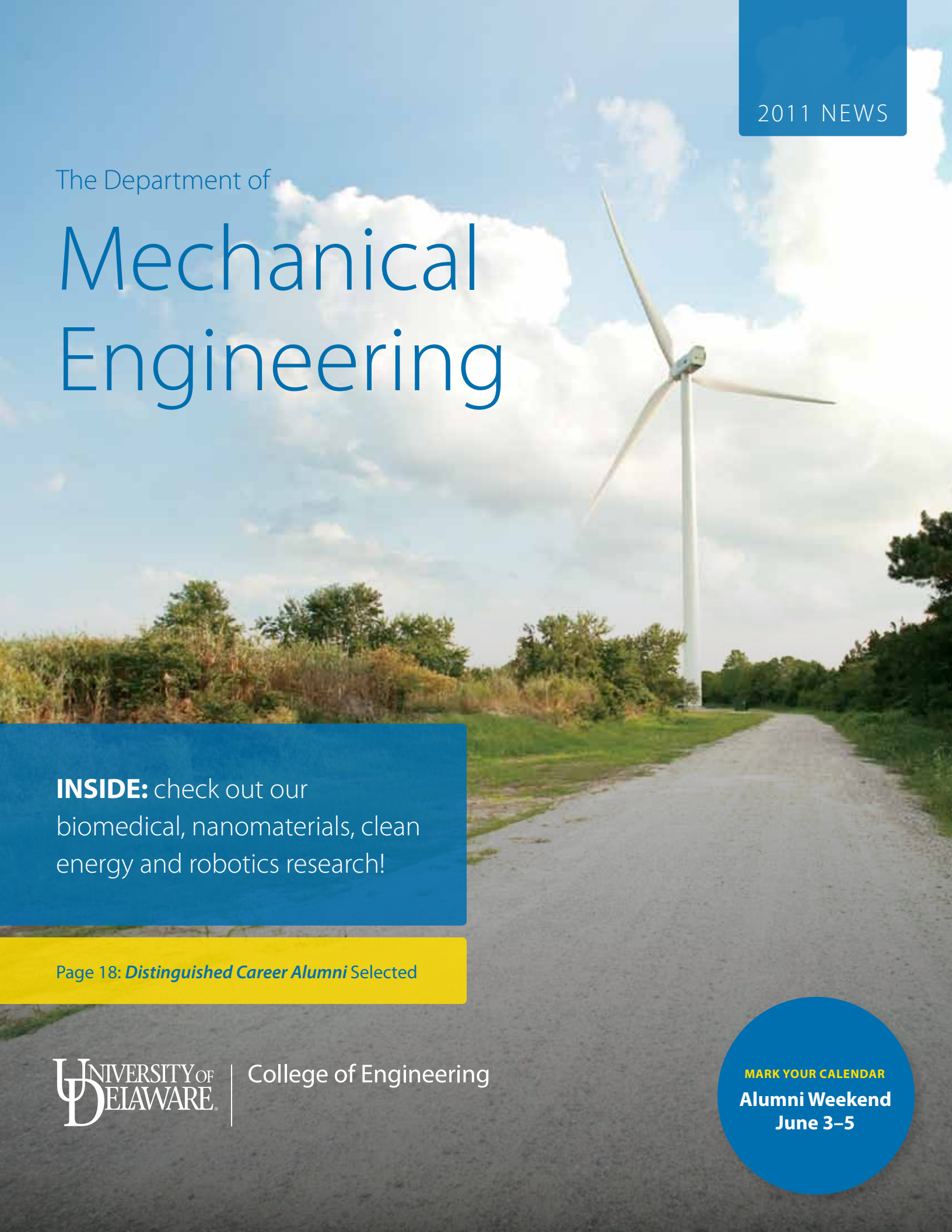
2011 NEWS

The Department of

Mechanical Engineering



INSIDE: check out our biomedical, nanomaterials, clean energy and robotics research!

Page 18: ***Distinguished Career Alumni*** Selected

UNIVERSITY OF DELAWARE | College of Engineering

MARK YOUR CALENDAR
Alumni Weekend
June 3–5

MESSAGE FROM THE CHAIR

Welcome to the 2011 Mechanical Engineering news magazine. I hope you will enjoy catching up and learning about the department's accomplishments during the last year.

I am delighted to report that our department continues to grow and forge new paths in science and engineering. We welcomed ***several new faculty members*** and have seen significant growth in student enrollment.

The department experienced its ***largest incoming graduate student class*** in 2010, with 35 first-year students compared to 25 students the previous year. This represents an impressive 40 percent increase in graduate enrollment over 2009.

This year's undergraduate senior class is one of our largest classes ever—with more than 100 students. You can learn about their accomplishments in the feature on senior design.

Advances in research remain a primary focus in our department. In the past year, departmental research ***funding has increased by 10 percent.*** Since 2005, research expenditures have increased by 80 percent.

Be sure to read the special research section of the magazine for a snapshot of the exciting research emerging from UD's mechanical engineering department in the areas of biomedical research, clean energy and environment, nanomaterials and nanotechnology, and robotics and control.

Finally, I would like to extend my heartfelt thanks to alumni, friends, faculty and staff whose donations continue to enhance the department. With your strong support, we initiated four new student awards last year. The first three are mechanical engineering alumni awards for outstanding sophomore, junior and senior students. The fourth is an award for outstanding student leadership.

Departmental fellowships and awards provide important financial support for students and enhance our department's ability to train and educate future leaders. We gratefully acknowledge your contributions to these non-endowed scholarships and awards.

Best regards,

Anette Karlsson

P.S. Don't forget to mark your calendar for Alumni Weekend June 3-5, 2011. We look forward to seeing you at the 7th Annual Mechanical Engineering Alumni Career Celebration and Reunion.

IN THIS ISSUE...

Looking for an old friend? Want to share your latest news? Searching for information on upcoming alumni events such as Homecoming? Now you can do it all in one place, ***www.UDconnection.com***. UD and the UD Alumni Association (UDAA) have collaborated to bring alumni a vibrant online community—so register and get active! The online community 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! Visit ***www.UDconnection.com*** today!

Be sure to like *University of Delaware Department of Mechanical Engineering* and *UD College of Engineering* on Facebook!

WE'RE ON facebook

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RESEARCH

Research underpins every engineering innovation. It is the scientific foundation that transforms intellectually exciting ideas into pioneering discoveries.

UD researchers investigate problems from a variety of angles in order to develop viable solutions to problems impacting society.

In the pages that follow, we offer a closer look at four research areas within our department destined to help redefine and reshape our world.

Anette Karlsson
Chair

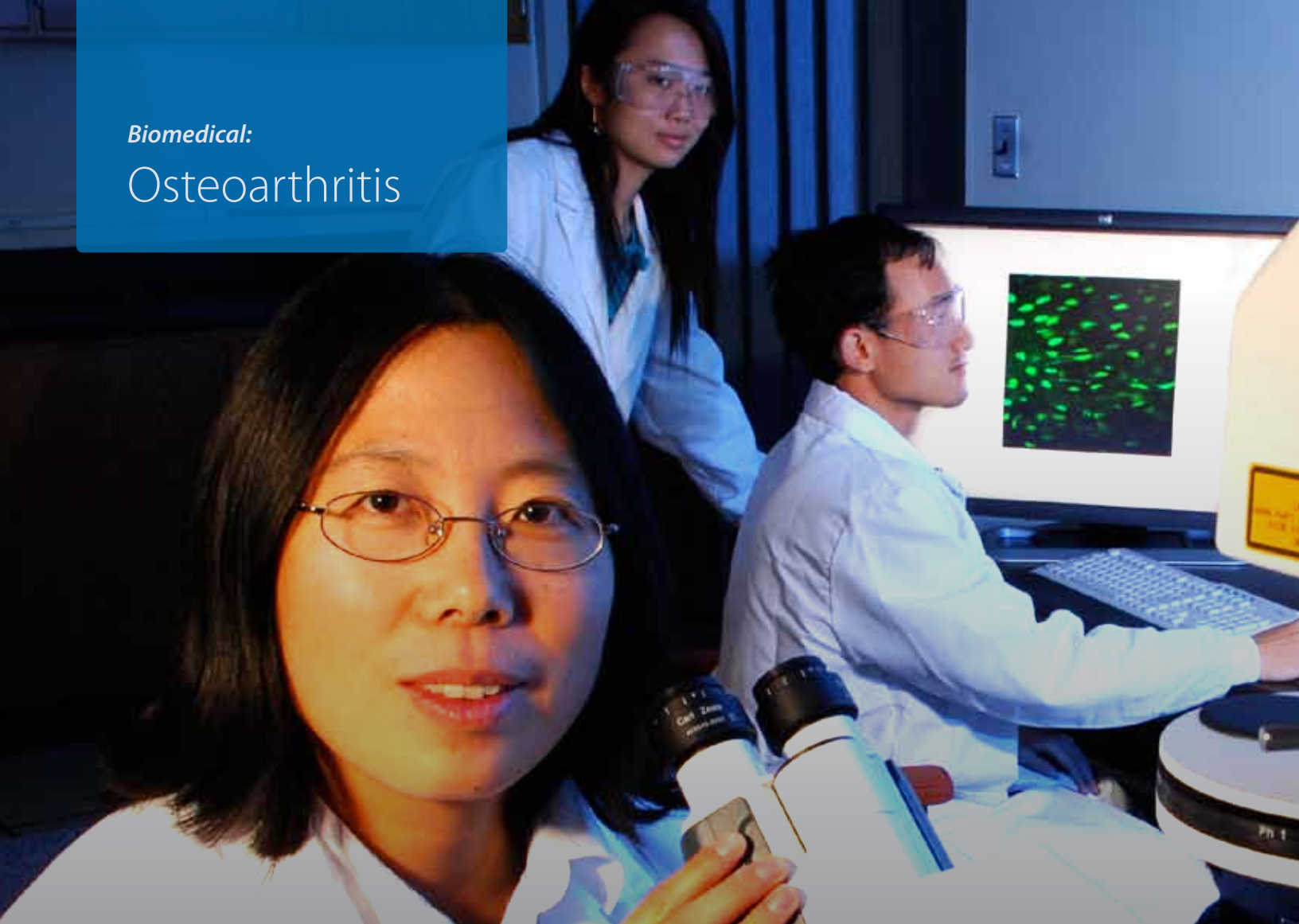
ME Faculty Research

		Biomedical Engineering	Clean Energy and Environment	Composites and Advanced Materials	Nano Materials and Nanotechnology	Robotics and Controls
Suresh Advani			•	•	•	
Sunil Agrawal		•				•
Thomas Buchanan		•				
David Burris		•	•	•	•	
Tsu-Wei Chou				•	•	
James Glancey		•		•		
Ian Hall				•		
Joshua Hertz			•	•	•	
Jill Higginson		•				
Anette Karlsson			•	•		
Michael Keefe				•		
X. Lucas Lu		•			•	

		Biomedical Engineering	Clean energy and environment	Composites and advanced materials	Nano materials and nanotechnology	Robotics and controls
Ioannis Poulakakis						•
Ajay Prasad		•	•		•	
Valery Roy			•			•
Michael Santare		•	•	•		
Kausik Sarkar		•				
Leonard Schwartz			•			
Jonghwan Suhr				•	•	
Herbert Tanner						•
Erik Thostenson				•	•	
Lian-Ping Wang		•	•			
Liyun Wang		•				
Bingqing Wei			•	•	•	

Biomedical:

Osteoarthritis



Osteoarthritis (OA) is a major public health issue causing chronic disability worldwide in the increasingly aging population. Characterized by loss of articular cartilage and degeneration of other joint tissues, this disorder falls behind other skeletal diseases such as osteoporosis and rheumatoid arthritis in available treatments. This is mainly because little is known about the underlying mechanisms and thus effective therapeutic targets are lacking.

Although multiple factors such as genetics and obesity may contribute to OA initiation and progression, biomechanical factors likely contribute to abnormal mechanical loading of the joint, affecting all the surrounding tissues including cartilage, bone and muscle.

