine shop in New Jersey
- Fortune 500 clients include DuPont, 3M, Exxon Mobile, Glad, Dow, Proctor & Gamble and Velcro. Recently signed a deal with Label Impressions, the world's first carbon-neutral, wind-powered label printing company.

DCA winnner's LabWare is Delaware Bio company of the year

LabWare, the laboratory software powerhouse started by 2015 mechanical engineering Distinguished Career Award honoree—**VANCE KERSHNER**, BME'79—was named the 2016 Company of the Year by the Delaware Bioscience Association, an organization promoting the life science industry in the First State.

LabWare, a "flat" organization along the lines of W.L. Gore (a LabWare customer), develops and implements software for automating laboratory operations. It is now the world's leading Laboratory Information Management Systems (LIMS) business, having blown by former industry leader Thermo Fisher Scientific in 2008. LabWare now captures about a quarter of global sales in LIMS, a market worth about $500 million worldwide, according to an article in the *News Journal*.

The privately-held company's client list includes DuPont, its first and current customer, along with AstraZeneca, Ashland, W.L. Gore and Proctor & Gamble. The Delaware Department of Public Health also uses LabWare's products for health testing ranging from disease outbreak to contamination of drinking water.

Kershner began his career at DuPont immediately after earning a bachelor's degree in mechanical engineering from University of Delaware. He now leads the UD College of Engineering Advisory Council.

He is also general partner in Leading Edge Ventures, an early stage venture capital fund focused on Delaware and the surrounding area, through which he has made a number of investments to get promising companies started and advises young companies on strategies based on his experience.

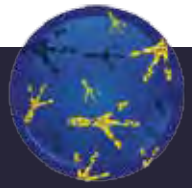
Read the full article at www.delawareonline.com/story/money/business/2016/04/20/labware-wins-delaware-bio-company-year-honor/83303594/

LabWare at a glance

- $118M+ annual revenue
- 430 employees in 40 countries
- Headquarters in Delaware. "There's no where else I would want LabWare to be," said Kershner.
- Customers include pharmaceutical, food and beverage, nuclear power, environmental and water testing industries

"One of the real keys to our success is the fact that we continue to do the things that we did when we were a little company. I don't see LabWare as this big global company. We're just a small group of people trying to do the right stuff."

–Vance Kershner, BME'79, in an April 2016 interview with the *News Journal*



www.UDconnection.com

www.UDconnection.com allows you to search the alumni directory, post class notes, update your contact information and see if there are any upcoming alumni events in your area. You can also take advantage of networking opportunities and volunteer opportunities to get involved with your alma mater!

2016 Distinguished Career Alumni

Eugene (Gene) Camponeschi, PhD'90

GENE CAMPONESCHI is an engineering consultant supporting the Office of Naval Research Manufacturing Technology program and the Naval Sea Systems Command. He earned B.S. and M.S. degrees in engineering science and mechanics from Virginia Tech and a Ph.D. in mechanical engineering from the University of Delaware. Camponeschi is a registered professional engineer in the state of Maryland.

He worked at the Naval Surface Warfare Carderock Division (NSWCCD) until his retirement in 2010, where he was a senior program manager responsible for the systems engineering of surface ship topsides with a focus on the transition of composite materials to U.S. Navy platforms.

Camponeschi served as the Systems Engineering Manager (SEM) for the Integrated Topside Design of the USS Zumwalt DDG 1000 Class Destroyer. The deckhouse and hangar for the DDG 1000 are composed of more than 200 tons of carbon fiber reinforced composite materials, making these structures the largest ship topside composite structures in the world. During his career he also served as the systems engineering manager on several other major programs focusing on the implementation of composites in ship systems.

He has received numerous Navy awards, including the NSWCCD Melville Award Recipient, which is the premier technical recognition awarded at Carderock. He received the Navy Meritorious Civil Service Award and the National Society of Professional Engineers Naval Sea Systems Command (NAVSEA) Engineer of the Year award. He was also awarded the NAVSEA Medallion to recognize his outstanding efforts and contributions.

In 2005, Camponeschi was named a Fellow of ASTM International. This honor is the highest society award bestowed by ASTM International. He has held numerous leadership positions within ASTM committee D30 on composite materials, including committee chairman from 1998–2001.

Eric Nauman, BSME'95

ERIC NAUMAN is professor in the School of Mechanical Engineering and the Weldon School of Biomedical Engineering and in the Department of Basic Medical Sciences at Purdue University. He received his BME from UD, and his M.S. and Ph.D. in mechanical engineering from the University of California, Berkeley.

Prior to joining the Purdue faculty in 2004, he was faculty in biomedical engineering at Tulane University. At Purdue, Nauman is the director of the Human Injury Research and Regenerative Technologies (HIRRT) Laboratory, exploring the mechanisms that govern pathologies including traumatic brain injury (TBI), spinal cord injury, musculoskeletal damage, atherosclerosis and cancer metastasis. His research focuses on orthopaedic tissue regeneration, the repair of vital organs, the development of novel cancer treatments, and the primary and secondary injury patterns of the central nervous system.

Nauman has authored or co-authored more than 90 journal publications and book chapters.

He has been involved with a team conducting one of the nation's most in-depth human research trials on the subject of TBI. Working with Purdue football players, as well as Lafayette area high school football and soccer players, they have examined the influence of subconcussive blows players receive each season and how they contribute to traumatic brain injury. The team's work has been featured in *Sports Illustrated*, as well as on NOVA, Frontline and HBO's Real Sports with Bryant Gumbel. Nauman also attended the "Healthy Kids and Safe Sports Concussion Summit" called by President Obama at the White House.

At Purdue, he received the College of Engineering Early Career Research Award of Excellence, the Willis A. Tacker Prize for Outstanding Teaching in Biomedical Engineering, and the Harry Solberg award for the Best Teacher in Purdue's School of Mechanical Engineering. He co-founded a nonprofit (IFoundation/Adapt-IF) to make the array of assistive technologies developed by students and faculty at Purdue widely available to those with disabilities.

As an educator, he has quantified the positive effects of active learning—the ability of case studies to improve collateral learning—and is currently developing a continuous quality improvement model for teaching mechanics courses that is anticipated to ease faculty adoption of novel teaching techniques.

He was recently awarded the Charles B. Murphy Award for outstanding undergraduate teaching for which his name will be entered into Purdue's Book of Great Teachers.

Nathan (Nate) Cloud BSME'64, MSME'73

NATE CLOUD, a licensed professional engineer, is president and founder of Cirrus Engineering, which offers engineering design/development services and consulting for manufacturing enterprises. He received both his bachelor's and master's degrees in ME from the University of Delaware.

Although drafted by the New York Knicks, Cloud chose to complete his bachelor's degree, get married and play professional basketball in the Eastern Professional League for six years. He was inducted into both the State of Delaware's and UD's sports halls of fame.

Following graduation, he was commissioned as an officer in the United States Army, where he served for two years as an engineer in the General Headquarters Offices of the Army Security Agency.

For 35 years, Cloud was employed by the DuPont Company, where he was named a DuPont Engineering Fellow, and he was a leader in the development of innovative product-processes and manufacturing systems aimed at the improvement and renewal of DuPont. One of these new business processes was adopted across the DuPont Company as a "best practice" for new product development. He was also selected by the National Academy of Sciences and Engineering to join the Committee on Visionary Manufacturing, which produced a book on the "Visionary Manufacturing Challenges for 2020." He is named inventor on several U.S patents.

Cloud has served the Department of Mechanical Engineering as an adjunct instructor and industrial liaison in the undergraduate education program, and as alumni relations coordinator since November 1998. He transferred his expertise in best practices for new product development to ME's senior design capstone course, where he worked to establish the curriculum in which teams of senior level students work with industry sponsors and faculty advisers to develop real engineering system designs. He has impacted more than 15 years of senior design by generating industry-sponsored projects and mentoring students in the course.

At Cirrus Engineering, Cloud has developed product-process systems for clients, including those supplying products to the histology marketplace and entrepreneurs developing new approaches to the custom apparel supply chain. He has also consulted businesses in the areas of innovation and advanced business planning, as well as law firms involved in litigation action.

Don Linsenmann, BSME'72, MSME'74

DON LINSENMANN is the CEO of Executive Transformation Mentoring, LLC. He earned both his B.S. and M.S. degrees in mechanical engineering from the University of Delaware and, in 1980, received his M.B.A. from Duke University.

After graduating from the University of Delaware, where his thesis research focused on the stability of anisotropic composite plates, Linsenmann joined General Dynamics Convair Division in San Diego as a finite element stress analyst. When an opportunity to join an entrepreneurial start-up with Exxon Enterprises arose, he was drawn to the chance to find new and creative applications for composite materials.

Linsenmann came to DuPont in 1984 with the acquisition of Exxon Enterprise's Materials Division, where he was the leader of a high-tech materials business. This acquisition was central to DuPont's Advanced Composites Business unit. With his M.B.A. from Duke, his role transitioned more to the creative marketing tasks of solving customers' problems with composite solutions.

He then led DuPont's Industrial Nylon business and transformed it into a global organization with regional autonomy, while transforming the manufacturing footprint to be less U.S.-centric. He was then appointed the managing director of European Lycra and ran that business while living in Geneva, Switzerland.

Based on his business background combining creativity with facts and data, he was selected to lead the Six Sigma journey for DuPont. In this role as vice president, Business Process Excellence, he led the global deployment of DuPont's Six Sigma activity. This deployment included all of DuPont's strategic business units, functions and regions. Reporting to the office of the CEO, he was involved with the strategic planning of Six Sigma at DuPont in addition to the operational deployment.

Linsenmann co-authored a book entitled *The Six Sigma Fieldbook: How DuPont Successfully Implemented the Six Sigma Breakthrough Management Strategy*, and has been an industry spokesperson regarding Six Sigma, having keynoted several international conferences.

After leading the Six Sigma program for more than 15 years, he retired from DuPont in 2015 and formed Executive Transformation Mentoring to help other businesses develop their future leaders by combining his lessons learned about creativity vs. facts and data.