The OA research efforts at the University of Delaware are led by Thomas Buchanan, George W. Laird Professor and director of the newly founded Delaware Rehabilitation Institute. Through the Center of Biomedical Research Excellency (COBRE), an $11 million five-year research program funded by the National Institute of Health, Professors Thomas Buchanan, Jill Higginson, Liyun Wang, Lucas Lu, David Burris, Kurt Manal and Chris Price in the ME department have focused on illuminating the mechanisms by which biomechanical factors regulate the joint functions at the molecular, cellular, tissue, joint and whole body levels. They are also developing novel intervention methods in preventing or deterring OA.

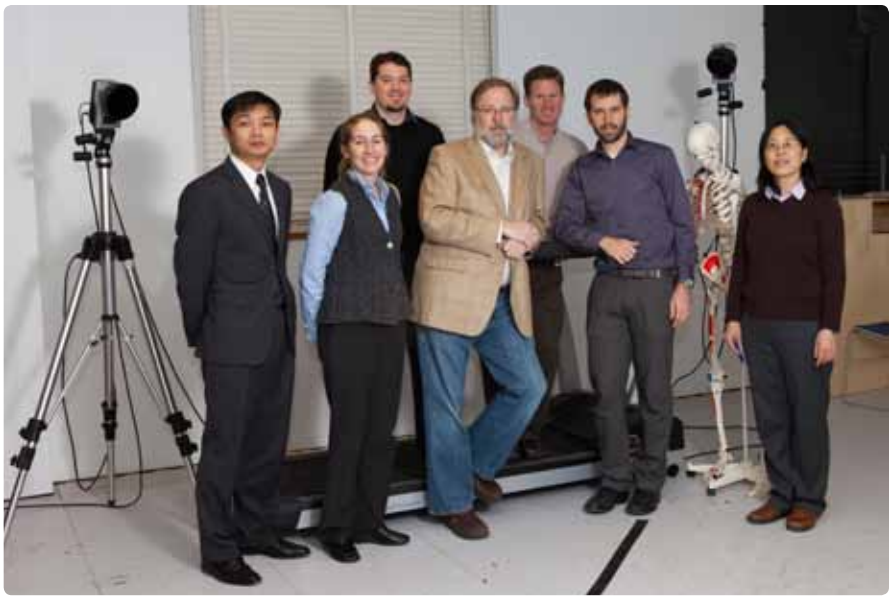
At the molecular and cellular levels, Professor Lucas Lu is investigating how mechanical forces influence chondrocyte functions using microscopy techniques, nanotechnology and computer modeling. As the sole cell type embedded in cartilage, chondrocytes are responsible in maintaining the composition and structure of the cartilage tissues under daily physical activities. Lu is utilizing a novel micro-patterned 3D system to culture the chondrocytes. Compared with the commonly used 2D culture disk system, this 3D system not only better maintains the cell phenotype, but also allows easy quantification of attachment forces that the cells insert to their surrounding matrix. Lu aims to systemically investigate the cellular signaling and gene expression under various degrees of mechanical stimulation. He hopes that his efforts will uncover new therapeutic interventions to treat OA at the cellular and molecular levels.

At the tissue level, Professor David Burris is investigating how local tissue structural damage influences cartilage tribological efficacy. Healthy cartilage provides extremely low friction coefficients and wear-free sliding over decades of continuous use. This amazing property is lost in OA cartilage. He hypothesizes that local structural damage can impede lubrication and induce additional

stresses which cause additional damage. To date, Burris has developed a custom microtribometer; demonstrated sustained fluid pressurization and lubrication for bovine cartilage in phosphate buffered saline over prolonged periods of testing with contact radii down to 100 µm; and developed in-situ methods for measuring the contact area and interstitial fluid pressure. He is actively developing strategies to study the degradation response to the mechanical stresses of sliding contacts.

Also at the tissue and preclinical level, Professors Liyun Wang and Chris Price are investigating how altered joint loading followed after joint injuries such as ACL rupture and meniscus tear induces the initiation progression of OA. They hypothesize that the highly viscularized subchondral bone compartment, which is capable of quick tissue turnover and remodeling upon mechanical alteration, is mechanically and biochemically coupled with the overlaying cartilage. Excess bone remodeling provides a vicious feedback leading to cartilage degradation. They aim to stop this loop by inhibiting bone turnover right after joint injury. The two have tested the efficacy of zoledronate in a preclinical mouse model. They found that injection of zoledronate twice a week for three months significantly suppressed the cartilage degradation seen in the non-treated animals after surgical destabilization of the joints. The mechanisms on the drug's effects on bone and cartilage are being studied with high-resolution CT imaging and immunochemistry. The "window of opportunity" of this early intervention will also be studied. If successful, the study will help develop a promising treatment option (inhibiting excess bone remodeling) for joint injury induced OA using an FDA approved agent or similar drugs.

At the clinical level, Professor Jill Higginson investigates muscle forces and coordination strategies during walking in individuals with age-related osteoarthritis of the knee through a combination of MRI, gait analysis, electromyography and biomechanical modeling and simulation. The goal of this longitudinal study is to relate changes in



biomechanical loading at the knee to changes in tibio-femoral cartilage geometry as OA progresses. Healthy individuals and those with signs of knee osteoarthritis were recruited to participate in clinical exams, strength tests, walking analysis and knee imaging. They found that individuals with knee OA reduce walking speed to reduce joint loads and exhibit decreased knee excursion with increased stiffness regardless of speed. Imaging data indicates that individuals without OA have a significant correlation between knee flexion angle and contact area, while the OA subjects did not. OA subjects exhibited greater articular cartilage contact area than the healthy controls at all flexion angles considered. Musculoskeletal simulations are used to determine contribution of muscles to knee contact forces. They found similar initial peak knee contact forces (KCF) among groups and decreased second peaks of KCF in subjects with increasing OA severity. Higginson hopes the data will be used to develop guidelines and non-surgical interventions to prevent or deter OA progression.

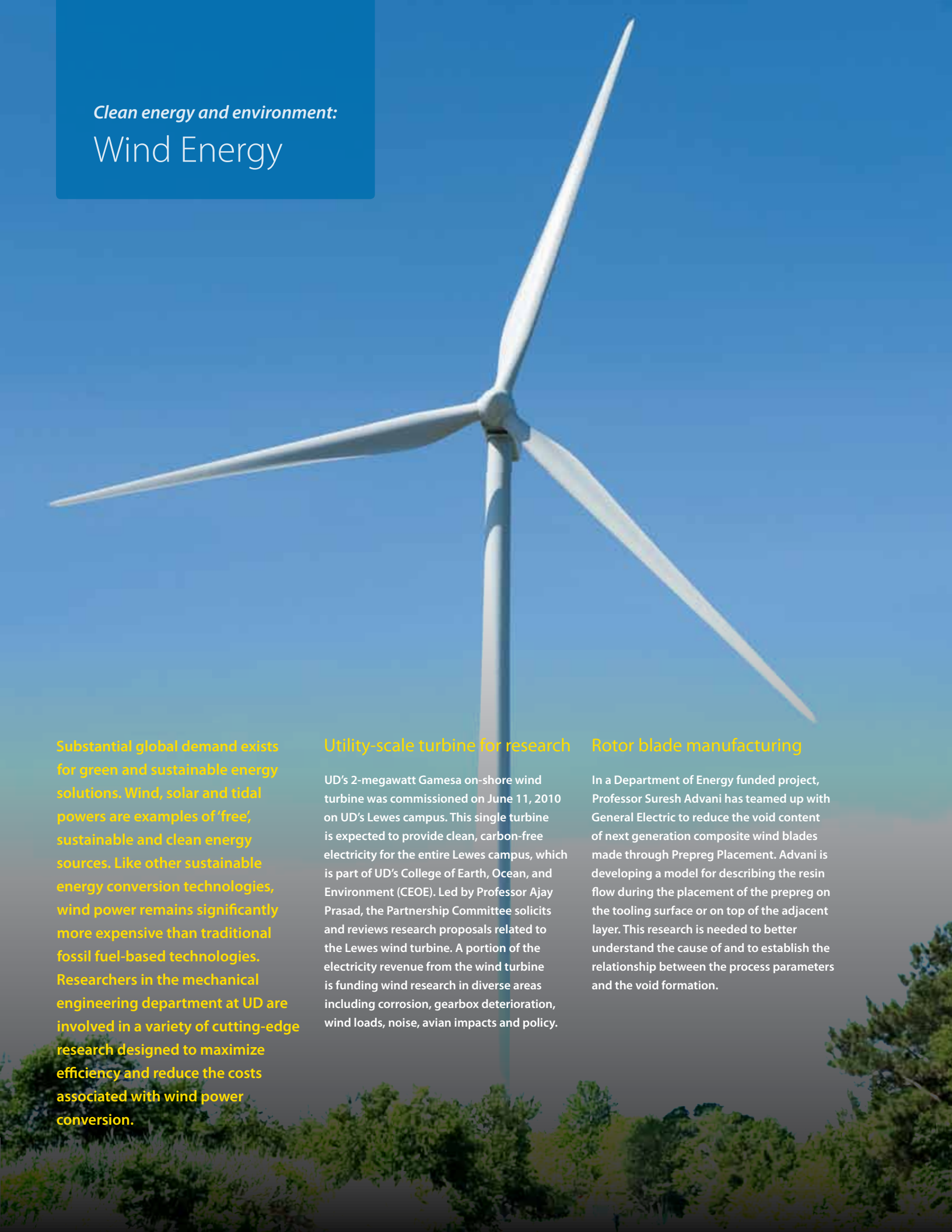
Also at the clinical level, Professors Thomas Buchanan and Kurt Manal are studying the neuromuscular strategies seen in patients with various joint impairments to develop physical intervention in reducing compressive forces at the knees. They hypothesize that the mechanical failure of cartilage due to high compressive forces at the knee can be secondary to other knee problems that alter the mechanical structure of the knee, such as ligament injuries, meniscal tears or other traumatic injuries. By combining imaging and modeling, patient-specific dynamic loading models are developed. They study the ways patients with different types of impaired knees deal with mechanical loads that have been shown to lead to osteoarthritis. They are currently developing a new approach to treating these patients, in collaboration with physical therapists, based on reduction of the knee compressive forces. In this new approach, real-time feedback is provided to the subjects about the medial and lateral compartment compressive loads at the knee joint during gait. If successful, an effective physical treatment option will be developed for OA patients.

Overall, the ME faculty are actively pursuing a better understanding of OA from a variety of angles and are working to develop novel and effective treatments of OA from bench to clinical setting and from the molecular to the whole body levels.

By Liyun Wang, Assistant Professor

Clean energy and environment:

Wind Energy



Substantial global demand exists for green and sustainable energy solutions. Wind, solar and tidal powers are examples of 'free', sustainable and clean energy sources. Like other sustainable energy conversion technologies, wind power remains significantly more expensive than traditional fossil fuel-based technologies. Researchers in the mechanical engineering department at UD are involved in a variety of cutting-edge research designed to maximize efficiency and reduce the costs associated with wind power conversion.

Utility-scale turbine for research

UD's 2-megawatt Gamesa on-shore wind turbine was commissioned on June 11, 2010 on UD's Lewes campus. This single turbine is expected to provide clean, carbon-free electricity for the entire Lewes campus, which is part of UD's College of Earth, Ocean, and Environment (CEOE). Led by Professor Ajay Prasad, the Partnership Committee solicits and reviews research proposals related to the Lewes wind turbine. A portion of the electricity revenue from the wind turbine is funding wind research in diverse areas including corrosion, gearbox deterioration, wind loads, noise, avian impacts and policy.

Rotor blade manufacturing

In a Department of Energy funded project, Professor Suresh Advani has teamed up with General Electric to reduce the void content of next generation composite wind blades made through Prepreg Placement. Advani is developing a model for describing the resin flow during the placement of the prepreg on the tooling surface or on top of the adjacent layer. This research is needed to better understand the cause of and to establish the relationship between the process parameters and the void formation.