Nominate an outstanding early-career alum! As part of our 125th celebration, we are establishing a new award recognizing outstanding early-career alumni who will lead us into the next 125 years of advancements in mechanical engineering. Look for more information soon on the nomination process.

2015–2016

Journal Publications by Mechanical Engineering Faculty

WITH CORE RESEARCH AREAS HIGHLIGHTED

Abu-Hakmeh A, Kung A, Mintz B, Kamal S, Cooper J, Lu XL, and Wan LQ. "Sequential Gelation of Tyramine Substituted Hyaluronic Acid Hydrogels Enhances Mechanical Integrity and Cell Viability." ***Medical & Biological Engineering & Computing***, (published online) DOI 10.1007/s11517-016-1474-0. Biomedical Engineering

Arch ES, Erol O, Bortz C, Madden C, Galbraith M, Rossi A, Lewis J, Higginson JS, Buckley JM, and Horne J. "Real-World Walking Performance of Individuals with Lower-Limb Amputation Classified as Medicare Functional Classification Level 2 and 3." ***JPO: Journal of Prosthetics and Orthotics***, 28 (2): 51-57 (2016). Biomedical Engineering

Arch ES, Stanhope SJ, and Higginson JS. "Passive-Dynamic Ankle-Foot Orthosis Replicates Soleus but Not Gastrocnemius Muscle Function during Stance in Gait: Insights for Orthosis Prescription." ***Prosthetics and Orthotics International***, (published online) DOI: 10.1177/0309364615592693. Biomedical Engineering

Baker AM, Torraco D, Judge EJ, Spernjak D, Mukundan R, Borup RL, Advani SG, and Prasad AK. "Cerium Migration during PEM Fuel Cell Assembly and Operation." ***ECS Transactions***, 69 (17): 1009-1015 (2015). Clean Energy and Environment

Bhargava S, Kubota M, Lewis RD, Advani SG, Prasad AK, and Deitzel JM. "Ultraviolet, Water, and Thermal Aging Studies of a Waterborne Polyurethane Elastomer-Based High Reflectivity Coating." ***Progress in Organic Coatings***, 79: 75-82 (2015). Composites and Advanced Materials

Bondade R, Zhang Y, Wei BQ, Gu T, Chen H, and Ma D. "Integrated Auto-Reconfigurable Power Supply Network with Multi-Directional Energy Transfer for Self-Reliant Energy Harvesting Applications." **IEEE Transactions on Industrial Electronics**, 63 (5): 2850-2861 (2016). Clean Energy and Environment

Cao Z and Wei BQ. "A Facile Route to Metal Oxides/Single-Walled Carbon Nanotube Macrofilm Nanocomposites for Energy Storage." ***Frontiers in Materials***, 2: 40 (2015). Clean Energy and Environment Nanotechnology

Cetinbas FC, Advani SG, and Prasad AK. "Optimization of Polymer Electrolyte Membrane Fuel Cell Catalyst Layer with Bidirectionally-Graded Composition." ***Electrochimica Acta***, 174: 787-798 (2015). Clean Energy and Environment Composites and Advanced Materials

Chen X, Zhou Y, Wang L, Santare MH, Wan LQ, and Lu XL. "Determining Tension–Compression Nonlinear Mechanical Properties of Articular Cartilage from Indentation Testing." ***Annals of Biomedical Engineering***: 1-11 (2015). Biomedical Engineering

Chen X, Zimmerman BK, and Lu XL. "Determine the Equilibrium Mechanical Properties of Articular Cartilage from the Short-Term Indentation Response." ***Journal of Biomechanics***, 48 (1): 176-180 (2015). Biomedical Engineering

Chowdhury SC, Swenson GR, Hague BZ, and Gillespie JW. "Molecular Dynamics Simulations of Single-walled Carbon Nanotube Bundle under Mechanical Loading." ***SAMPE Journal***, 51 (3): 40-48 (2015). Nanotechnology Composites and Advanced Materials

Cortes DH, Suydam SM, Silbernagel KG, Buchanan TS, and Elliott DM. "Continuous Shear Wave Elastography: A New Method to Measure Viscoelastic Properties of Tendons in Vivo." ***Ultrasound in Medicine & Biology***, 41 (6): 1518-1529 (2015). Biomedical Engineering

Cowperthwait AL, Campagnola N, Doll EJ, Downs RG, Hott NE, Kelly SC, Montoya A, Bucha AC, Wang L, and Buckley JM. "Tracheostomy Overlay System: An Effective Learning Device using Standardized Patients." ***Clinical Simulation in Nursing***, 11 (5): 253-258 (2015). Biomedical Engineering

Dai H, Gallo G, Schumacher T, and Thostenson ET. "A Novel Methodology for Spatial Damage Detection and Imaging using a Distributed Carbon Nanotube-Based Composite Sensor Combine with Electrical Impedance Tomography." ***Journal of Non-Destructive Evaluation***, (published online) DOI 10.1007/s10921-016-0341-0. Nanotechnology Composites and Advanced Materials

Dai H, Thostenson ET, and Schumacher T. "Processing and Characterization of a Novel Distributed Strain Sensor using Carbon Nanotube-Based Nonwoven Composites." ***Sensors***, 15 (7): 17728-17747 (2015). Nanotechnology Composites and Advanced Materials

Doshi SN and Thostenson ET. "Self-Sensing Carbon Nanotube Composites: Processing and Characterization." In ***Multi-Functionality of Polymer Composites: Challenges and New Solutions***, edited by K. Friedrich and U. Brewer, 752-784: Elsevier (2015). Nanotechnology Composites and Advanced Materials

Firestone J, Archer CL, Gardner MP, Madsen JA, Prasad AK, and Veron DE. "Opinion: The Time has Come for Offshore Wind Power in the United States." ***Proceedings of the National Academy of Sciences of the United States of America***, 112 (39): 11985-11988 (2015). Clean Energy and Environment

Fu J, Tanner HG, and Heinz J. "Concurrent Multi-Agent Systems with Temporal Logic Objectives: Game Theoretic Analysis and Planning through Negotiation." ***Control Theory & Applications***, *IET* 9 (3): 465-474 (2015). Robotics and Controls

Fu J, Tanner HG, Heinz JN, Karydis K, Chandlee J, and Koirala C. "Symbolic Planning and Control using Game Theory and Grammatical Inference." ***Engineering Applications of Artificial Intelligence***, 37: 378-391 (2015). Robotics and Controls

Gallo GJ and Thostenson ET. "Electrical Characterization and Modeling of Carbon Nanotube and Carbon Fiber Self-Sensing Composites for Enhanced Sensing of Microcracks." ***Materials Today Communications***, 3: 17-26 (2015). Nanotechnology Composites and Advanced Materials

Gallo GJ and Thostenson ET. "Spatial Damage Detection in Electrically Anisotropic Fiber-Reinforced Composites using Carbon Nanotube Networks." ***Composite Structures***, 141: 14-23 (2016). Nanotechnology Composites and Advanced Materials

Gangloff JJ, Hwang WR, and Advani SG. "The Investigation of Bubble Mobility in Channel Flow with Wavy Porous Media Walls." ***International Journal of Multiphase Flow***, 70: 1-14 (2015). Composites and Advanced Materials

Gao X, Gillespie JW, Jensen RE, Li W, Haque BZ, and McKnight SH. "Effect of fiber surface texture on the mechanical properties of glass fiber reinforced epoxy composite." ***Composites Part A: Applied Science and Manufacturing***, 74: 10-17 (2015). Composites and Advanced Materials

Gould BJ and Burris DL. "Effects of Wind Shear on Wind Turbine Rotor Loads and Planetary Bearing Reliability." ***Wind Energy***, (2015). Clean Energy and Environment

Grabowski WW, Wang L-P, and Prabha TV. "Macroscopic Impacts of Cloud and Precipitation Processes on Maritime Shallow Convection as Simulated by a Large Eddy Simulation Model

with Bin Microphysics." ***Atmospheric Chemistry and Physics***, 15 (2): 913-926 (2015). Clean Energy and Environment

Gu T and Wei BQ. "Fast and Stable Redox Reactions of MnO 2/CNT Hybrid Electrodes for Dynamically Stretchable Pseudocapacitors." ***Nanoscale***, 7 (27): 11626-11632 (2015). Clean Energy and Environment Nanotechnology

Gunning NS, Feser J, Beekman M, Cahill DG, and Johnson DC. "Synthesis and Thermal Properties of Solid-State Structural Isomers: Ordered Intergrowths of SnSe and MoSe2." ***Journal of the American Chemical Society***, 137 (27): 8803-8809 (2015). Composites and Advanced Materials

Han B, Chery DC, Yin J, Lu XL, Lee D, and Han L. "Impacts of pH and Ionic Strength on the Nanomechanical Properties of Ionically Cross-Linked Polyelectrolyte Networks." ***Soft Matter.***, 12: 1158-1169 (2016). Composites and Advanced Materials Nanotechnology

Han F, Meng G, Zhou F, Song L, Li X, Hu X, Zhu X, Wu B, and Wei BQ. "Dielectric Capacitors with Three-Dimensional Nanoscale Interdigital Electrodes for Energy Storage." ***Science Advances***, 1 (9): e1500605 (2015). Clean Energy and Environment Nanotechnology

Haque BZ, Chowdhury SC, and Gillespie JW. "Molecular simulations of stress wave propagation and perforation of graphene sheets under transverse impact." ***Carbon***, 102: 126-140 (2016). Composites and Advanced Materials Nanotechnology

Haque BZ, and Gillespie JW. "A new penetration equation for ballistic limit analysis." ***Journal of Thermoplastic Composite Materials***, 28 (7): 950-972 (2015). Composites and Advanced Materials

Hsiao H, Higginson JS, and Binder-Macleod SA. "Baseline Predictors of Treatment Gains in Peak Propulsive Force in Individuals Poststroke." ***Journal of Neuroengineering and Rehabilitation***, 13 (1): 1 (2016). Biomedical Engineering