Advani is also exploring new composite blade manufacturing techniques for Gamesa as part of a new infusion technique to manufacture their new generation of composite wind blades. Advani and other researchers from UD's Center for Composite Materials are characterizing the materials and the process of manufacturing these large wind blades. Using a simulation tool developed by Advani called Liquid Injection Molding Simulation (LIMS); researchers are investigating various virtual manufacturing scenarios that will lead to efficient mold filling without any macro or micro voids.

Rotor blade failure prediction and prevention

Professor Anette Karlsson is part of an international research team investigating the durability of rotor blades and other lightweight materials used in wind turbines. Funded by the National Science Foundation, Karlsson's work focuses on understanding how damage initiates and evolves in one particular class of light-weight structures, referred to as "sandwich structures." Similar to what we serve for lunch, sandwich structures contain two outside face sheets (the bread) designed to carry most of the load and an internal core (the meat) needed to optimize strength and stiffness. Wind turbines are typically located in remote areas, making repair of failing structures difficult, if not impossible. By focusing on how the damage evolves with time, the team is combining experimental work with numerical computer simulations to develop life-prediction models for these materials.

Rotor blade aerodynamics

Professor Leonard Schwartz is studying the fluctuating load on a wind turbine blade as it spins within the terrestrial boundary layer, which results in a periodic wind loading at the blade rotation frequency. His group is extending an existing steady-state blade-element calculation procedure for the aerodynamic forces to predict the fluctuating torque and twisting moment distributions. The benefits of individual blade element pitch control, to mitigate these fluctuations, can then be estimated. These distributions can also be used to predict the changes in the blade shape as it rotates.

UD's Gamesa-Lewes turbine provides an opportunity to verify such predictions on an industrial scale machine. Schwartz hopes to flush mount a small video camera on a blade root and track identified locations (e.g. painted spots or lines) using timed frames, which would enable development of a solid-geometry analysis that can extract the blade deflection histories from the movie frames. This observational information can be compared with the theoretical predictions to drive blade design improvements and also provide data for blade health monitoring. To our knowledge, no such video method has been developed.

Drivetrain design and reliability

Premature drivetrain failure is an industry-wide problem. Gearbox failure, in particular, is the largest contributor to turbine downtime and lost revenue. Compounded with expensive hardware repair or replacement, drivetrain failures contribute significantly to the cost of wind technology.

When a gearbox fails, there is little evidence of the cause. Recent work suggests that the prevailing drivetrain failures initiate at critical bearings of the gearbox. Through a Department of Energy funded project, Professor David Burris is working with the Gearbox Reliability Collaborative (GRC) formed by the National Renewable Energy Laboratory to improve gearbox reliability. In the Materials Tribology Laboratory, Burris is targeting the failure mechanisms of these bearings to gain better insights into the tribological aspects of drivetrain reliability.

Researchers in Burris' laboratory are conducting small-scale failure experiments under controlled laboratory conditions to better understand the roles of lubricant degradation, particulates and corrosion under conditions that promote fatigue (high load, low speed) and scuffing (low load, high speed). Laboratory results will be scaled up to identify potential 'weak links' in the design of the G90 and offer improved drivetrain design strategies.

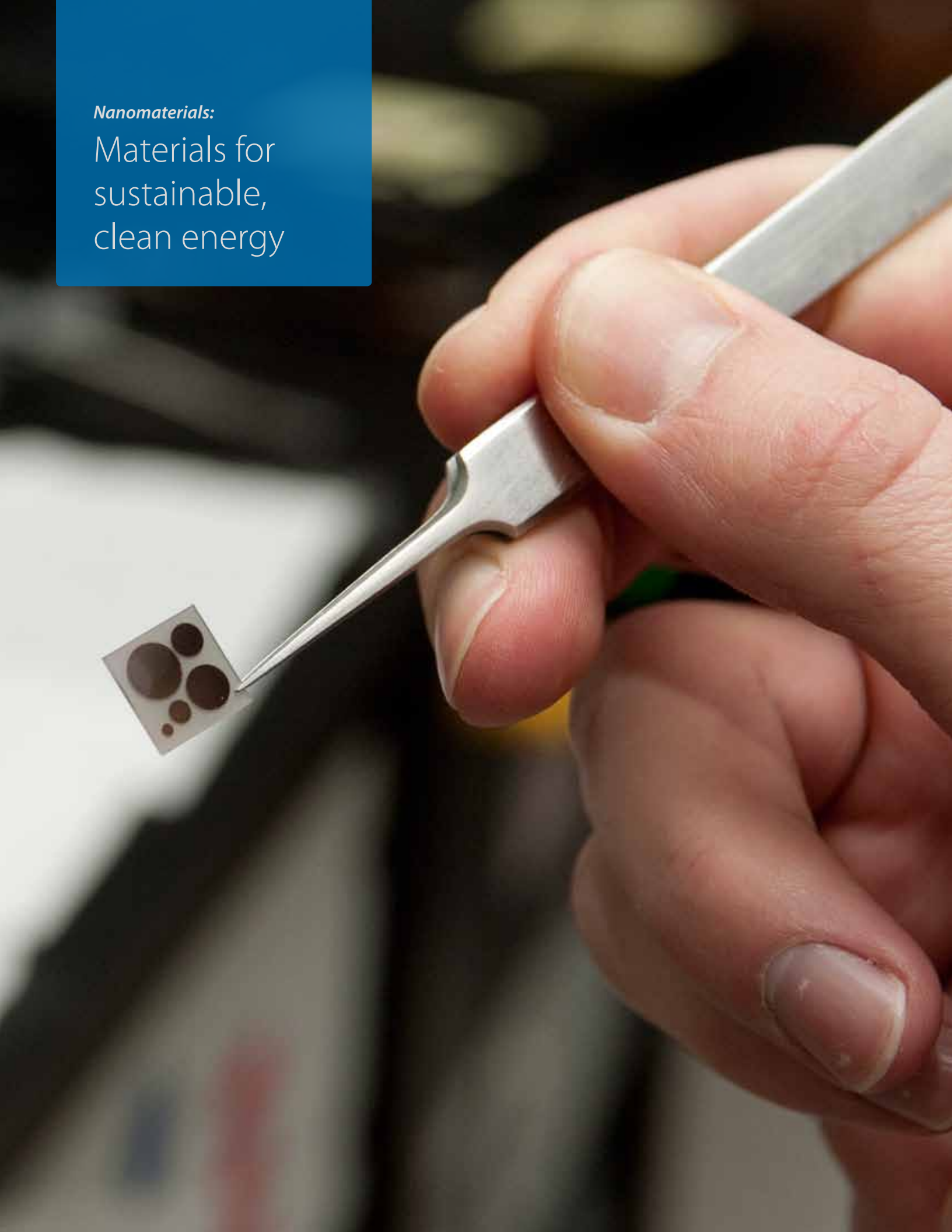
Optimal spacing of turbine arrays

Turbines in an offshore array can number in the hundreds. Typically laid out in a regular grid pattern, the lateral and longitudinal spacing between individual turbines within the array require careful consideration to minimize the effect of the wake, or region of deficit of velocity and kinetic energy power reduction, an upstream turbine can have on a downstream turbine. UD researchers have modeled the flow downstream of a single wind turbine as a turbulent axisymmetric wake using well known scaling laws to compute the wake diameter, wake velocity defect and wake power recovery as functions of downstream distance from the rotor. These results show that the power recovers quickly for small downstream distances, but beyond approximately 10 rotor diameters, power recovery slows. These findings explain why the offshore wind farm community has settled on 10 rotor diameters as a suitable longitudinal spacing.

Ocean current energy using tethered turbines

To capture the substantial power created by flowing seawater, which has potential as a source of electric power generation, UD researchers have helped design an underwater array of ocean current turbines that can be tethered to the ocean floor. The turbines "fly" like kites in the ocean current at heights determined by the weight and buoyancy of the turbine, the lift and drag forces that are acting upon it, and the length of the tether line. The design includes a full assessment of all the forces acting on the turbine and the tether, as well as optimization of the tether material and the anchor.

By Suresh Advani, George W. Laird Professor and David Burris, Assistant Professor



Nanomaterials:

Materials for sustainable, clean energy

Certainly one of the biggest challenges in today's world is sustainably harvesting, transporting and efficiently using energy. Mechanical engineering, with a traditional focus on thermodynamics, heat transfer and machine design, is well poised to respond to these concerns.

Researchers in UD's mechanical engineering department are also using another traditional focus area—materials development and processing—to address the growing need for unique materials, especially nanomaterials, for fuel cells, batteries and supercapacitors.

New fuel cell materials

Assistant Professor Joshua Hertz is focused on developing new materials for solid oxide fuel cells. Solid oxide fuel cells [SOFCs] work by electrochemically oxidizing a fuel, transforming chemical energy directly into electricity. Since they can efficiently operate from complex fuels, including biofuels, they are anticipated to become a highly important sustainable energy technology. Currently, the solid electrolyte component provides poor low-temperature oxygen ion conductivity and the kinetics of the electrochemical reactions at the electrodes are insufficient. These difficulties require operation at temperatures in excess of 800 degrees Celsius. Such high temperatures necessitate slow startup and shutdown procedures, exotic gas-sealing techniques, expensive components to house the cell itself and a limited lifespan, making SOFCs cost prohibitive to commercial production.

In work recently funded by the Department of Energy Office of Basic Energy Science, Hertz and his research team are creating electrolytes from multilayers of materials—with layer thicknesses of just a few nanometers (about one-hundred-thousandth the width of a human hair)—in order to strain the atomic lattices. Hertz expects that strain can improve oxygen ion conductivity, a critical parameter in improving the energy output of solid oxide fuel cells and other devices based on solid electrolytes at lower temperatures. A few groups have shown that strain can affect the ease with which ions move in solids, but Hertz' research includes a very systematic study to fundamentally understand how these effects can be used to improve the mobility of oxygen ions.

Novel applications for carbon nanotubes

The use of carbon nanotubes and similar nanostructures within energy-related devices is the focus of Associate Professor Bingqing Wei's research. According to the U.S. Department of Energy, lighting accounts for roughly nine percent of domestic electricity usage, and thus more efficient lighting technology can considerably impact nationwide energy usage. Wei's research group received worldwide attention—including mention in both *Nature* and *Science*—for work demonstrating that conventional incandescent light bulbs can be made much more efficient by replacing the tungsten filament with one made from strands of carbon nanotubes.

Wei's group has also focused recently on novel, inexpensive processing techniques to fabricate carbon nanotubes, as well as the use of carbon nanotube macrofilms for electrodes for batteries and supercapacitors. Electrochemically, the macrofilms can provide high performance because of the extremely high active surface area at which ions can adsorb. Perhaps just as important, the meshed, stranded nature of the films provides the ability to deform without losing electrical connectivity. Taking advantage of this, Wei's group has recently published on stretchable capacitors and lithium-ion battery electrodes that maintain their electrochemical capacity despite volumetric changes exceeding 400% during lithium insertion and removal.

Advancing polymer fuel cells

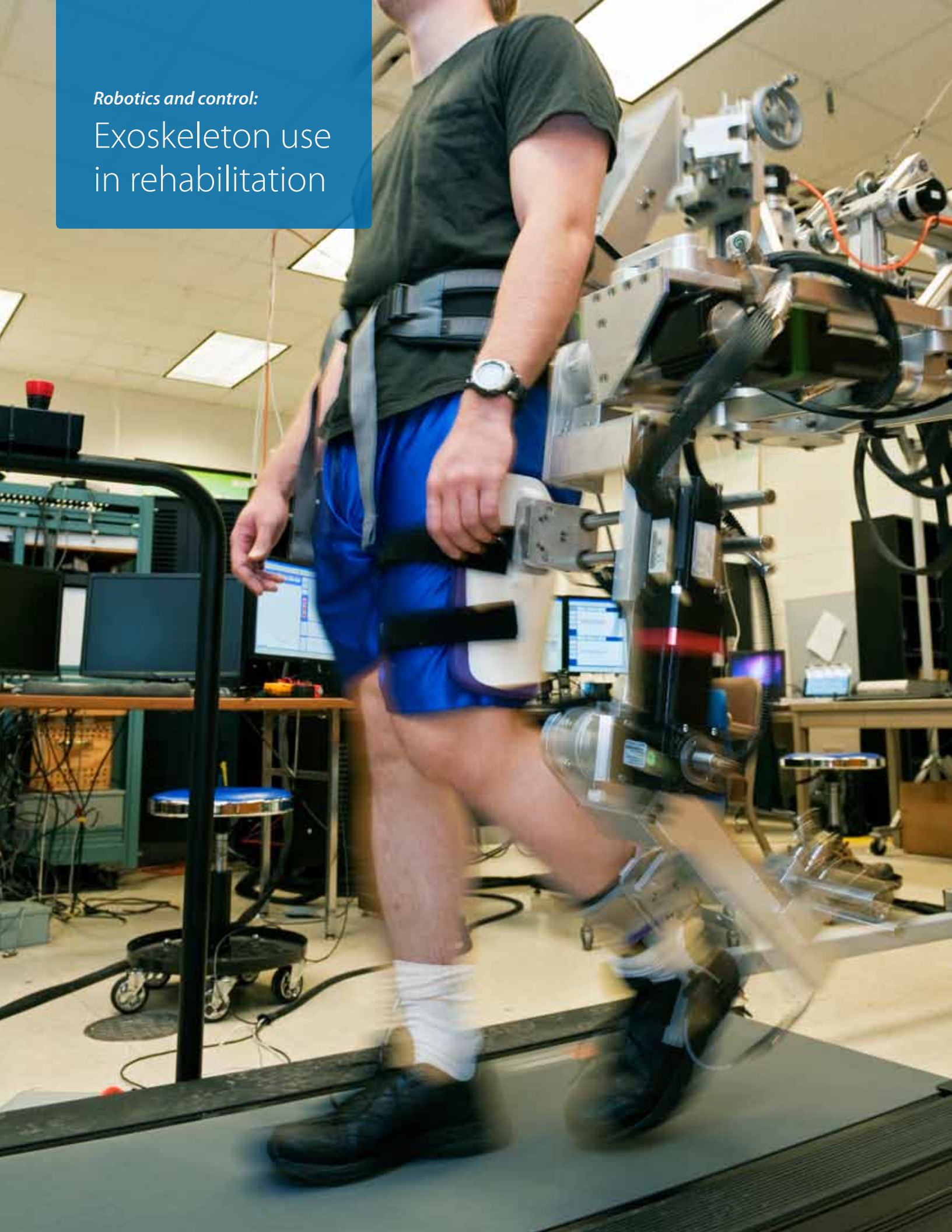
Lastly, a strong effort of the department is in materials development for polymer fuel cells. Professors Karlsson, Santare, Prasad and Advani have worked closely with industry to examine the mechanical properties of polymer electrolytes under varying environmental conditions. This work will be especially important if cars powered by polymer fuel cells are expected to perform in the wide range of temperatures and humidities found year-round across the U.S.

In addition, Professors Prasad and Advani have researched new metal foams and photolithographically patterned metal foils for improved gas diffusion layers. Working with surface chemists, the group has also determined the reasons for catalyst degradation within the electrodes of working fuel cells.

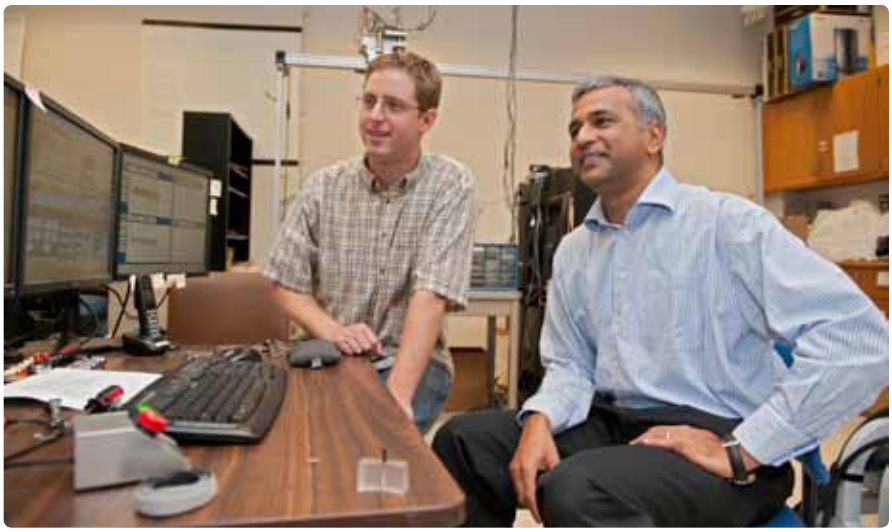
By Joshua Hertz, Assistant Professor

Robotics and control:

Exoskeleton use in rehabilitation



Applications of dynamics and control range from manufacturing to medical rehabilitation, from vibration damping in aircraft to the assembly of satellite parts in outer space. As manufacturing processes become more complex and the performance of electromechanical systems becomes more demanding, the area of dynamics and control continues to grow and become more challenging. When applied in medicine, robotics and mechatronics have the potential to assist in rehabilitation due to their sensing and actuation capabilities.



Researchers in a group led by Professor Sunil K. Agrawal are advancing the development of robotic exoskeletons for gait training of the movement impaired. The research, funded by the National Institute of Health's Bioengineering Research Partnerships program, shows promise in helping chronic* stroke survivors regain leg function and improve walking ability using a virtual biomechanics training environment.

Many stroke survivors develop compensatory strategies to overcome functional losses in knee flexion or dorsiflexion of the ankle on the affected side. The result is often a shallow foot path and/or poor balance, which can eventually lead to secondary compensations like back pain, muscle strain and joint pathology that further impair a person's natural movement.

Using an actively driven leg exoskeleton (ALEX) that can modulate foot movement using motors at the joints, or a gravity balancing un-motorized orthosis (GBO) designed to alter gravity at the hip and knee joints, can help study subjects overcome learned compensation techniques by moving through a preselected footpath with a built-in window of variability selected by the trainer. The robotic device corrects movements outside the desired window using an elastic resistance.

ALEX II is the latest device designed and fabricated by the University of Delaware research team. Like its predecessor, ALEX II applies torques at the hip and knee joints of users.

Neither the weight of the leg or back support is born by the subject, but instead the back support provides configuration independent gravity compensation for the device. The unilateral exoskeleton leg can be modified easily to accommodate users with either a left or right paretic leg. Several adjustments within the exoskeleton leg can also be made, to improve fit to the user.

Three adjustable prismatic joints adjust to the subject's pelvic width, thigh length and shank length, providing an additional degree of freedom and allowing rotation about a vertical axis through a parallel linkage system. This allows for medial and lateral rotations of the leg, with those rotations taking place along the longitudinal axis of the leg.

A dSPACE 1103 control system is used to implement the real time controls and all data collection. The low-level controller is designed to accommodate for gravity and drive train friction. Control is managed by torque regulation. When walking in the exoskeleton, but without the force field, the system regulates the torque at each joint to be zero. During gait training, torque control is determined by modeling a virtual spring.

Each shoe worn by the subject is instrumented with three pressure sensors, mounted at the heel, ball and toe of the foot. These provide data about foot contact with the treadmill, while two ATI6 Mini-45 six degree of freedom force-torque sensors mate the exoskeleton to each orthotic. Data collected includes foot speed, joint motion, toe clearance and other factors that impact walking, which aid researchers in measuring if improvements are retained over time.

Over 700,000 people suffer strokes each year and as many as 3 million survivors are living with its after-effects, providing a wide market for impact of this landmark technology.

In addition to robotic exoskeletons, Agrawal's research team has also developed novel robotics for neuro-motor training and assistance, including pediatric mobile robots, arm exoskeletons, wheelchairs and walkers.

*The term chronic, when applied to stroke survivors, refers to those who are six months past their brain insult.

By Sunil Agrawal, Professor

7th annual ME Alumni Career Celebration and Reunion set for Alumni Weekend, June 3-5

Reconnect with classmates and faculty for an educational afternoon followed by complementary refreshments and networking. Continue the celebration on campus with fellow Blue Hens for a weekend filled with programs and activities.

ME will host its 7th Annual Alumni Career Celebration and Reunion at the Roselle Center for the Arts on Friday, June 3, from 12:00-6:30 p.m. Continuing its tradition of cutting-edge topics, this year's event will feature presentations on alternative energy for transportation. Attendees will have an opportunity to hear about the current state of alternative energy research and the economic implications of alternative energy vehicles. In addition, the celebration provides classmates and faculty an opportunity to reconnect, socialize and discuss engineering career perspectives.

Anette Karlsson, department chair, will kick off the afternoon with a welcome and overview of department activities and ongoing research. Following the presentations, the department will honor four new recipients of the Distinguished Career Award.

"As with past years, we have a select group of very qualified recipients receiving awards," said Bill Wagamon, who leads the selection committee.

"This year's recipients represent diverse fields such as law, solar power, steel and plastics manufacturing, and pharmaceuticals. We're very excited to honor them with this award prior to the start of Alumni Weekend."

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ME Program highlights

Broad Overview of Technology and UD ME Research in Alternative Energy for Transportation
Professor Ajay Prasad | University of Delaware

Battery Engineering in the Transportation Industry
Professor Ann Marie Sastry | CEO of Sakti3
Arthur F. Thurnau Professor | University of Michigan

Alternative Energy and Fuel Cell Research at General Motors and its Application to the Chevy Volt and Future Vehicles
Dr. Balsu Lakshmanan | General Motors

Fisker Automotive Development and Production of Electric Powered Cars: An Eye on Delaware and the World
Frank Faga | VP of Manufacturing, Fisker Automotive

Distinguished Career Alumni will be honored June 3

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College of Engineering events

Engineering Alumni Association Golf Tournament
Friday, June 3, 7:00 a.m.–1:30 p.m.
Deerfield Golf & Tennis Club

College of Engineering Alumni Reception
Friday, June 3, 6:00–8:00 p.m.
DuPont Hall

Women in Engineering Panel Discussion
"Forging a career with an engineering degree"
Saturday, June 4, 10:00 a.m.–12:00 p.m.
Center for Composite Materials Conference Room

Register and view a complete list of events:
www.UDconnection.com/AlumniWeekend

Mechanical Engineering
ALUMNI COUNCIL

Newly reformed chair's council holds meeting

On November 3, 2010, ME held its first meeting of the newly reformed Mechanical Engineering Chair's Council (MECC) comprised of alumni who are leaders in business and government. Through collaborative efforts between MECC, the department chair and faculty, the group's overall mission is to strengthen the Department of Mechanical Engineering, while shaping and supporting its strategic objectives and goals.

"This is a perfect time to reestablish the council," said Anette Karlsson, department chair, "and I'm very pleased that we were able to form a group consisting of all these very impressive leaders. The department has seen record growth in student enrollment and research funding, and guidance from the council members will help us advance to the next level."

"Members enjoyed learning about the department, its growth and future plans, as well as its challenges," said Armand Battisti, director of development, who has been assisting in forming the group. "Most members remarked how much the department had changed in size, scope and research focus. The meeting included some free time for members to share information about themselves and their careers, while also providing an opportunity for needed insight and outreach in support of the department's efforts to train leaders in the mechanical engineering field."

The council will meet annually and members serve two-year terms, advocating the department's programs and activities. "It is important for me," Karlsson added, "to get input from individuals that have a broad range of experience in both industry and government. I am delighted and grateful for the dedication of the council members and look forward to working together in achieving our mission."

The council's new members are:

Ellen Fletcher Benedict, BME '75
Director | Strategy & Business Programs, Philips Healthcare

Paul N. Costello, BME '66
President | Evergreen MGT Consulting

John C. Gooden, BME '88
Vice President | MDavis, Inc.