Hsiao H, Knarr BK, Higginson JS, and Binder-Macleod SA. "Mechanisms to Increase Propulsive Force for Individuals Poststroke." ***Journal of NeuroEngineering and Rehabilitation***, 12 (1): 40 (2015). Biomedical Engineering

Hsiao H, Knarr BK, Higginson JS, and Binder-Macleod SA. "The Relative Contribution of Ankle Moment and Trailing Limb Angle to Propulsive Force during Gait." ***Human Movement Science***, 39: 212-221 (2015). Biomedical Engineering

Hsiao H, Knarr BK, Pohlig RT, Higginson JS, and Binder-Macleod SA. "Mechanisms used to Increase Peak Propulsive Force Following 12-Weeks of Gait Training in Individuals Poststroke." ***Journal of Biomechanics***, 49 (3): 388-395 (2016). Biomedical Engineering

Hsiao, H, Awad LN, Palmer JA, Higginson JS, and Binder-Macleod SA. "Contribution of Paretic and Nonparetic Limb Peak Propulsive Forces to Changes in Walking Speed in Individuals Poststroke." ***Neurorehabilitation and Neural Repair***, (published online) DOI: 10.1177/1545968315624780. Biomedical Engineering

Huang G, Kaess M, and Leonard JJ. "Consistent Unscented Incremental Smoothing for Multi-Robot Cooperative Target Tracking." ***Robotics and Autonomous Systems***, 69: 52-67 (2015). Robotics and Controls

Huang G, Zhou K, Trawny N, and Roumeliotis SI. "A Bank of Maximum A Posteriori (MAP) Estimators for Target Tracking." *Robotics,* ***IEEE Transactions on***, 31 (1): 85-103 (2015). Robotics and Controls

Kakodkar RR and Feser JP. "A Framework for Solving Atomistic Phonon-Structure Scattering Problems in the Frequency Domain using Perfectly Matched Layer Boundaries." ***Journal of Applied Physics***, 118 (9): 094301 (2015). Composites and Advanced Materials

Kannappan P, Tanner HG, Trembanis AC, and Walker JH. "Machine Learning for Detecting Scallops in AUV Benthic Images: Targeting False Positives." ***Computer Vision and Pattern Recognition in Environmental Informatics***: 22 (2015). Robotics and Controls

Kao P-C, Srivastava S, Higginson JS, Agrawal SK, and Scholz JP. "Short-term performance-based error-augmentation Versus error-reduction Robotic Gait Training for Individuals with Chronic Stroke: A Pilot Study." ***Physical Medicine and Rehabilitation – International***, 2 (9): 1066 (2015). Biomedical Engineering

Kao P-C, Higginson CI, Seymour K, Kamerdze M, and Higginson JS. "Walking Stability during Cell Phone use in Healthy Adults." ***Gait & Posture***, 41 (4): 947-953 (2015). Biomedical Engineering

Karydis K, Liu Y, Poulakakis I, and Tanner HG. "A Template Candidate for Miniature Legged Robots in Quasi-Static Motion." ***Autonomous Robots***, 38 (2): 193-209 (2015). Robotics and Controls

Karydis K, Poulakakis I, Sun J, and Tanner HG. "Probabilistically Valid Stochastic Extensions of Deterministic Models for Systems with Uncertainty." ***The International Journal of Robotics Research***, 34 (10): 1278-1295 (2015). Robotics and Controls

Kelly GS., Advani SG, and Gillespie JW. "A Model to Describe stick–slip Transition Time during Ultrasonic Consolidation." ***The International Journal of Advanced Manufacturing Technology***, 79 (9-12): 1931-1937 (2015). Composites and Advanced Materials

Khandha A, Manal K, Wellsandt E, Buchanan TS, and Snyder-Mackler L. "The Onset of Knee Osteoarthritis After Anterior Cruciate Ligament Surgery is Associated with Early Unloading Followed by an Extended Period of Normal Loading." ***Osteoarthritis and Cartilage***, 23: A101-A102 (2015). Biomedical Engineering

Khare HS, Moore AC, Haidar DR, Gong L, Ye J, Rabolt JF, and Burris DL. "Interrelated Effects of Temperature and Environment on Wear and Tribochemistry of an Ultralow Wear PTFE Composite." ***The Journal of Physical Chemistry C***, 119 (29): 16518-16527 (2015). Composites and Advanced Materials

Kim JH and Roberts D. "A joint-space Numerical Model of Metabolic Energy Expenditure for Human Multibody Dynamic System." ***International Journal for Numerical Methods in Biomedical Engineering***, 31 (9) (2015). Robotics and Controls

Kim JH, Roberts D, Meusch J, and Rahmatalla S. "Kinematic and Kinetic Evaluation of a Throwing Model using Motion Primitives." ***International Journal of Robotics and Automation***, 30 (1): 98-109 (2015). Robotics and Controls

Knarr BK and Higginson JS. "Practical Approach to Subject-Specific Estimation of Knee Joint Contact Force." ***Journal of Biomechanics***, 48 (11): 2897-2902 (2015). Biomedical Engineering

Knarr BK, Higginson JS, and Zeni JA. "Change in Knee Contact Force with Simulated Change in Body Weight." ***Computer Methods in Biomechanics and Biomedical Engineering***, 19 (3): 320-323 (2016). Biomedical Engineering

Koepf EE, Advani SG, Prasad AK, and Steinfeld A. "Experimental Investigation of the Carbothermal Reduction of ZnO using a Beam-Down, Gravity-Fed Solar Reactor." ***Industrial & Engineering Chemistry Research***, 54 (33): 8319-8332 (2015). Clean Energy and Environment

Kubota M, Prasad AK, Deitzel JM, Teather EWH, and Advani SG. "Thin Polymeric Film Microstructure Manipulation for Diffused Reflectance Applications." *Polymer* ***Engineering & Science***, 55 (12): 2878-2883 (2015). Composites and Advanced Materials

Lai X, Price C, Modla S, Thompson WR, Caplan J, Kirn-Safran CB, and Wang L. "The Dependences of Osteocyte Network on Bone Compartment, Age, and Disease." ***Bone Research***, 3: 15009 (2015). Biomedical Engineering

Leasure JM and Buckley JM. "Biomechanical Evaluation of an Interfacet Joint Decompression and Stabilization System." ***Journal of Biomechanical Engineering***, 136 (7): 071010 (2014). Biomedical Engineering

Leasure JM, Camisa W, Wanberg PM, Buckley JM, Ames CP, and Kondrashov DG. "Failure of Standardized Biomechanical Testing Protocol to Predict Rod Fracture in a 3-Column Spine Osteotomy Model." ***The Spine Journal***, 15 (10): S190 (2015). Biomedical Engineering

Li Q, Doyran B, Gamer LW, Lu XL, Qin L, Ortiz C, Grodzinsky AJ, Rosen V, and Han L. "Biomechanical Properties of Murine Meniscus Surface Via AFM-Based Nanoindentation." ***Journal of Biomechanics***, 48 (8): 1364-1370 (2015). Biomedical Engineering

Li X, Ren X, Xie F, Zhang Y, Xu T, Wei BQ, and Choy WCH. "High-Performance Organic Solar Cells with Broadband Absorption Enhancement and Reliable Reproducibility Enabled by Collective Plasmonic Effects." ***Advanced Optical Materials***, 3 (9): 1220-1231 (2015). Clean Energy and Environment

Li X, Ren X, Zhang Y, Choy WCH, and Wei BQ. "An all-Copper Plasmonic Sandwich System obtained through Directly Depositing Copper NPs on a CVD Grown graphene/copper Film and its Application in SERS." ***Nanoscale***, 7 (26): 11291-11299 (2015). Nanotechnology

Li Y, Kim H-I, Wei BQ, Kang J, Choi J-B, Nam J-D, and Suhr J. "Understanding the Nanoscale Local Buckling Behavior of Vertically Aligned MWCNT Arrays with Van Der Waals Interactions." ***Nanoscale***, 7 (34): 14299-14304 (2015). Nanotechnology

Liddle K, Buckley JM, Matitiyahu A, and Marmor M. "A New Method to Intra-Operatively Measure Local Bone Strength in Osteoporotic Bone using a Modified Surgical Tool." ***Journal of Medical Devices***, 8 (4): 044508 (2014). Biomedical Engineering

Lindemer MD, Advani SG, and Prasad AK. "Graetz–Brinkman Problem in Laminar Core-Annular Flow of Two Immiscible Liquids." ***International Journal of Thermal Sciences***, 89: 362-371 (2015). Clean Energy and Environment Composites and Advanced Materials

Lobo MA, Koshy J, Hall ML, Erol O, Cao H, Buckley JM, Galloway JC, and Higginson J. "Playskin Lift: Development and Initial Testing of an Exoskeletal Garment to Assist Upper Extremity Mobility and Function." ***Physical Therapy***, 96 (3): 390-399 (2016). Biomedical Engineering

Mäder E, Liu J-W, Hiller J, Lu W, Li O, Zhandarov S, and Chou T-W. "Coating of Carbon Nanotube Fibers: Variation of Tensile Properties, Failure Behavior and Adhesion Strength." ***Frontiers in Materials***, 2: 53 (2015). Composites and Advanced Materials Nanotechnology

Manal K, Gardinier E, Buchanan TS, and Snyder-Mackler L. "A More Informed Evaluation of Medial Compartment Loading: The Combined use of the Knee Adduction and Flexor Moments." ***Osteoarthritis and Cartilage***, 23 (7): 1107-1111 (2015). Biomedical Engineering

McDaniel PB, Deitzel JM, and Gillespie JW. "Structural hierarchy and surface morphology of highly drawn ultra high molecular weight polyethylene fibers studied by atomic force microscopy and wide angle X-ray diffraction." ***Polymer***, 69: 148-158 (2015). Composites and Advanced Materials

Meng F, Lu W, Li O, Byun J-H, Oh Y, and Chou T-W. "Graphene-Based Fibers: A Review." ***Advanced Materials***, 27 (35): 5113-5131 (2015). Composites and Advanced Materials Nanotechnology

Minnicino MA and Santare MH. "Predicting Microdroplet Force Response using a Multiscale Modeling Approach." ***Composites Part A: Applied Science and Manufacturing***, 80: 39-52 (2016). Composites and Advanced Materials

Molina RA, Bohlen H, Kwiat D, Leasure J, Buckley JM, and Lattanza L. "Biomechanical Evaluation of Lateral Ulnar Collateral Ligament Reconstruction Techniques." ***Ann Orthop Rheumatol***, 3 (2): 1047 (2015). Biomedical Engineering

Moore AC and Burris DL. "Tribological and Material Properties for Cartilage of and Throughout the Bovine Stifle: Support for the Altered Joint Kinematics Hypothesis of Osteoarthritis." ***Osteoarthritis and Cartilage***, 23 (1): 161-169 (2015). Biomedical Engineering

Moore AC, Zimmerman BK, Chen X, Lu XL, and Burris DL. "Experimental Characterization of Biphasic Materials using Rate-Controlled Hertzian Indentation." ***Tribology International***, 89: 2-8 (2015). Composites and Advanced Materials

Needle AR, Kaminski TW, Baumeister J, Higginson JS, Farquhar WB, and Swanik CB. "The Relationship between Joint Stiffness and Muscle Activity Differs in Unstable Ankles and Copers." ***Journal of Sport Rehabilitation***, (2015). Biomedical Engineering

Nilakantan G, Merrill RL, Keefe M, Gillespie JW, and Wetzel ED. "Experimental investigation of the role of frictional yarn pull-out and windowing on the probabilistic impact response of kevlar fabrics." ***Composites Part B: Engineering***, 68: 215-229 (2015). Composites and Advanced Materials

Obaid AA, Heider D, and Gillespie JW. "Investigation of electro-mechanical behavior of carbon nanotube yarns during tensile loading." ***Carbon***, 93: 731-741 (2015). Composites and Advanced Materials Nanotechnology

Obaid AA, Yarlagadda S, and Gillespie JW. "Combined effects of kink bands and hygrothermal conditioning on tensile strength of polyarylate liquid crystal co-polymer and aramid fibers." ***Journal of Composite Materials***, DOI: 10.1177/0021998315574754. Composites and Advanced Materials

Pahlajani CD, Sun J, Poulakakis I, and Tanner HG. "Performance Bounds for Mismatched Decision Schemes with Poisson Process Observations." ***Systems & Control Letters***, 75: 69-76 (2015). Robotics and Controls

Panagou D, Tanner HG, and Kyriakopoulos KJ. "Control Design for a Class of Nonholonomic Systems Via Reference Vector Fields and Output Regulation." ***Journal of Dynamic Systems, Measurement, and Control***, 137 (8): 081011 (2015). Robotics and Controls

Parajuli A, Liu C, Li W, Gu X, Lai X, Pei S, Price C, You L, Lu XL, and Wang L. "Bone's Responses to Mechanical Loading are Impaired in Type 1 Diabetes." ***Bone***, 81: 152-160 (2015). Biomedical Engineering

Parishani H, Ayala O, Rosa B, Wang L-P, and Grabowski WW. "Effects of Gravity on the Acceleration and Pair Statistics of Inertial Particles in Homogeneous Isotropic Turbulence." ***Physics of Fluids (1994-Present)***, 27 (3): 033304 (2015). Clean Energy and Environment

Peloquin JM, Santare MH, and Elliott DE. "Advances in Quantification of Meniscus Tensile Mechanics Including Nonlinearity, Yield, and Failure." ***Journal of Biomechanical Engineering***, (2015). Biomedical Engineering

Peng C, Teng Y, Hwang B, Guo Z, and Wang L-P. "Implementation Issues and Benchmarking of Lattice Boltzmann Method for Moving Rigid Particle Simulations in a Viscous Flow." ***Computers & Mathematics with Applications***, (2015). Clean Energy and Environment

Poulakakis I, Young G, Scardovi L, and Leonard N. "Information Centrality and Ordering of Nodes for Accuracy in Noisy Decision-Making Networks." ***IEEE Transactions on Automatic Control***, 61 (4): 1040-1045 (2016). Robotics and Controls

Quan Z, Wu A, Keefe M, Qin X, Yu J, Suhr J, Byun JH, Kim BS, and Chou T-W. "Additive Manufacturing of Multi-Directional Preforms for Composites: Opportunities and Challenges." ***Materials Today***, 18 (9): 503-512 (2015). Composites and Advanced Materials

Rider AN, Yeo E, Gopalakrishna J, Thostenson ET, and Brack N. "Hierarchical Composites with High-Volume Fractions of Carbon Nanotubes: Influence of Plasma Surface Treatment and Thermoplastic Nanophase-Modified Epoxy." ***Carbon***, 94: 971-981 (2015). Composites and Advanced Materials Nanotechnology

Rider AN, An Q, Brack N, and Thostenson ET. "Polymer nanocomposite–fiber Model Interphases: Influence of Processing and Interface Chemistry on Mechanical Performance." ***Chemical Engineering Journal***, 269: 121-134 (2015). Composites and Advanced Materials Nanotechnology

Robbins AK, Mateson AB, Khandha A, Pugarelli JE, Buchanan TS, Akins RE, and Barthold JS. "Fetal Rat Gubernaculum Mesenchymal Cells Adopt Myogenic and Myofibroblast-Like Phenotypes." ***The Journal of Urology***, (2015). Biomedical Engineering

Roberts D, Quacinella J, and Kim JH. "Energy Expenditure of a Biped Walking Robot: Instantaneous and Degree-of-Freedom-Based Instrumentation with Human Gait Implications." ***Robotica***: 1-18 (2016). Robotics and Controls

Rosa B, Parishani H, Ayala O, and Wang L-P. "Effects of Forcing Time Scale on the Simulated Turbulent Flows and Turbulent Collision Statistics of Inertial Particles." ***Physics of Fluids (1994-Present)***, 27 (1): 015105 (2015). Clean Energy and Environment

Ruggiero L, Zimmerman BK, Park M, Han L, Wang L, Burris DL, and Lu XL. "Roles of the Fibrous Superficial Zone in the Mechanical Behavior of TMJ Condylar Cartilage." ***Annals of Biomedical Engineering***, 43 (11): 2652-2662 (2015). Biomedical Engineering

Salegio S, Sparrey CJ, Camisa W, Rosenzweig ES, Strand SC, Moseanko R, Hawbecker S. "Development of a Cervical Spinal Cord Contusion Model in Non-Human Primates." ***Journal of Neurotrauma***, 31: A13 (2014). Biomedical Engineering

Sas HS, Šimáček P, and Advani SG. "A Methodology to Reduce Variability during Vacuum Infusion with Optimized Design of Distribution Media." ***Composites Part A: Applied Science and Manufacturing***, 78: 223-233 (2015). Composites and Advanced Materials

Schwartz LW. "Numerial Modeling of Coating Flow on Porous Materials." ***Converting Quarterly***, 5: 82-85 (2015). Composites and Advanced Materials

Shah SK, Tanner HG, and Pahlajani CD. "Optimal Navigation for Vehicles with Stochastic Dynamics." ***Control Systems Technology, IEEE Transactions on***, 23 (5): 2003-2009 (2015). Robotics and Controls

Simacek P and Advani SG. ""Equivalent" Permeability and Flow in Compliant Porous Media." ***Composites Part A: Applied Science and Manufacturing***, 80: 107-110 (2016). Composites and Advanced Materials

Simacek P and Advani SG. "Simulating Tape Resin Infiltration during Thermoset Pultrusion Process." ***Composites Part A: Applied Science and Manufacturing***, 72: 115-126 (2015). Composites and Advanced Materials

Simacek P, Merotte J, and Advani SG. "Compression Resin Transfer Molding Simulation for Net Shape Manufacturing of Composite Structures for Automotive Applications." ***SAMPE Journal***, 52 (1): 19-29 (2016). Composites and Advanced Materials

Singh AV, Raymond M, Pace F, Certo A, Zuidema JM, McKay CA, Gilbert RJ, Lu XL, and Wan LQ. "Astrocytes Increase ATP Exocytosis Mediated Calcium Signaling in Response to Microgroove Structures." ***Scientific Reports***, 5 (2015). Biomedical Engineering

Singh H, Whitney DG, Knight CA, Miller F, Manal K, Kolm P, and Modlesky CM. "Site-Specific Transmission of a Floor-Based, High-Frequency, Low-Magnitude Vibration Stimulus in Children with Spastic Cerebral Palsy." ***Archives of Physical Medicine and Rehabilitation***, 97 (2): 218-223 (2016). Biomedical Engineering

Sockalingam S, Bremble R, Gillespie JW, and Keefe M. "Transverse Compression Behavior of Kevlar KM2 Single Fiber." ***Composites Part A: Applied Science and Manufacturing***, 81: 271-281 (2016). Composites and Advanced Materials

Sockalingam S, Gillespie JW, and Keefe M. "Dynamic Modeling of Kevlar KM2 Single Fiber Subjected to Transverse Impact." ***International Journal of Solids and Structures***, 67: 297-310 (2015). Composites and Advanced Materials

Srinivasan PP, Parajuli A, Price C, Wang L, Duncan RL, and Kirn-Safran CB. "Inhibition of T-Type Voltage Sensitive Calcium Channel Reduces Load-Induced OA in Mice and Suppresses the Catabolic Effect of Bone Mechanical Stress on Chondrocytes." ***PloS One***, 10 (5): e0127290 (2015). Biomedical Engineering

Srivastava S, Kao P-C, Kim SH, Stegall P, Zanotto D, Higginson JS, Agrawal SK, and Scholz JP. "Assist-as-Needed Robot-Aided Gait Training Improves Walking Function in Individuals Following Stroke." ***Neural Systems and Rehabilitation Engineering, IEEE Transactions on***, 23 (6): 956-963 (2015). Biomedical Engineering