Daniel S. Hudson, BME '82
Regional Director | Panattoni Development Company

Thomas J. Itchkawich, BME '83
Senior Program Director | Orbital Sciences Corporation

James R. Laser, BEA '69
Consultant | Whitney Consulting, Inc.

Douglas B. McKenna, BME '82
CEO, VP Technology | Micropore, Inc.

John S. Thackrah, Jr., BME '79
Executive Director | U. S. Navy Military Sealift Command

Alumni council member Q&A

Ellen Fletcher Benedict, BME '75

Ellen Fletcher Benedict is director of Strategy and Business Programs, Global Oncology Care for Philips Healthcare. After completing her bachelor's degree in mechanical engineering at UD, Benedict earned her master of science in biomedical engineering from Rensselaer Polytechnic Institute (RPI). Her 20-year career in the medical device industry includes roles in development and clinical research engineering, product management and strategic marketing. Benedict has been involved in developing cardiac assist devices, cardiovascular ultrasound systems, a spectroscopic system for the detection of cancer and surgical endoscopy systems.

Benedict is a member of the newly reformed Mechanical Engineering Chair's Council. She attended the group's first meeting held November 3, 2010 and said the meeting "provided a great opportunity to talk with undergraduate and graduate students." She added, "I was very impressed with the students' enthusiasm for their research projects and for the University. I'm pleased my fellow council members represent a broad spectrum of career paths and industries, and I look forward to working with them, Dr. Karlsson and mechanical engineering faculty and students to help guide and support the department's strategic objectives and goals."

How has your UD experience and education helped to shape your career?

I developed fundamental skills that have served me well in both technical and business-oriented roles. It also provided the opportunity to explore a new discipline of engineering that became the foundation for my career. Mechanical engineering fostered an interest in biomedical engineering, which led me to pursue a master of science at RPI and a career in the medical device industry. As I transitioned from engineering roles in product development and clinical research to business roles in strategic marketing and business development, it required an analytical approach to problem-solving, understanding complex new technologies and the ability to work collaboratively with engineering professionals on multidisciplinary teams.

What do you remember most about your undergraduate experience? Were there any specific people of influence from your college days?

I especially remember four professors who guided and mentored me at UD. Jack Vinson provided encouragement and support as my faculty advisor, Herb Kingsbury provided opportunities that developed my interest in biomedical applications, including an orthopedic biomechanics course he team taught with an orthopedic surgeon, and Tsu Wei Chou and Wally Walters were great teachers who laid the foundation for a stimulating and enjoyable educational experience.

What do you think can be done to increase opportunities for women to pursue engineering degrees and what opportunities exist for professional women engineers?

We need to expose young women, as well as young men, to engineering at an early age. In my town of Andover, Massachusetts, public school curriculum includes a hands-on engineering class for all three years of middle school. I've had the opportunity to work with students on the design and construction of a prosthetic arm and it was great to see girls as engaged as boys.

It's important for young men and women to view engineering as a "gender neutral" profession. In an era when women engineering students were still something of a novelty, I always felt accepted as an equal to male engineering students and faculty. I had the confidence to take a position in an industrial research and development organization when I graduated, and also to pursue a graduate degree in my engineering field of interest.

Finally, it's important for women to see female role models in industry. At Philips, I've known women who advanced through research and engineering functions to positions of vice president and general manager of business units and research laboratories.

Ann Massey Badmus BME '84

Ann Massey Badmus launched her private law practice specializing in immigration law in 1993. Representing clients worldwide on a broad range of immigration issues, she is a nationally recognized immigration law expert who has been featured prominently in numerous business publications and was recognized in 2009 as an Outstanding Minority Business Owner in northern Texas.

Badmus credits her UD education with preparing her for a successful law career.

"The challenging mechanical engineering curriculum gave me the discipline to attend law school while working full-time and to work the long hours that come with a law career," she said. "I represent numerous engineers and scientists who qualify for permanent residence (green card) based upon their scientific contributions to the U.S., and I believe my engineering background helps me accurately present their highly technical information as I advocate for these clients."

After earning her bachelor's degree in mechanical engineering from UD in 1984, Badmus worked for Delmarva Power as a distribution engineer designing electrical power distribution lines throughout Delaware, while also pursuing her law degree.

"While working at Delmarva Power, I realized how law influenced everything including engineering design," explained Badmus. "I investigated law as a career path and decided to give it a try. Once in law school, I knew law was the career for me."

She graduated from Widener University School of Law, obtaining her juris doctor degree in 1989 and began her new career at the commercial law firm of Ashby & Geddes in Wilmington, Delaware. While at Ashby & Geddes, she helped numerous businesses to comply with corporate laws and also tried many cases regarding business issues.

Today, Badmus is active in her community giving talks about immigration and teaching continuing education classes. She has written numerous published articles about immigration and a book on immigration for physicians entitled "Immigration Prescription: The Practical Guide to US Immigration for Foreign Born Physicians."

Mark E. Conroy '80

Mark Conroy is president and CEO of MegaWatt Solar, an iEnergies portfolio company. Headquartered in Hillsborough, North Carolina, the company delivers solar power generation systems to the utility market. Conroy joined iEnergies as operating officer in 2008 after 28 years as an executive in global sales, service and operations at General Electric. Conroy serves on the Board of Directors for the Solar Energy Industries Association.

Conroy earned his bachelor's degree in mechanical engineering at UD in 1980, with an emphasis on solar energy. "My early interest in alternative energy and solar led me to study in this area and to perform my senior research project in this segment," he explained. "This interest in energy generation led to a 30-year career in the energy field and then right back to solar as this industry began to gain global traction in recent years. UD provided me with a solid foundation for professional growth. My engineering background enables me to look at a problem objectively and pragmatically. I then apply the business skills that I learned both at UD and at GE to set the proper direction for the business."

After joining General Electric's Technical Marketing Program, Conroy held several leadership positions including lead customer service manager—New England for GE Power Generation Services, nuclear services executive for GE Nuclear Energy, region service director for GE Power Systems in North Asia, region sales executive for North Asia covering China, Korea, Taiwan, Guam and the Philippines and power systems executive & general manager for GE Structured Services. In 2006, he was named general manager of GE Solar Technologies located in Newark, DE.

Conroy also conceived the creation of a solar-powered water filtration system that GE developed following the 2004 Asia Tsunami. "I felt that GE needed to develop a product to aid in the relief of all of the people who were affected by this terrible disaster where potable water was going to be a critical issue," he said. "It was a complex effort with health and safety concerns. Relief efforts included a number of global GE units from Germany, Pennsylvania, New York and Delaware."

Recalling his UD undergraduate experience, Conroy said his fond interest in automobiles led him to participate in the mini baja design project and competition as the project leader. "My interest in solar fueled my participation in several projects and studies under Dr. Karl Boer," he added. "I made many great friends that I still connect with today."

Distinguished Career Awards

Four distinguished alumni will be honored at Alumni Weekend on June 3, 2011. Alumni are selected for recognition based on several criteria, including achievement, impact, uniqueness and interest.

William H. Lotter, Jr. '56

William H. Lotter completed his bachelor's degree in mechanical engineering in 1956. He went on to have a diverse career encompassing the paper, plastics and steel industries. Lotter was one of the founding members of Delaware Manufacturing Extension Partnership's Board of Directors and served as chairman of the board for several years. He was also a member of the Manufacturing Committee of the State Chamber of Commerce.

"Besides the technical education I received at UD, the engineering curriculum taught me discipline and problem solving," said Lotter. "Both can be effectively utilized in practicing engineering and management positions." His breadth of experience covered all disciplines involved with engineering, manufacturing and executive positions—and most notably, training, management and proactive involvement of associates. "Having your associates involved in problem solving and decision making fosters teamwork," he said. "Don't be afraid to take calculated risks."

The majority of his career was in small to medium size, growth-oriented manufacturers. Lotter engineered the start-up of Specialty Composites Corporation, a manufacturer of polyurethane foam products utilizing a patented thin sheet casting process. During his 22 years at Specialty Composites, Lotter designed and installed the initial production equipment, while increasing sales and profits steadily. He held positions as director of engineering, director of operations, and then became president and chief executive officer. He left Specialty Composites to become vice president and general manager of Insteel Industries. Transitioning Insteel from a financial loss position to a profitable wire mill, Lotter retired after seven years with the company.

Lotter enjoys staying active in his community. In Delaware, he was a member of the City of Newark's Board of Elections. In Pennsylvania he was involved in local civic associations, public library and the Kennett Symphony. "Get involved and give back to the community," he said. "Your career experience and problem-solving ability will help in your involvement and will be much appreciated."

Paul H. Norton '80

Paul Norton is vice president of Business and Platform Development for West Pharmaceutical Services Inc., a leader in developing products to enhance pharmaceutical administration and improving health care worldwide. He is responsible for establishing new business and product development support for an electronic drug delivery system that improves patient quality of life with less painful, less frequent injection therapy.

Norton earned his bachelor's degree in mechanical engineering at UD in 1980, and his master's degree in management with a concentration in business administration from Pennsylvania State University in 1992. He is the sole or primary inventor on six patents and contributing inventor on a seventh. Patents are in the field of transferring object into barrier isolators and medical devices. Other patents in the area of novel medical devices are pending.

"Being successful in the engineering field is a team effort," he said. "During my experience at UD, I had the opportunity to work with smart, talented future engineers. Apart from being loads of fun, this was a great foundation for the multidisciplinary collaboration that I have been fortunate to have in my career."

Norton joined the West Company in 1986 as a process engineer. During the last twenty-five years with the company, he held various engineering and management positions. Prior to joining the West Company, Norton independently established a complete peanut processing plant in Egypt while working for Proctor Schwartz as a field service engineer.

In 2010, Norton sponsored a senior design team of mechanical engineering students. The team designed a needle alignment system for an "intra-dermal" injection device currently under development at West.

"The team needed to learn the 'real life' lessons of dimensional tolerances and apply creative solutions considering the special requirements of sterility and patient/device interaction," explained Norton.

"What I remember most from my undergraduate experience is Dr. Zimmerman's and the ME program's capstone project of building a 'mini baja' vehicle from scratch," he said. "I also recall spending 40 hours a week in the machine shop and learning that technicians are also talented and valuable in getting projects done."

The Department of Mechanical Engineering proudly recognizes its growing team of faculty

Meet eight talented assistant professors who recently joined and complement the department's already distinguished faculty. Continued growth will enable ME to address some of the greatest engineering challenges including advanced materials, health care, sustainability (energy and the environment) and national security.

2010 AFOSR Young Investigator Award Recipient

DAVID L. BURRIS

Ph.D. '07 • UNIVERSITY OF FLORIDA

David is interested in understanding the fundamental phenomena responsible for friction and wear during sliding contact. His research activities are diverse and include design of novel experimental instrumentation, development of in-situ methods for observing the buried interface, design of nanocomposite and multifunctional materials, multi-scale measurements (nano-macroscale contacts), response modeling and performance forecasting. His research currently targets challenges in space lubrication, wind energy and bio-lubrication.

JOSHUA L. HERTZ

Ph.D. '06 • MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Joshua's research focuses on the development of new nanomaterials for renewable energy, primarily solid oxide fuel cells. He is also interested in advanced batteries, polymer fuel cells and hydrogen generation. He has a special interest in fabrication of ceramic nano-composites with improved performance and new characterization methods that can measure the macro- to nano-scale transport properties of these materials.

XIN "LUCAS" LU

Ph.D. '07 • COLUMBIA UNIVERSITY

To understand the etiology of osteoarthritis and osteoporosis, Lucus is investigating the mechanotransduction at both molecular and cellular levels using microscopy techniques, nanotechnology and computer modeling. He hopes his efforts will uncover new therapeutic interventions to mitigate or treat these diseases. His research focuses on the mechanobiology in the musculoskeletal system, specifically how cartilage and bone cells sense mechanical forces generated during physical activity and transfer these signals into orchestrated cellular activity.