Srivastava S, Kao P-C, Reisman DS, Higginson JS, and Scholz JP. "Coordination of Muscles to Control the Footpath during Over-Ground Walking in Neurologically Intact Individuals and Stroke Survivors." ***Experimental Brain Research***: 1-12 (2016). Biomedical Engineering

Sun J and Tanner HG. "Constrained Decision-Making for Low-Count Radiation Detection by Mobile Sensors." ***Autonomous Robots***, 39 (4): 519-536 (2015). Robotics and Controls

Suydam SM, Soulas EM, Elliott DM, Silbernagel KG, Buchanan TS, and Cortes DH. "Viscoelastic Properties of Healthy Achilles Tendon are Independent of Isometric Plantar Flexion Strength and cross-sectional Area." ***Journal of Orthopaedic Research***, 33 (6): 926-931 (2015). Biomedical Engineering

Tamrakar S, An Q, Thostenson ET, Rider AN, Haque BZ, and Gillespie JW. "Tailoring Interfacial Properties by Controlling Carbon Nanotube Coating Thickness on Glass Fibers using Electrophoretic Deposition." ***ACS Applied Materials & Interfaces***, (2015). Composites and Advanced Materials Nanotechnology

Valbuena R, Ariel L, and Tanner HG. "Flocking, Formation Control, and Path Following for a Group of Mobile Robots." ***Control Systems Technology, IEEE Transactions on***, 23 (4): 1268-1282 (2015). Robotics and Controls

Wang J, Simacek P, and Advani SG. "Fast Mold Filling Simulation Based on the Geodesic Distance Calculation Algorithm for Liquid Composite Molding Processes." ***CMES: Computer Modeling in Engineering & Sciences***,107 (1): 59-79 (2015). Composites and Advanced Materials

Wang J-G, Jin D, Zhou R, Shen C, Xie K, and Wei BQ. "One-Step Synthesis of NiCo 2 S 4 Ultrathin Nanosheets on Conductive Substrates as Advanced Electrodes for High-Efficient Energy Storage." ***Journal of Power Sources***, 306: 100-106 (2016). Clean Energy and Environment Nanotechnology

Wang J-G, Kang F, and Wei BQ. "Engineering of MnO 2-Based Nanocomposites for High-Performance Supercapacitors." ***Progress in Materials Science***, 74: 51-124 (2015). Clean Energy and Environment Composites and Advanced Materials Nanotechnology

Wang J-G, Xie K, and Wei BQ. "Advanced Engineering of Nanostructured Carbons for lithium–sulfur Batteries." ***Nano Energy***, 15: 413-444 (2015). Clean Energy and Environment Nanotechnology

Wang J-G, Zhou R, Jin D, Xie K, and Wei BQ. "Controlled Synthesis of NiCo 2 S 4 Nanostructures on Nickel Foams for High-Performance Supercapacitors." ***Energy Storage Materials***, 2: 1-7 (2016). Clean Energy and Environment Nanotechnology

Wang L, Advani SG, and Prasad AK. "CNT/Nafion-Based Composite Fuel Cell Membranes for Improved Durability." In ***Nanoparticles for Catalysis, Energy and Drug Delivery***, edited by RS Chaughule and AR Kapdi. USA: American Scientific Publishers (2015). Clean Energy and Environment Nanotechnology

Wang L, Kang J, Nam J-D, Suhr J, Prasad AK, and Advani SG. "Composite Membrane Based on Graphene Oxide Sheets and Nafion for Polymer Electrolyte Membrane Fuel Cells." ***ECS Electrochemistry Letters***, 4 (1): F1-F4 (2015). Clean Energy and Environment Composites and Advanced Materials Nanotechnology

Wang L, Wang L-P, Guo Z, and Mi J. "Volume-Averaged Macroscopic Equation for Fluid Flow in Moving Porous Media." ***International Journal of Heat and Mass Transfer***, 82: 357-368 (2015). Clean Energy and Environment Composites and Advanced Materials

Wang L-P, O Ardila OGC, Ayala O, Gao H, and Peng C. "Study of Local Turbulence Profiles Relative to the Particle Surface in Particle-Laden Turbulent Flows." ***Journal of Fluids Engineering***, 138 (4): 041307 (2016). Clean Energy and Environment

Wang L-P, Peng C, Guo Z, and Yu Z. "Flow Modulation by Finite-Size Neutrally Buoyant Particles in a Turbulent Channel Flow." ***Journal of Fluids Engineering***, 138 (4): 041306 (2016). Clean Energy and Environment

Wang L-P, Peng C, Guo Z, and Yu Z. "Lattice Boltzmann Simulation of Particle-Laden Turbulent Channel Flow." ***Computers & Fluids***, 124: 226-236 (2016). Clean Energy and Environment

Wang Y, Wang L, Advani SG, and Prasad AK. "Double-Layer Gas Diffusion Media for Improved Water Management in Polymer Electrolyte Membrane Fuel Cells." ***Journal of Power Sources***, 292: 39-48 (2015). Clean Energy and Environment

Wei B, Xie K, Zhang C, Wang J-G, and Jin D. "Synthesis of Ultralong MnO/C Coaxial Nanowires as Freestanding Anodes for High-Performance Lithium Ion Batteries." ***Royal Society of Chemistry***, (2015). Clean Energy and Environment Nanotechnology

Wellsandt E, Gardinier ES, Manal K, Axe MJ, Buchanan TS, and Snyder-Mackler L. "Decreased Knee Joint Loading Associated with Early Knee Osteoarthritis After Anterior Cruciate Ligament Injury." ***The American Journal of Sports Medicine***, 44 (1): 143-151 (2016). Biomedical Engineering

Whiteman ZS, Bubna P, Prasad AK, and Ogunnaike BA. "Design, Operation, Control, and Economics of a Photovoltaic/Fuel Cell/Battery Hybrid Renewable Energy System for Automotive Applications." ***Processes***, 3 (2): 452-470 (2015). Clean Energy and Environment

Xie K and Wei B. "Nanomaterials for Stretchable Energy Storage and Conversion Devices." In ***Nanomaterials for Sustainable Energy***, edited by Q. Li: Springer (2016). Clean Energy and Environment Nanotechnology

Xie K, Han Y, Wei W, Yu H, Zhang C, Wang J-G, Lu W, and Wei B. "Fabrication of a Novel TiO 2/S Composite Cathode for High Performance lithium–sulfur Batteries." ***RSC Advances***, 5 (94): 77348-77353 (2015). Clean Energy and Environment Composites and Advanced Materials

Xu P, Kang J, Suhr J, Smith JP, Booksh KS, Wei B, Yu J, Li F, Byun J-H, and Oh Y. "Spatial Strain Variation of Graphene Films for Stretchable Electrodes." ***Carbon***, 93: 620-624 (2015). Clean Energy and Environment Nanotechnology

Xu P, Wei B, Cao Z, Zheng J, Gong K, Li F, Yu J, Li O, Lu W, and Byun J-H. "Stretchable Wire-Shaped Asymmetric Supercapacitors Based on Pristine and MnO2 Coated Carbon Nanotube Fibers." ***ACS Nano***, 9 (6): 6088-6096 (2015). Clean Energy and Environment Nanotechnology

Ye, J., A. C. Moore, and D. L. Burris. "Transfer Film Tenacity: A Case Study Using Ultra-Low-Wear Alumina–PTFE." ***Tribology Letters***, 59 (3): 1-11 (2015). Composites and Advanced Materials

Yeager M and Advani S. "Numerical Model of Fiber Wetting with Finite Resin Volume." ***Integrating Materials and Manufacturing Innovation***, 4 (1): 1-16 (2015). Composites and Advanced Materials

Yu H, Heider D, and Advani S. "Comparison of Two Finite Element Homogenization Prediction Approaches for through Thickness Thermal Conductivity of Particle Embedded Textile Composites." ***Composite Structures***, 133: 719-726 (2015). Composites and Advanced Materials

Yu H, Heider D, and Advani S. "Prediction of Effective through-Thickness Thermal Conductivity of Woven Fabric Reinforced Composites with Embedded Particles." ***Composite Structures***, 127: 132-140 (2015). Composites and Advanced Materials

Yu H, Heider D, and Advani S. "Role of in-Plane Stacking Sequence on Transverse Effective Thermal Conductivity of Unidirectional Composite Laminates." ***International Journal of Heat and Mass Transfer***, 85: 897-903 (2015). Composites and Advanced Materials

Yu H, Xie K, Hu J, Shen C, Wang J-G, and Wei B. "The Importance of Raw Graphite Size to the Capacitive Properties of Graphene Oxide." ***RSC Advances***, 6 (21): 17023-17028 (2016). Nanotechnology

Yu H, Heider D, and Advani S. "A 3D Microstructure Based Resistor Network Model for the Electrical Resistivity of Unidirectional Carbon Composites." ***Composite Structures***, 134: 740-749 (2015). Composites and Advanced Materials

Yu J, Wang L, Lai X, Pei S, Zhuang Z, Meng L, Huang Y, Li Q, Lu W, and Byun J-H. "A Durability Study of Carbon Nanotube Fiber Based Stretchable Electronic Devices Under Cyclic Deformation." ***Carbon***, 94: 352-361 (2015). Clean Energy and Environment Nanotechnology

Yu Z, Lin Z, Shao X, and Wang L-P. "Effects of Finite-Size Particles on the Turbulent Flows in a Square Duct." ***Bulletin of the American Physical Society***, 60 (2015). Clean Energy and Environment

Yu Z, Lin Z, Shao X, and Wang L-P."A Parallel Fictitious Domain Method for the Interface-Resolved Simulation of Particle-Laden Flows and its Application to the Turbulent Channel Flow." ***Engineering Applications of Computational Fluid Mechanics***, 10 (1): 160-170 (2016). Clean Energy and Environment

Zang X, Zhu M, Li X, Li X, Zhen Z, Lao J, Wang K, Kang F, Wei B, and Zhu H. "Dynamically Stretchable Supercapacitors Based on Graphene Woven Fabric Electrodes." ***Nano Energy***, 15: 83-91 (2015). Clean Energy and Environment Nanotechnology

Zhang C, Wang J-G, Jin D, Xie K, and Wei B. "Facile Fabrication of MnO/C core–shell Nanowires as an Advanced Anode Material for Lithium-Ion Batteries." ***Electrochimica Acta***, 180: 990-997 (2015). Clean Energy and Environment Nanotechnology

Zhang D, Heider D, and Gillespie JW. "Determination of void statistics and statistical representative volume elements in carbon fiber-reinforced thermoplastic prepregs." ***Journal of Thermoplastic Composite Materials***, DOI: 10.1177/0892705715618002. Composites and Advanced Materials

Zhang X, Rad AB, Huang G, and Wong YK. "An Optimal Data Association Method Based on the Minimum Weighted Bipartite Perfect Matching." ***Autonomous Robots***, 40 (1): 77-91 (2016). Robotics and Controls

Zhao W, Elias AL, Rajukumar LP, Kim H-I, O'Brien DJ, Zimmerman BK, Penev ES, Terrones M, Yakobson BI, and Wei B. "Controllable and Predictable Viscoelastic Behavior of 3D Boron-Doped Multiwalled Carbon Nanotube Sponges." ***Particle & Particle Systems Characterization***, 33 (1): 21-26 (2016). Nanotechnology

Zhao W, Shan C, Elias AL, Rajukumar LP, O'Brien DJ, Terrones M, Wei B, Suhr J, and Lu XL. "Hyperelasticity of Three-Dimensional Carbon Nanotube Sponge Controlled by the Stiffness of Covalent Junctions." ***Carbon***, 95: 640-645 (2015). Nanotechnology

Zhou G, Byun J-H, Wang Y-Q, Cha H-J, Lee J-U, Jung B-M, Song J-I, Kim B-S, and Chou T-W. "Mechanism of Sonication-Assisted Electrophoretic Deposition of Carbon Nano-Fiber on Carbon Fabrics." ***Composites Science and Technology***, 107: 29-35 (2015). Composites and Advanced Materials Nanotechnology

Zhou G, Wang YQ, Byun J-H, Yi J-W, Yoon S-S, Cha H-J, Lee J-U, Oh Y, Jung B-M, and Moon H-J. "High-Strength Single-Walled Carbon Nanotube/Permalloy Nanoparticle/Poly (Vinyl Alcohol) Multifunctional Nanocomposite Fiber." ***ACS Nano***, 9 (11): 11414-11421 (2015). Composites and Advanced Materials Nanotechnology

Zhou Y, David MA, Chen X, Wan LQ, Duncan RL, Wang L, and Lu XL. "Effects of Osmolarity on the Spontaneous Calcium Signaling of in Situ Juvenile and Adult Articular Chondrocytes." ***Annals of Biomedical Engineering***: 1-10 (2015). Biomedical Engineering

Zhou Y, Park M, Cheung E, Wang L, and Lu XL. "The Effect of Chemically Defined Medium on Spontaneous Calcium Signaling of in Situ Chondrocytes during Long-Term Culture." ***Journal of Biomechanics***, 48 (6): 990-996 (2015). Biomedical Engineering

Zhou M, Deng Y, Liang K, Liu X, Wei B, and Hu W. "One-Step Route Synthesis of Active carbon@La2NiO4/NiO Hybrid Coatings as Supercapacitor Electrode Materials: Significant Improvements in Electrochemical Performance." ***Journal of Electroanalytical Chemistry***, 742: 1-7 (2015). Clean Energy and Environment Nanotechnology

Zhu M, Zhang L, Li X, He Y, Li X, Guo F, Zang X, Wang K, Xie D, and Li X. "TiO 2 Enhanced Ultraviolet Detection Based on a graphene/Si Schottky Diode." ***Journal of Materials Chemistry A***, 3 (15): 8133-8138 (2015). Nanotechnology

Zimmerman BK, Bonnevie ED, Park M, Zhou Y, Wang L, Burris DL, and Lu XL. "Role of Interstitial Fluid Pressurization in TMJ Lubrication." ***Journal of Dental Research***, 94 (1): 85-92 (2015). Biomedical Engineering

Zong Y, Peng C, Guo Z, and Wang L-P. "Designing Correct Fluid Hydrodynamics on a Rectangular Grid using MRT Lattice Boltzmann Approach." ***Computers & Mathematics with Applications*** (2015). Clean Energy and Environment

Thank you to our donors!

We wish to thank the many ME friends and alumni who have made generous contributions between July 1, 2014 and June 30, 2015. Your gifts are used for many worthwhile purposes, including support of our interdisciplinary fundamental research and educational programs. To donate, use the enclosed envelope or 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.

Names written in blue represent gifts made specifically to ME.

**Indicates deceased*

Special Thanks

The Department is proud to recognize donors who gave more than $10,000 in outright gifts and pledge payments during fiscal year 2015 (July 1, 2014–June 30, 2015).