2008 NSF CAREER Award Recipient

HERBERT G. TANNER

PH.D. '01 • NATIONAL TECHNICAL UNIVERSITY OF ATHENS

Bert's research interest lies in cooperative control of multi-robot systems. He is interested in designing algorithms with provably correct and predictable behavior that coordinate robots to work as a team and perform, as a group, tasks they cannot do alone. He is often inspired by biology, especially collective animal behaviors such as flocking, schooling and swarming. Mobile robotic networks engineered based on this technology can be applied to search and mapping, distributed pattern recognition, autonomous navigation, cooperative behavior planning and reconnaissance and surveillance.

IOANNIS POULAKAKIS

Ph.D. '08 • UNIVERSITY OF MICHIGAN

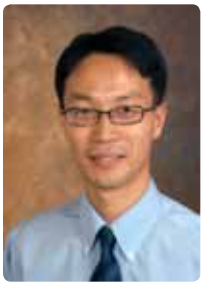
Ioannis' current research interests are in the application of nonlinear control theory in biologically inspired legged robots. On a macroscopic level, locomotion on land can be understood through archetypal reductive models capable of capturing the targeted behavior, e.g. running. The coordinated recruitment of the robot plant into such "target" models constitutes the central problem addressed in this work, which aims at offering a mathematically precise feedback control methodology for synthesizing controllers for legged robots.

2009 AFOSR Young Investigator Award Recipient

ERIK T. THOSTENSON

Ph.D. '04 • UNIVERSITY OF DELAWARE

Erik's research focuses on processing and characterization of composite materials composed of carbon nanotube and advanced fiber reinforcements. He has developed new techniques for the development of structure/property relationships in novel multifunctional composites including nanotube-reinforced polymer and ceramic composites. His current research focuses on sensors and actuators based on carbon nanotube composites with applications in structural health monitoring.



2009 NSF CAREER Award Recipient

JONGHWAN SUHR

Ph.D. '05 • RENSSELAER POLYTECHNIC INSTITUTE

Jonghwan's research interests include energy-absorbing composites, lightweight multifunctional composites, structural health monitoring and bio-inspired material systems. An advocate of interdisciplinary research, his work focuses on composite materials, mechanical engineering, aerospace structures and bio-mimetics that impact structural applications to stimulate scientific discovery, support novel material development, advance future aerospace technologies, facilitate technology transfer and enhance student learning.

LIYUN (LEANN) WANG

Ph.D. '02 • CITY UNIVERSITY OF NEW YORK

Liyun's research interests are bone and cartilage biomechanics. Her research seeks to address the fundamental question of how mechanical forces influence the normal function and pathology of the musculoskeletal system. Liyun combines cutting-edge technologies in engineering, biology and imaging to investigate molecular transport dynamics and cell-cell signaling. She hopes to advance understanding of osteoporosis and osteoarthritis and improve their diagnosis and treatment.

Buchanan directs Delaware Rehabilitation Institute

BY DIANE KUKICH

Thomas S. Buchanan, George W. Laird Professor of Mechanical Engineering at the University of Delaware, is now director of the Delaware Rehabilitation Institute (DRI).

The mission of the new institute is to find innovative and improved ways to help people recover from injury and disease by bringing together biologists, clinical scientists, engineers and policy experts to critically address the issues faced by those with disabilities.

"Tom Buchanan brings tremendous skill and expertise to the Delaware Rehabilitation Institute," said University Provost Tom Apple. "He has been a top researcher in the area of biomechanics and has a great history of collaboration. He's a proven leader in establishing research teams and interdisciplinary research-based programs."

Buchanan sees Delaware as having a unique strength in rehabilitation sciences. "We have more than 50 faculty members in five colleges and ten departments here at UD doing research in this area," he said, "with over $15 million a year in external funding. This is a really exciting opportunity to promote the great work that's already underway and bring it all together to raise Delaware to a position of national prominence."

DRI will be an important component of UD's growing health sciences presence in fields including biology, biomedical engineering, physical therapy, applied physiology, nursing and others.

"The work at UD ranges from subcellular-level research to the development of physical therapy approaches to policy and community engagement," Buchanan said. "We have multidisciplinary programs in a number of areas, including osteoarthritis, stroke, pediatrics and rehabilitation robotics. And our partners in the Delaware Health Sciences Alliance will provide important clinical support for our research."

DRI will initially have administrative space in UD's McDowell Hall, with plans to locate the institute and core research facilities at the former Chrysler site over the next five years. "These shared core labs will be multidisciplinary and will include biologists, engineers and clinical researchers all working together," Buchanan said.

"I look forward to working with Tom to establish DRI as one of our leading interdisciplinary research institutes along the Path to Prominence™," said Mark Barteau, senior vice provost for research and strategic initiatives. "With the Delaware Health Sciences Alliance and the NIH INBRE program, DRI will boost our research, education and outreach programs in the health sciences to a new and exciting level for UD."

The 2008 recipient of the E.A. Trabant Award for Women's Equity, Buchanan is credited with playing a key role in the increase in women faculty in engineering at UD and with engaging his female colleagues in collaborative research.

Buchanan earned his doctorate in theoretical and applied mechanics from Northwestern University. He joined the UD faculty in 1996, served as chair of the Department of Mechanical Engineering from 2004 to 2008, and was appointed deputy dean in the College of Engineering in 2008. He has also served as academic director of UD's interdisciplinary Biomechanics and Movement Science Program and director of its Center for Biomedical Engineering Research.

He is president of the American Society of Biomechanics and a fellow of the American Society of Mechanical Engineers, the American Institute for Medical and Biological Engineering and the American College of Sports Medicine.

"[Buchanan is] a proven leader in establishing research teams and interdisciplinary research-based programs."

—Tom Apple

As deputy dean of engineering, Buchanan spearheaded the creation of the new biomedical engineering bachelor's degree program. He also initiated and coordinated cluster searches within the college.

"These contributions represent the achievement of major goals for the college in strengthening our undergraduate programs and in allowing us to focus our faculty hiring in strategic areas," said engineering dean Michael Chajes. "We greatly appreciate Tom's contributions as deputy dean over the past two years, and we look forward to continued collaborations with him in the area of rehabilitation science."

Chou sought after as international lecturer on nanocomposites

Tsu-Wei Chou, Pierre S. du Pont Chair of Engineering at the University of Delaware, is in high demand as an expert on nanocomposite materials, delivering six invited lectures in Asia, South America, Europe and the United States in 2010.

Nanotechnology is an active research area, says Chou, with implications in aeronautics and biotechnology, among other things. He views lecturing as an important way to elevate the work done by UD researchers.

"I am very pleased to have the opportunity to enhance the University of Delaware's visibility at scientific, technical gatherings. It is the best forum to share our research findings with our colleagues in nanoscience and nanotechnology worldwide," explained Chou.

Chou was a plenary speaker at the 7th Asian-Australasian Conference on Composite Materials in Taipei, Taiwan on Nov. 16, where he discussed the hierarchical structural levels of carbon nanotubes used in composites and summarized the challenges and opportunities in basic research of these materials. The biannual conference brought together over 700 attendees from 23 countries.

He shared results of his exploratory research using carbon nanotubes as a tool for sensing damage in multifunctional fiber composites during a keynote address at the 2010 Annual Conference of the Materials Research Society of Taiwan, attended by 1,100 researchers.

Carbon nanotubes, with their extremely small size and unique electrical conductivity, can be used to penetrate the regions around the fibers and between the layers of composites and form an electrically conductive network, said Chou.

The carbon nanotubes act as sensors in situ, providing a quantitative measure of the onset and accumulation of matrix damage and the effectiveness of self-healing in fiber composites. Research in this area enhances our capability in monitoring the integrity of fiber composites in their structural applications.

Chou also gave invited lectures at the 2nd International Conference on Nanomechanics and Nanocomposites in Beijing, China; the Minerals, Metals & Materials Society (TMS) 2010 Annual Meeting in Seattle, Washington; the 2010 Materials & Surface Science Institute Distinguished Lecture at the University of Limerick in Ireland; and the first joint materials conference of TMS (U.S.) and ABM (Brazil) in Rio de Janeiro, Brazil.

"Dr. Chou has been invited to give an exceptionally high number of plenary sessions this year at international conferences, which attests to his worldwide recognized research," said Anette Karlsson, chair in the Department of Mechanical Engineering.

A long-time faculty member in the Department of Mechanical Engineering and well established researcher, Chou has devoted much of his forty-year career to studying process-structure-property relationships in fiber composites.

In 2000, he began studying the potential application of tiny carbon tubes called 'nanotubes'—which measure from less than one to a few nanometers (one billionth of a meter) in diameter—in structural and functional materials. Today, Chou's work is advancing scientific and engineering knowledge of material behavior across length scales from the atomistic to macroscopic levels.

"Dr. Chou has been invited to give an exceptionally high number of plenary sessions this year at international conferences, which attests to his worldwide recognized research."

—Anette Karlsson

Chou is a fellow of six professional societies in mechanical engineering. He has authored over 300 archival journal papers and book chapters, as well as several books. He is recognized by The Thomson Institute for Scientific Information (ISI) as one of the "Highly Cited Researchers" in the world.

Interdisciplinary Science & Engineering Lab

Home for UD's Institutes/Centers in Energy, Environment and Policy

Projected Completion: Fall 2013 | www.udel.edu/iselab

Scheduled for completion in 2013, the University of Delaware's Interdisciplinary Science and Engineering Laboratory (ISE-Lab) will bring together teaching, learning and research in an integrated way, with the research providing content for the curriculum that cultivates discovery learning through the exploration of real-world problems.

FRONT

CLEAN ROOM

CONFERENCE ROOM

CLASSROOM

LOCATION

Cloud physics workshop stimulates new approaches to multiscale problems

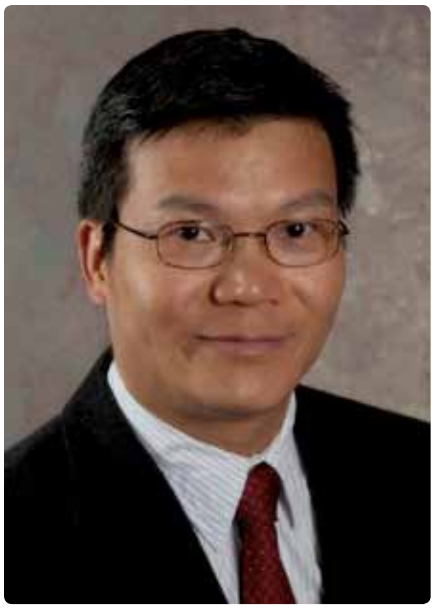
Over 50 people representing seven institutions exchanged ideas on multiscale computing of cloud physics at a workshop held August 16–17, 2010.

The workshop, hosted by the University of Delaware with support from the National Science Foundation (NSF), brought together experts in cloud physics, turbulent multiphase flows, applied mathematics, computer engineering and computer science to discuss interdisciplinary research issues related to the cloud physics.

The effort is the result of a collaborative project between UD and the National Center for Atmospheric Research (NCAR) in Boulder, Colorado. Funded through NSF's Accelerating Discovery in Science and Engineering through Petascale Simulations and Analysis (PetaApps) program, the project is developing tools and simulation models to couple large-eddy simulation of cloud dynamics and direct numerical simulation of cloud microphysics on upcoming petascale computers. This information can then be used to develop cloud physics parameterization for next-generation weather and climate models.

"Clouds play an essential role in the weather, the hydrological cycle and the earth's climate system," said Lian-Ping Wang, UD professor and principal investigator for the project. "We wanted to encourage dialogue among investigators within the project team and researchers from various disciplines to stimulate new ideas and approaches for multiscale problems."

Invited speakers included Raymond Shaw and Jeffrey Marshall. Shaw, a cloud physicist from Michigan Technological University, explained the nature of multiscale interactions and turbulent fluctuations in clouds from observational perspectives. Marshall, a professor at University of Vermont, discussed complex physical issues and a wide range of applications of adhesive particles in electric fields.