Estate of Paul F. Berry Jr. '51*

Charles H. Collier III '65

Paul N. '66 and Flo Z. Costello

David R. Helwig '73 and Constance LaRoe Helwig '73

John B. Kelly '83 and Terri Connor Kelly '83

Vance V. Kershner '79

William G. Mavity '72

Wayne E. McCabe '57

Estate of Mr. W. David Teter*

James and Katherine J. Williams

Joseph Adelmann '11

Alan '82 '84 and Donna Aleixo

Robert W. Alexander '89 and Rebecca Wagner Alexander '90

Paul J. Anderson '74

Gregory W. Antal '79 '86M

Enrique E. Antezana '71

James H. Art '72

David T. '77 and Dawn B. Bach

Cheryl LeBlanc Bachman '83 and William S. Bachman

Nicolaas A. Ballintyn '75 '82M

Lyndon O. Barton '72M and Olive Simon Barton '04

Vincent G. Basilio '93 and Laura Semian Basilio '93

George S. Batchis '61

Gary J. '85 '88M and Patricia S. Becht

Ellen Fletcher Benedict '75 and Richard A. Benedict

Stephen D. Benson '67

Darlene Gorton Bergener '96

Ian R. Beringer '13

Eric P. Beyeler '85M '87PhD and Sarah Bryan Beyeler '83 '94M

Richard A. Biddle '78 and Anne Schulte Biddle '80

Geoffrey A. Bidlack '77

Gerard B. Bijwaard '63 and Patricia Burke Bijwaard '64M

Robert C. '66 and Georgia F. Bill

Benjamin I. '08 and Caitlin A. Binder-Markey '07

Robert W. Bloom '73 '75M and Lynne Adams Bloom '99M

David E. Botzler '82 and Maureen Donahue Botzler '84

Alex T. '80 and Diane P. Bourdon

G. Ronald '62 and Elaine M. Bower

Aaron K. Brauner '10 '11M

Michael E. Brennan '12

Donald J. Bridge '86 and Michele Pokoiski Bridge '86

Anthony J. Bruno Jr. '70 '75 and Andrea Recordon Bruno '71

Amy C. Bucha '12 '14M

Jennifer M. Buckley '01

James G. Buckmann '13

Nancy McKinley Bull '81

Watson S. Bullock '67

John S. Burns III '74

Eric J. Busillo '06

Joonhyung Byun '91PhD

W. Murray '50 and Mollie B. Campbell

Eugene T. Jr. '90PhD and Mary W. Camponeschi

E. Fenton Carey Jr. '67 '70M

Michael J. Caruso '05 and Kaitlin Hoffman Caruso '05

Dean R. Cave '83

Yeon Chang '88PhD

Liang Cheng '10PhD

Leslie J. Clarke Jr. '67

W. Richard Clendaniel '53 and Nancy Peck Clendaniel '55

Nathan '63 '73M and Carolyn T. Cloud

W. David Cockey '76 and Katherine Ward Cockey '82M

Joseph F. Cook '72 and Nancy Hughes Cook '72

Anthony M. Coppola '11

Terrell L. Corder '10

Edward J. Coyle '79 '81M and Mary Johnson Coyle '79

Leslie Hersh Crane '97M

Thomas E. Craven '70 '83M and Linda Scarborough Craven '72

Timothy G. Crawl-Bey '93M and Tamika Moses Crawl-Bey '95

Kevin J. Cresswell '91 and Lisa Niedbala Cresswell '92

Donald L. Crouch '58

Anna E. D'Alessio '13

William P. D'Amico Jr. '77PhD and Patricia Harman D'Amico '64 '71M

Edward Jr. '66 and Marie J. Darlington

Paul E. Davis '67 and Isabelle Manwiller Davis '67

Mark A. Sr. '81 '83M and Katherine H. Degli Obizzi

D. Cameron DeHeer '90 and Heather Cullen DeHeer '89

Edmund J. '97 and Josselyn Delussey

Daniel H. Derick '84 and Patricia Murch Derick '88 '99M

Ryan J. Derrig '11 '12M

James '93M '04PhD and Carmel J. DeSpirito

Andrew J. Devenny '15

Dennis O. Dever '80 and Joyce Polecaro Dever '80

John T. Diamanty '85

James S. Dick '59 and Louise Lattomus Dick '59

William A. Dick '78 and Katrina S. Cheney

David S. Diefenderfer '86 and Carolyn Suggs Diefenderfer '86

Ralph B. Dill III '66

Arthur R. '72 and Patricia A. DiNicola

Charles G. Dixon '75

Kenneth S. Dominy '90

Mark J. Donald '71

Neil R. Donnelly '12

R. Dennis Dove '63 and Pamela Stavrou Dove '63

Chandler S. Jr. '59 and Sharon K. Eason

Charles D. Eberle III '84 and Sueann Hall Eberle '87

Bernard W. Ebersole III '79 and Jennifer J. Matlack '75

David C. Ellsworth '83 and Charisse Carroll Ellsworth '82

Ian H. Enterline '08

John J. Erhart '79

Raul Esparza Jr. '73

Deborah Sanders Faison '83

Michael J. Falduto '12

Bakhtier Farouk '79M '82PhD

James B. Faunce '79 '81 and Candace Collins Faunce '79

Robert C. Ferguson Jr. '56 '62 and Dorothy Strobel Ferguson '56

Scott P. Fifield '82

William W. Finch Jr. '86 '88M '97PhD and Jennifer Gotkin Finch '90

John A. Firgau II '82

Robert F. Fischer '69

Richard E. Fisher '53

John M. III '89 and Lynne A. Fletcher

Henry O. Foster '65PhD

Sean M. Foster '91

Robert A. Freedman '87 and Diane Forschirm Freedman '88

Robert H. '72 and Francine S. Freedman

Stephen F. Fromyer Jr. '78

Christopher S. Gale '09 and Erica Vacaro Gale '10

B. Sean Gallagher '99

Gerard J. Gallo '11 '15M

Thomas A. Gamble '52

George J. '72 and Molly H. Gard

Adria M. Garhart '87

Clavel Albay Gempesaw '82M '91PhD and Conrado M. Gempesaw II

Robert B. Gifford Jr. '98 and Kathryn Kaser Gifford '99 '04M

Dean S. Gilchrist '68

Thomas M. Golden '82

Noel A. Goldstein '99

Mirek Golebiowski '82

David H. Good '76

William D. Green '61 and Constance Reburn Green '61

Paul V. Grey '73 and Theresa Clifton Grey '82

Eric F. Griesinger '81

Philip F. Griffin '91 '95M

Paul M. '86 and Ana Maria C. Gulian

Mohinder K. Gupta '66M

Charles W. Gurney '54

Nasreen F. Haideri '88 and William McFarland

H. Martin Halvorsen Jr. '65

Richard F. Hammond '52

Scott R. Hansen '01

Robert M. Hartman '88PhD

Fred G. Harvey '50

Barry W. Hauf '67

John L. '69 and Judy M. Haverstick

Gary A. '80 and Lisa M. Hecht

Sassan Hejazi '83

Mark J. '81 and Kathleen S. Heller

Stephen C. '78 and Nina R. Hemberger

Bryan E. Hennigan '10

Samuel A. Hewes '75

Donald T. Hoffecker '51 and Muriel Bear Hoffecker

Art '55 and Jacqueline V. Holveck

Gregory E. Homan '82

Edwin F. Hopkins '00 and Christine Bavaro Hopkins '00

John W. Hopkins '83 and Ellen York Hopkins '83

Mark W. '80 and Mary B. Hopkins

Thomas E. Hopkins '55 '60M and Sally Steele Hopkins

Luanne Murphy Houck '87

Edmund O. Howell '58

Shiping Hu '97M

Clinton H. Hubbard Jr. '68

Daniel S. Hudson '82 and Mabeth Wilson Hudson '82

George S. Hudson '56 and Barbara Pearce Hudson '58

John I. Hudson '81

Karen A. Hudson '84

Donald J. '72 and Karen M. Hufford

John D. Hukill '54 and Jay Rowland Hukill '56

David Hutton '67 and Susan Deppert Hutton '67

Frank S. II '58 and Jane G. Hyer

Richard G. Irwin Jr. '86 and Catherine Platt Irwin '82

Edward C. Jackson '83 and Ruth Gregory Jackson '83

David L. Jacoby '76 and Esther Kim Jacoby '79

Carl H. Jahn '50

Sharnita P. James '14

Suresh S. Jayanthi '95M and Padma Kondury Jayanthi '98M

Scott T. Jednacz '72

Mark P. Jenkins '14

Charles E. '73 and Constance T. Joanedis

Adriaan Jobse '62 '64M

Chetwyn M. Jones '07

Seward L. Jones '53

Robert A. Jurf '81 '84M '87PhD and Julie Bischoff-Jurf '82 '86M

Edward J. '57M and Mildred E. Kaliski

Clayton D. Kauffman Jr. '58

James W. Kegelman '88 and Natalie Forster Kegelman '91

Jerome T. Kegelman '78 and Mary E. Cassidy Kegelman

Elizabeth M. Keighley '07

Edward J. Kelczewski '60

Darrell C. '85 and Adrienne O. Kelly

James D. Kersch '12

Peter B. and Karen G. Kettler

Young-Kil '73M '76M '78PhD and Susan M. Kim

Brent L. King '96 '99M

Irvin B. King '65

Durand R. Kinloch III '61 '65M '70PhD and Barbara Keen Kinloch '62

Robert W. Kinney '70

Stephen P. '77 and Ericka M. Kinsey

William J. Kistler '11

Howard S. '67M '70PhD and Janet H. Kliger

Frederick H. Kohloss '51M

Travis J. Krell '12

Steven J. '79 and Holly E. Krinsky

Ashok Krishnamurthy '95M

Michael D. Kutzer '05 and Lindsay Novotny Kutzer '06

Andrew W. Lane '12

James R. Laser '69

Jody Laynor Latimer '87 and Timothy C. Latimer

Melissa D. Lauten '15

Jeffrey M. Lawrence '98 '05PhD and Carolina Rodriguez Lawrence '05M

Jeffrey M. LeBlanc '11 and Amanda L. Jett '11

Carter M. '79 and Roslyn K. Ledeker

Kyung Bin Lee '15

Mark O. LeFevre '76

George A. Leleko '72

Jacqueline Cuthbertson Lenyon '93 '95M

C. Jackson Levis '50 and Sally L. Hunter

Jun Li '15

Jamie Hirsch Linton '90M and Michael F. Linton

Charles J. Litz Jr. '51

Chia S. Liu '65M '67PhD

Yang Liu '15

Anthony M. Loccisano '12

John B. Long Jr. '57

William H. Lotter Jr. '56*

Frederick G. Ludman '69 and Lois Binley Ludman '65

John P. Ludman '92 and Angela Spinelli Ludman '92 '98M

Bradford S. Luff '82

Wayne A. Lyons '61

G. Greer MacMasters Jr. '58

Patrick C. Madden '52

David J. Maguigan '70 '76M and Jane Mayberry Maguigan '75

Daniel M. Maguire '86M

F. J. Mainwaring Jr. '61 '63M and Barbara Bloom Mainwaring '62

John F. Maiorano '57

Paul J. Manning '85

Brent L. Marsh '68 '70M '73PhD

John R. Martin '84

Jon P. '82 '84M and M. Megan Allen Martin

Thomas R. Masino Jr. '90

Mark A. Maurer '84

Raymond A. McCauley '09 '13M

James P. McFadden '50 and Nancy Corcoran McFadden

Richardson D. McKelvie '79

Thomas A. McKenna '52 and Jane Vannerson McKenna '52

P. L. McWhorter III '54

John S. McWilliams '90

Zachary R. Melrose '11 '14M

Joan Greaves Messick '92 and Steven J. Messick

Edward A. Miller '63 and Patricia Bell Miller '59

Russell N. Miller '74

Scott P. Milsom '94

Doug Minami '91

Steve E. Minor '79 and Vicki Turpin Minor '80

James P. Modrak '67PhD

Mary Louise Brzezicki Mogan '84 and Kenneth J. Mogan

Robert T. Monaghan Sr. '52

Leslie Horton Montena '94

Carl G. Moore Jr. '74

G. Frank Moore '49

Grace A. Moore '87

Reza F. Moqtaderi '71 and Susan Mitchell Moqtaderi '69

William T. '61 and Nancy S. Morris

Anne W. Morrison '69 '73M

John L. Morrow Jr. '73 and Dana-Jeanne Fricker Morrow '73

Louis S. Munson '73

Craig W. Murray '93 and Dana Testa Murray '96

Lawrence E. Murray '58 and Dorette Mueller Murray '58

Martha Meaney Murray '87

William L. '49 and Audrey L. Natale

J. David Nicoll '68 and Jill Hunsinger Nicoll '69

Ralph M. '80 '96M and Jill L. Nigro

David H. Nixon '80

Tina Susi Nolte '90 and Christopher G. Nolte

Paul E. Oberdorfer III '71

Lois B. Olsen

Oluseyi O. Onawola '04M

Sarah L. O'Neill '09

Richard T. Onley '50

Kathryn K. Ordemann '15

Timothy C. '00 and Lauren E. O'Shea

David C. Palma '09

Yen-Cheng Pan '73M '77PhD

Alan J. Panaccione Jr. '15

Richard C. Parsons '09

Richard L. Pase '63

William S. Patterson Jr. '58 and Elisabeth Snowberger Patterson '56

Charles W. Pell '83

Jessica E. Penman '15

Patty Penman

Richard W. Perry '56

Gary N. '87 and Jennifer Peterson

Lawrence M. Phillips '50

Oren B. Jr. '68 and Judith N. Phillips

Lijuan Pi '09M

Robert H. Pigford '68 and Patricia Houchin Pigford '66

William A. '70 and Sandra V. Podgorski

Frederick W. Polaski '71 and Mary Jean Walnock Polaski '73

James H. '72 and Mary W. Poole

Steven R. Poole '86

Thomas E. '83 and Jacquelyn L. Price

Barry H. '65 and Elizabeth H. Pritchard

Francis Puchino '98

Paul F. Pustolski '74

Jennifer Watt Pyle '79 and Harvey B. Pyle

Kennith L. '84 and Laura S. Quesenberry

Ryan M. Quirk '15

James M. Radka '76

Ted Rausch '80

Gloria S. Reagan

James R. Reagan '49*

Jason W. '02 and Jalina Reinhardt

Kevin Reynolds '77 and Valerie Holtje Reynolds '77

Donald R. Rice '73

William D. Richards '63

Mark A. '83 '84M and Sandra J. Richter

Donald R. Ritter '71

Ferdinand C. Ritter '49*

Miguel A. Rodriguez-Labarca '93 and Michelle Bower Rodriguez-Labarca '93

Zachary D. Rogers '13

Gregory J. Rohrbacker '83

Stephen D. Rosenkrantz '14

Theodoros D. Roustopoulos '12

Christopher J. Ryan '96 '11M and Katherine Link Ryan '95

John K. Ryder '86 and Suzette Asbury Ryder '86

Richard B. Sager '55

J. Matthew Scarborough '96 '97M and Melissa Bailey Scarborough '03M

Michael E. Schenk '15

Andrew P. Schmalz '06M

Nikolas J. Schreiber '14

Kevin R. Schultz '10

Thomas F. Sealman '62

Amir R. Sedigh Haghighat '09 '15M

Barry S. Seidel '53 and Phyllis Schulman Seidel '55 '81M

Kenneth E. Seitzer '78

George J. '72 and Maryann Sestak

Larry L. Shafer '74

Hayley J. Shaw '14

Joseph J. Shen '73

C. A. Jr. '72 and Kimberly P. Simmons

George B. Simpson '54 and Paula Turek Simpson '58

Balvinder Singh '85

Robert J. '72 and Angela A. Singley

Daniel M. Skedzielewski '72 and Christine A. Jadach '71

Corporate Donors & 2016 Senior Design Sponsors

(Senior design sponsors in yellow)

Agoge Automation, LLC

The Air Products Foundation

Boeing Company

Bregenzer Brothers Roofing and Sheet Metal

BRG Sports

Candor Enterprises Inc.

Chevron Corporation

Cirrus Engineering Inc.

DePuy-Synthes

ExxonMobil Corporation

ExxonMobil Foundation

Fenner Precision

Fidelity Charitable Gift Fund

First Clearing, LLC

GE Aviation

General Electric Foundation

Goodwill of Delaware & Delaware County

Hologic (2 teams)

Independence Prosthetics & Orthotics

LiteCure LLC

Merck

National Philanthropic Trust

Norwalt Design

Organiponic Inc

Philips Electronics North American Corporation

Precision AirConvey

Schiller Grounds Care

Schneider Electric North America Foundation

Siemens Healthcare Diagnostics (2 teams)

SimUCare

Southco

Southco, Incorporated

Speakman

Superior Tube

Terumo Medical Corporation

Therapeutic Nutrition LLC

W. L. Gore & Associates, Inc.

West Pharmaceutical

Xergy

Zodiac Arresting Systems

Andrew M. Skocypec '15

John R. Sr. '68 and Lois H. Slack

Randall T. Sleight '04M

Alton P. Smith Jr. '66 '73M and Suzanne McCoy Smith '67

Andrew H. Smith '13

Price K. Snyder '51

Thomas W. Soper '13

Nancy R. Sottos '86 '90PhD

Matthew P. Spencer '00

J. Bruce Spiller '73 and Evelyn Ewing Spiller '75

Louis T. Staats III '79

Jonathan R. Stahl '90

George F. Starzmann '59

John R. Starzmann '68 and M. Carol Hitchens Starzmann '68

Matthew A. Stauffer '87 and Susan Sowter Stauffer '78 '87

Frederick P. '64 '66M and Arlene Stecher

Kyle D. Steelman '10 and Lindsay McNinch Steelman '10

Eugene N. Jr. '67 and Evelyn D. Sterling

John J. Stevens '90

Robert L. '58 and Gretta E. Stevens

Jon R. Stevenson '83

Jennifer Aruffo Stiles '84 '89M

G. Mark Stofega Jr. '67 and Janet Fallow Stofega '67

Charles P. Streithof Jr. '51 and Jacqueline McSwain Streithof '50

Carl W. Strickler '78

Barry L. '81 and Rebecca L. Strohmeier

Walter P. Jr. '67 '71M and Barbara H. Stroud

Terry L. Stuchlik '76 and Kelly Carmine Stuchlik '76

Walter B. Sturek Sr. '71PhD

Swaminathan S. Subbiah '89PhD

Erin M. Sullivan '10

Scott P. '70 and Donna L. Sullivan

Richard D. Swope '60 '62M '66PhD

David L. Sysko '64 '76M and Patrice Kosey Sysko '70

Scott C. Talley '86 and Jennifer Hogan Talley '87

James E. Tardona Jr. '79

George G. Tatnall '57

Robert E. Tatnall '64 and Sandra Hilseberg Tatnall '64

Robert S. '88 and Carol A. Taylor

William J. Taylor Jr. '83 '88M and Jan Patterson Taylor '83

David G. Tennent '78

Margaret G. Thomasmeyer '15

Larry J. Thompson Jr. '94

Robert H. Thompson '57 '61M

Steven J. '84 '88 '97PhD and Lydia R. Timmins

Xiao L. Tong '98PhD

Evelyn Crowl Tucker '79

Peter A. '66M and Louise Tuschak

Thomas C. Van Meter '57 and Barbara Lewis Van Meter '58

Joseph C. Vankoski '66 and Deborah Lovell Vankoski '65

Michael V. Vari '86 '95M

Richard G. Vincent '48

Jack R. and Midge Vinson

Jennifer K. Vitlip '15

Kenneth R. '77 and Jill B. Waeber

William B. III '62 and Allyn A. Wagamon

Joseph A. Jr. '71 and Cynthia E. Walkowski

James J. and Sally F. Waller

Lian-Ping and Yalien Wang

Matthew J. Ward '11

Newton G. '61 and Marilyn M. Wattis

Margaretmary Torelli Weidert '72 and Robert M. Weidert

Jeffrey C. Weil '67

Elizabeth Boelhouwer Werner '84 and Robert A. Werner

James W. Wert '65

Edward D. Western '65 and Virginia Alexander Western '66

Cindy Connor White '84

Walter E. White Jr. '56

Jesse A. Whitley '10

Kenneth L. Wiggins '72

Shantel Conquest Williams '94

Dale W. Wilson '77 '82M and Barbara Thielemann Wilson '81

David L. Wimberley '69 '70M '75M '77PhD

Amanda L. Winkelmayer '15

Thomas P. Wirt '85

Edwin L. Wisseman '69

Fred Wolpert '69M

Thomas A. Wood Jr. '51

Steven D. Wright '02 '11M and Bonnie Willis Wright '05

Scott K. Wroten '13

Eric B. Wurtzel '12

John B. Wyckoff '89

Jin Yan '07PhD

Da-Jie Yang '97PhD

Michael Yeager '12

Aristedes Yiournas '01

Bruce A. '79 '82M '85PhD and Babetta M. Yost

Mark W. and Sharon B. Zacharias

Chengkun Zhang '13PhD

Steven W. Zorrer '84 and Laura L. Fontana

Ways to help

PARTNER

Mechanical engineering is the broadest of the engineering disciplines, providing our students a wide range of knowledge and skills in fields such as biomechanical engineering, clean energy/ environment, composites/advanced materials, nanotechnology, and robotics/controls. Our curriculum integrates teamwork, communication and hands-on learning experiences that prepare students to address today's challenges.

Strategic partnerships with industry expand the college's impact, while cultivating a culture of interdisciplinary collaboration, leadership and entrepreneurship among future engineers. We invite companies to partner with the Department of Mechanical Engineering through the following opportunities:

- Recruitment
- Scholarships/fellowships
- Internships/co-ops
- Professional engineering education
- Event sponsorship & brand recognition
- Senior design
- Professional student organizations
- Advisory committees
- Research
- Guest lectures

To discuss a corporate partnership program, contact: Shabool Henry, director of Corporate and Foundation Relations, shenry@udel.edu or 302-831-4460.

VOLUNTEER

Volunteering gives you the opportunity to stay engaged in the ME community, while our students gain access to unparalleled mentorship. As an alum, you can provide feedback on how the department can prepare students for the new challenges engineers face today. No matter your age or experience, your perspective is valuable. We invite you to partner with us to build the next generation of mechanical engineers.

- Serve as an ME125 ambassador, contact: Paul Costello (ME'66), pncostello@comcast.net
- Judge, advise or submit a design project, contact: Elaine Nelson, nelson@udel.edu
- Advise the department, contact: Michael Keefe, keefe@udel.edu
- Be a guest speaker for classes or student engineering groups, contact: Terrie Kalesse, terrie@udel.edu
- Mentor students and/or student organizations (e.g. ASME, SWE), contact: Terrie Kalesse, terrie@udel.edu

GIVE

Support the $1.25M Design Studio Renovation

The ME Design Studio is a one of-a-kind workshop, laboratory, teaching and community space where students and faculty work in multi-disciplinary teams to solve technical problems. Unidel Foundation has already committed $670K, or 53 percent of the total costs needed to upgrade design facilities and equipment. Gifts given to Mechanical Engineering during the 125th Anniversary through June 30, 2017 will bridge the gap in completing this effort.

Create/support a scholarship, fellowship or professorship fund

Contact Barbara Maylath, director of Development, bmaylath@udel.edu or (302) 831-7273.

UNIVERSITY OF DELAWARE | College of Engineering
DEPARTMENT OF MECHANICAL ENGINEERING

126 Spencer Lab
University of Delaware
Newark DE, 19716

"We were privileged to have a rich pool of top-level candidates for this position. Dennis Assanis' combination of administrative experience and outstanding academic credentials clearly set him apart."

–Terri Kelly, BME'83, President and CEO of W.L. Gore and Associates, Mechanical Engineering Distinguished Career Award honoree 2006, UD Trustee and Co-Chair of the Presidential Search Committee

Meet our newest ME faculty member:

INCOMING UD PRESIDENT DENNIS ASSANIS

- Distinguished educator with a world-wide reputation as a scholar and expert in both fundamental and applied studies of internal combustion engines and energy systems.
- Provost and senior vice president for academic affairs at Stony Brook University and vice president for Brookhaven National Laboratory Affairs since 2011.
- Inducted as a member of the National Academy of Engineers in 2008 for his scientific contributions to improving fuel economy and reducing emissions of internal combustion engines and for promoting automotive engineering education.
- 17 years with the University of Michigan as the Jon R. and Beverly S. Holt Professor of Engineering and Arthur F. Thurnau Professor; director of the Michigan Memorial Phoenix Energy Institute; founding director of the U.S.-China Clean Energy Research Center for Clean Vehicles and director of the Walter E. Lay Automotive Laboratory.
- Chaired the University of Michigan's Department of Mechanical Engineering from 2002–2007.
- Fellow of the American Association for the Advancement of Science (AAAS), the American Society of Mechanical Engineers (ASME) and the Society of Automotive Engineers (SAE).