Lian-Ping Wang

Scientific exchanges such as this are expected to continue as high-performance computing is now recognized as the third pillar, in addition to the traditional theoretical and experimental approaches, in supporting innovation and discovery in science and engineering.

Bone research at UD recognized by Orthopaedic Research Society

ADAPTED FROM UDAILY STORY BY DIANE KUKICH

Christopher Price, research assistant professor in the Department of Mechanical Engineering, won the Orthopaedic Research Society's New Investigator recognition award for his groundbreaking work on fluid flow in bone.

Co-authored with Liyun Wang and UD doctoral students Xiaozhou Zhou and Wen Li, the research provides the first concrete evidence of fluid flow in mechanically loaded bone samples, a critical piece in the puzzle of bone metabolism and mechanotransduction, the processes by which cells convert mechanical stimuli into biological and chemical activity.

Price hopes that the work will contribute to a better understanding of what causes people to gain or lose bone mass. With osteoporosis as a major health threat for an estimated 44 million Americans, or 55 percent of people 50 years of age and older, the work has important implications for individual and public health. In addition, millions of other people, including children, suffer from bone fragility due to genetic disorders such as osteogenesis imperfecta.

According to Liyun Wang, assistant professor of mechanical engineering at UD and Price's postdoctoral adviser from 2008 to 2010, "This is a very prestigious award, and it's rarely granted to researchers in engineering. Most past recipients have been in biological or medical sciences."

Concepts to reality

Student teams approach real business challenges with innovation and hard work

Senior Design is a capstone design course structured to prepare graduating students for the workforce. The program integrates classroom learning in a collaborative research environment where young engineers explore and solve real-world engineering challenges for business, industrial and government sponsors.

During the course, students apply academic knowledge and skill to product design, system solutions or process improvements with the help of involved faculty advisors and access to the department's research facilities.

Project sponsors are integral to the program's success because their unsolved problems form the basis for student discovery. Student teams begin by gaining understanding of the customer's (project business sponsor) requirements, defining the project scope and creating the concept. They work closely with their sponsors to engineer quantitative solutions that can be implemented within a business framework. Projects are executed in a single semester (September—December) by groups of three to five students with diverse backgrounds and capabilities.

An essential feature of the course is designing and building a prototype. Here UD mechanical engineering students go beyond conceptualizing a solution—they transform their design into hardware and actually create a working prototype. As they design, analyze, construct, test and improve their prototype on campus, students sharpen their organization, time management, self-discipline and technical writing skills, all while gaining valuable work experience.

Specific project details, such as how full-scale products will function within the sponsor's business, reinforce technical feasibility, prove commercial viability of the concept and drive prototype improvements and enhancements.

The program culminates with Senior Design Day—the hallmark of this semester-long course. This is where student teams present their results to their industry sponsor, along with a defined list of next steps needed to move the project toward implementation. It is a wonderful opportunity for students to shine as they demonstrate how far they've come under the watchful tutelage of their mentors.

Read on to meet this year's winning teams.

2010 senior design teams

CNH // ROUND BALER WEIGHING SYSTEM

Derek Maier, Kelley Pyle, Richard Skinner, Joe Snodgrass

ALCORE // AEROSPACE COMPOSITE TOOLING

Brian Traylor, Kyle Steelman, Tom Mulrooney, Zach Melrose

DDK // DIAMOND WAFER THICKNESS GAUGE

David Kim, Nnamdi Ibeka, Jeff LeBlanc, Matt Lindemer

EFC SYSTEMS // HANDHELD ROTARY ATOMIZER

Steven Biebel, Joseph Adelmann, Sarah Friedrich, David Salindong, Andrew Fitchwell

ILC DOVER // SILICON GLOVE PAD SHAPING SYSTEM

Michelle DeBonis, Melynda Schreiber, Bryan Hennigan, Kirk Harbaugh

ENGINEERED ARRESTING SYSTEMS // IN-LINE PUNCH TEST MACHINE

Anthony Coppola, Erik Andres, John Licciardello, Kevin Ayotte

JUGOS DEL SUR & DIAMOND STATE PORT CORP // JUICE CONCENTRATE SHIPPING BIN IMPROVEMENT

Geoff Andersen, Stephen Falance, William Scott, Adnan Khawaja

WEST Pharmaceutical and Sun Edge teams emerge as 2011 Senior Design standouts

BY KATIE GALGANO

Twenty-five student teams culminated their senior design experience Dec. 13 as they delivered final presentations of their semester-long projects to sponsors, review panelists, faculty, staff, fellow students and parents gathered at the Trabant Student Center.

All of the projects offered hands-on experience in solving real-world problems posed by industrial sponsors within the engineering industry. Students collaborated to develop a variety of working prototypes ranging from a handheld rotary atomizer to a battery heated portable eyewash station. The projects were judged based on three main criteria: design synthesis, resource/project management and communication.

The student teams are advised by 1964 ME alumnus Nate Cloud and professors James Glancey, Nils A. Hakansson, Robert Hartman, Michael Keefe and Steven Timmins. Cloud also identifies and secures business sponsors who contribute projects each year.

This year's two outstanding teams were Team WEST Pharmaceutical (Kyle Randall, Julianne Douglass, Michael Foley and Jeffrey Lugo) and Team Sun Edge (Matthew Rector, Andrew Baker, Luke Grim and Kelsey Olsen).

2010 Sponsors

Alcore
CNH America
Delaware Diamond Knives
EFC Systems
Engineered Arresting Systems
FSAE
ILC
Jugos Del Sur/ Diamond State Port Corp
Siemens
Sky-trax
Southco
Speakman Safety Products
SRT, LLC
Sun Edge, LLC
Superior Tube
Survice
Synthes
The Plasticoid Co
USSC, LLC
Global Seating systems, LLC
W.L.Gore
West Innovation Concepts
West Phamaceutical Svcs
Yamagochi International

TEAM PLASTICOID // WRAPPING/BAGGING SYSTEM IMPROVEMENT

Ashley Beppel, Steve Mann, Cara O'Shea, Ariel Roach

SKYTRAX // MOBILE PALLET DETECTOR SYSTEM

Dave Hilgart, Deirdre Jayko, Geoffrey Stafford, Allan Burleigh

SIEMENS // MICROBIOLOGY TITER PLATE LOADER

Paul Masullo, Maxime Dempah, Daniel McCarthy, Daniel Russakow, Leah Putman

SOUTHCO // ELECTROMECHANICAL LATCHING MECHANISM

Daniel Tavares, Ryan Lee, Rebecca Buxbaum, Vadim Rodin, Ryan Malin

Team WEST Pharmaceutical

Team WEST Pharmaceutical designed an easy-to-use adaptor that eliminates errors and damage caused during syringe use by ensuring the appropriate angle and depth of the needle during intradermal injections.

While most senior design projects evolve from research to concept creation to construction and validation testing, Team WEST Pharmaceutical followed an unconventional path. Through the support from project sponsor and UD alumnus Paul Norton (see DCA spotlight on pg. 19), the team was provided access to the WEST facility's rapid prototyping machine, allowing them to have several prototypes built directly from concept drawings.

Once they narrowed the field to three working concepts, the team had nursing students and inexperienced students rank the designs after testing the prototypes by giving an injection on pig skin. The team also injected the pig skin with green dye and analyzed frozen sections to determine what percentage of the dye had entered the dermal layer.

The team's guided twist lock adaptor emerged as the best design because it solved the most pressing problem of needle bending.

Outstanding Project!

This adaptor is currently being reviewed for viability as part of the patent process at WEST Pharmaceutical.

"The most gratifying part of this experience was when we were told that there were several other groups working on similar projects within WEST. For the first time, my contributions and ideas are real and may have an effect on the real world," reflects team leader, Kyle Randall.

Team West Innovation Concepts// Intradermal Drug Delivery Adaptor

Kyle Randall, Julianne Douglas, Jeffrey Lugo, Michael Foley

SPEAKMAN // BATTERY HEATED PORTABLE EYEWASH STATION

Kyle McLean, Munetaka Kubota, Andrew Fassler, Gerard Gallo

SUPERIOR TUBE // TUBE CROP & DEBURR PROCESS IMPROVEMENT

Matt Ward, Josh Blechman, Tom Daddario, Bill Ogram

SRT // SURGICAL ROBOT RADIATION DELIVERY CAPSULE

Richard Readdy, Michael Serafinas, Rachel Waylett, Emmanuel Ungaro

SURVICE // TUBING MEASUREMENT DEVICE

Ross Buckwalter, Adriana Vega, Edward Bonnevie, Oren Nusblat

Team Sun Edge

Team Sun Edge's project involved bringing to life a two-dimensional concept of a solar module that capitalizes on light concentration to increase the cost-effectiveness of solar power. The challenge to create a full-scale prototype module robust enough to withstand both testing in the lab and outdoors, however, proved difficult.

In order to accurately test their model and complete their final project, the group needed a testing device that could imitate the sun. Since purchasing one was expensive and inefficient, the team pioneered their own replica sun source to test their project.

The late delivery of a critical part complicated the project and ultimately prevented the team from presenting a fully assembled solar panel on Senior Design Day. The team did present an assembled tube and a full support system for review, which Sun Edge plans to incorporate into a prototype to demonstrate the benefits of the technology to potential investors.

Outstanding Project!

"This project was not an engineering calculation intensive project, but a scheduling and logistic challenge. I learned invaluable project management lessons that will be a great help in the industry," says team leader, Matthew Rector.

Team Sun Edge
Light Concentrator Solar Panel

Matt Rector, Kelsey Olsen, Andrew Baker and Luke Grim (pictured separately).

SYNTHES // AUTOMATED TESTING STATION FOR MATRIX SCREWS

Alex Aten, Andrew Paulus, Charles Hunt, Adam Thomas

W.L.GORE // FILTER BAG SEAL BAND IMPROVEMENT

Ryan Lewis, Sean Wilcox, Shannon Deibel, Laurie Williamson

USSC // TRANSIT VEHICLE SEAT SUSPENSION ADJUSTMENT

Roy Collins, Mike Campbell, Caitlin Pretz, Regina Adeleye

YAMAGOCHI INTERNATIONAL // SOLAR HOT CUP

Tara Feller, Ian Levy, Craig Sobin, Michael Brupbacher, Alex Vanarelli

Sponsor Benefits

- 1,200+ engineering hours devoted to your promising business idea
- Access to future engineering resources
- Exposure to students with creative young minds and high employment potential
- Connection to advanced research and technology at UD

2010–11 Senior Design Advisors

Nate Cloud

Jim Glancey

Nils Hakansson

Bob Hartman

Mike Keefe

Steve Timmins

FSAE // CHASSIS

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Photo by Dawn Fiore

ME students win at international Composite App Challenge

BY DIANE KUKICH

An integrated structural composite fuel cell developed by two University of Delaware graduate students may someday help transform the world of renewable energy.

For their innovative idea, Cedric Jacob and John Gangloff have won a $10,000 cash prize in the Owens Corning Composite App Challenge, a global competition to find new applications for composite materials. They received the award at a trade show hosted by the American Composites Manufacturers Association (ACMA) in Fort Lauderdale, Fla., on Feb. 3.

Jacob and Gangloff, both doctoral students in mechanical engineering, have been affiliated with UD's Center for Composite Materials and its Center for Fuel Cell Research over the past several years. Their winning concept exploits the benefits of advanced composites to lower vehicle weight, increase power output and significantly reduce the cost of manufacturing and assembly.

Participation in the Composite App Challenge was international. The other winners included a student from Brazil who proposed a concept for low-cost composite construction materials and a researcher from India with an idea for composite shipping containers. The overall winner was a South African company that received $200,000 to bring a recyclable composite pallet box to market.

"We plan to invest the $10,000 in our future projects. In determining the direction of those projects, we're willing to talk with anyone who will talk to us and can teach us something about how to translate our ideas into products that can be brought to market."

—Cedric Jacob

"The competition was not only a technical challenge but also a business challenge," said Gangloff. "We had to make the case that our idea works from an engineering perspective and that it's potentially viable in terms of the global market."

Meeting the other winners gave the two budding entrepreneurs some valuable insights into that market and what it takes to be successful. They learned, for example, that Lomold Pty Ltd., the South African company that won the application award, has been working on its pallet box for 13 years and will finally see the product commercialized in 2012.

"We realize that to make it big, we need help, we need to ask questions, and we need to learn more," said Jacob. "We plan to invest the $10,000 in our future projects. In determining the direction of those projects, we're willing to talk with anyone who will talk to us and can teach us something about how to translate our ideas into products that can be brought to market."

Jack Gillespie, CCM director and Donald C. Phillips Professor, points to the center's entrepreneurial environment as the catalyst for Jacob and Gangloff's success.

"With our strong connections to industry and government, we encourage our students to think about how their work might solve an industrial problem or address a military need," he said. "Internships with our industrial and government sponsors provide our students with valuable insights into relevant issues and opportunities, and we encourage them to unleash their creativity in this process."

Fuel cells provide electric power that can be used in applications including car engines, power stations and power packs for portable electronics. According to a July 2008 Energy Business Report, the global fuel cell industry is expected to generate more than $18.6 billion in 2013.

"John and Cedric's winning application, which integrates advanced composite materials into novel fuel cell technology, is truly innovative," said Anette Karlsson, chair of UD's Department of Mechanical Engineering. "It shows a very creative and interdisciplinary approach to saving weight and reducing the cost of fuel cells. Their idea will make fuel cells more cost effective, which in turn will make them more competitive with the traditional combustion engine."

About the competition

Launched in April 2010, the Composite App Challenge was the brainchild of Ashish Diwanji, vice president of innovation for Owens Corning Composite Solutions. The challenge offered a $200,000 commercial development award for a composite application that can be introduced by the end of 2012 and up to a total of $50,000 for composite ideas that effectively address marketplace needs, appear to be technically feasible, and have a perceived market opportunity. One $20,000 award was available to anyone and up to three $10,000 awards were reserved for students.

Individuals and teams were asked to submit applications and ideas in four categories — infrastructure durability, fuel efficiency, renewable energy and protection from harm. The entry phase of the competition closed Aug. 15 and participation was almost evenly divided between ideas and applications. Fifty-two percent of the entries were ideas and 48 percent were applications with the potential to reach the market in 2012.

Semi-finalists and finalists were invited to provide additional information for subsequent rounds of review. Judges were looking at the content of the idea, the potential market opportunity, the time needed to commercialize the application, the business case, technical feasibility and the contestant's ability to commercialize the application or solution. The judges based their final decisions on the likelihood of scalability and long-term success.

Owens Corning is a leading global producer of glass fiber reinforcements for composite systems and residential and commercial building materials.

Engineers Week 2011

The University of Delaware's College of Engineering marked the 60th anniversary of National Engineers Week Feb. 20-26 with a multitude of activities designed to engage students, faculty and staff.

Students enjoyed an engineering style Texas hold 'em game, geocaching, a mousetrap powered car race, the Order of the Engineer Ring Ceremony, the space beam challenge and a business etiquette luncheon.

To see more pictures, visit the College of Engineering Facebook page (www.facebook.com/UDengineering).


Dial

Undergraduate spotlights

The UD College of Engineering not only trains engineers, but also develops leaders. Below are three undergraduates who are well on their way to a bright future.

Edward Bonnevie

Edward Bonnevie has a deep interest in understanding what causes Osteoarthritis (OA).

This curiosity inspired Bonnevie to seek undergraduate research opportunities through UD's Science and Engineering Scholars program. For the past two summers, he has conducted undergraduate research under Assistant Professor David Burris, analyzing the lubrication and load bearing properties of articular cartilage to learn about the mechanisms of damage propagation in OA.

This research led to a refereed journal article in Tribology Letters, a featured article in Tribology and Lubrication Technology, the silver prize at the 2010 STLE annual meeting and an invitation to present the research at STLE this May.

"It has been one of the greatest opportunities of my life," says Bonnevie, who graduates in May. "I chose mechanical engineering because it held the most possibilities – I can do anything from alternative energy to robotics to composite materials to biomechanics."

Bonnevie will earn his Bachelor's in Mechanical Engineering with Distinction through UD's challenging Honors Program, but he has also found time to give back, serving as a teaching assistant and as a member of Tau Beta Pi. A member of UD's track and field and cross-country teams, he is a recipient of the Colonial Athletic Association Scholar Athlete of the Year award.

Upon graduation, Bonnevie will work toward his doctorate and hopes to become a professor at a research institution.

Rebecca Buxbaum

Leadership and achievement are not new to Becky Buxbaum.

As president of UD's Tau Beta Pi student chapter, she actively promotes the academic excellence and exemplary character of her fellow engineering students. Through UD's student chapter of Engineers without Borders (EWB-UD) Guatemala team, she helped design a bridge that will unite the village of San Jose Pentacalapa with its crop fields.

She also spent one summer working with Professors Suresh Advani and Ajay Prasad designing a website and writing a program to analyze data collected from the hundreds of sensors contained in UD's Fuel Cell Buses.

"Both of my parents are engineers. I was torn between electrical engineering and mechanical engineering originally, and then decided I liked ME better," she says.

Buxbaum's senior design team worked with Southco, a lock manufacturer in Concordville, Pennsylvania, to improve the strength of an existing lock while integrating an electric actuator to make the lock operable remotely. The design is currently under consideration by Southco for commercial production.

A Distinguished Scholar, Buxbaum believes her UD experience has positioned her to succeed. She graduates this May through UD's challenging Honors Program with a bachelor's degree in ME and minors in math, economics and history.

She has accepted a job at W.L. Gore & Associates upon graduation and plans to pursue a master's degree at night.

Sarah Friedrich

"There is no doubt in my mind that I made the right choice in an undergraduate institution," says UD senior Sarah Friedrich.

"Engineering is a great major to combine my academic interest in science and math, and in my opinion, mechanical engineering offers the most diversity of all the disciplines."

A member of the University's prestigious Honors Program and a former Science and Engineering Scholar, Friedrich has become an enthusiastic researcher nearing completion of her senior thesis in nanotechnology under faculty advisor Erik Thostenson.

"The ME faculty are extremely intelligent and devoted to their students. At a major research university this combination can be hard to find, but at UD they make it look easy," she says. Their success has inspired Friedrich to also pursue an academic career.

While at UD, Friedrich has encouraged many prospective students to enroll in UD's mechanical engineering program. She is the secretary/outreach coordinator for UD's Society for the Advancement of Material and Process Engineering (SAMPE) student chapter, a member of Tau Beta Pi, a teaching assistant and a frequent Blue and Gold Saturday volunteer.

After graduation, Friedrich plans to pursue her doctorate in biomedical engineering or mechanical engineering.

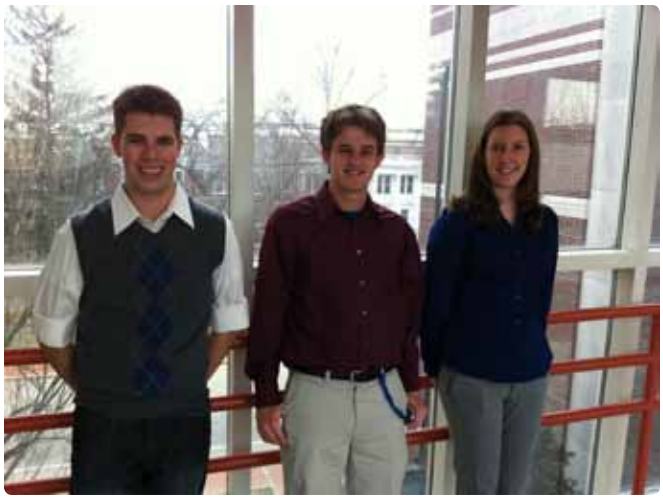
Students innovate for the UD fuel cell bus program

BY AJAY K. PRASAD

During summer 2010, a number of undergraduate students added their energy and imagination to advance the technology of our fuel cell buses. To date, the UD Fuel Cell Bus Program has demonstrated two buses on our campus. The first fuel cell hybrid bus has been in operation since 2007 and incorporates a 20 kW fuel cell stack with 60 kWh of battery storage in a 22-ft platform. The second bus has been in operation since 2009 and is identical to the first bus, except that it features a dual stack for a total power of 40 kW. Two 30-ft fuel cell buses will be added in 2011 and 2012. Since its inception, the Fuel Cell Bus Program has been popular with undergraduate students seeking summer research opportunities. Here, the recent contributions of three students are highlighted.

Shane Marcks, an ME senior, contributed to the design and testing of a novel hydrogen ejector to recirculate unused hydrogen from the fuel cell stack outlet back to the stack inlet. At present, our buses employ a hydrogen recirculation pump for this purpose. This pump is prone to corrosion and seizing, and consumes substantial parasitic power from the stack. A variable flow ejector is preferable because it is driven by the mechanical energy of the high-pressure hydrogen in the fuel tanks rather than electrical power. Our ejector employs a "spike nozzle" design to achieve good supersonic nozzle performance over a wide range of flow rates. A linear actuator is used to adjust the position of the needle at the nozzle opening to regulate hydrogen pressure under feedback control from the stack pressure. Marcks first modeled the entire feedback system for the spike nozzle ejector in MATLAB/Simulink and developed a suitable control algorithm. He then helped to fabricate all the mechanical components, and successfully tested the ejector system on a lab bench using compressed air as a proxy for hydrogen. This was a very significant achievement. Marcks' next task will be to implement this novel ejector in the bus itself. The bus manufacturer (EBus) is extremely interested in our progress, and is eager to install this new hydrogen recirculation system in future buses.

Erik Andres, also an ME senior, worked on a "driver user interface" program. This software has been installed on both buses on netbook PCs, which are equipped with touch screens and mounted in a "heads up" position at the very top of the windshield. The software provides a more user-friendly interface for monitoring and controlling the buses' functions than the 16-button keypad and 2-line text display currently afford, and will later perform more advanced functions like accurately estimating remaining charge in the nickel-cadmium batteries and displaying remaining vehicle range. It will also help the driver by providing more detailed descriptions of any faults that the fuel cell/battery hybrid system might experience, along with corrective actions. Andres' new interface is a valuable tool to rapidly familiarize bus drivers with the novel technologies and systems on board our fuel cell hybrid buses, and to facilitate safe and reliable bus operation.



Shane Marcks, Erik Andres and Rebecca Buxbaum.

Finally, Rebecca Buxbaum, also an ME senior, created software to automate the generation of statistical data and plots of the buses' performance metrics. On-board data acquisition computers relay critical performance data automatically to a server in our lab using cellular data connections. Buxbaum's software analyzes those data and places them on a web page which can be accessed by the research team or the general public (http://fluidsnet.me.udel.edu/bus1data/). This link takes the viewer to a calendar from which a particular bus run can be selected. Each selected run shows up as a summary and can then be further examined in a variety of more detailed views. For example, it is possible to view the actual path of the bus during the run using the Map option. Next, the Faults option allows one to study the faults (if any) experienced by the bus on that particular run. The Graphs option provides the user with a detailed profile of bus performance in terms of battery state-of-charge, energy, bus velocity and hydrogen consumption vs. time. Finally, the Download option allows the user to access the actual data files for further analysis. This software is a very powerful tool to assess the health and effectiveness of our buses both in real-time and on an archival basis. The Federal Transit Administration (our sponsor) has shown great interest in publicizing this development within its organization.

The undergraduate students were mentored in their daily activities by research associates Doug Brunner and Adam Kinzey. Professors Suresh Advani and Ajay Prasad provided overall guidance and supervision. We look forward to involving more undergraduates in exciting projects in the future.

Alumni support builds a strong legacy in Mechanical Engineering—$5.1 million and growing

The Department of Mechanical Engineering at UD is a nationally recognized program that includes many interdisciplinary efforts, such as the Center for Biomedical Engineering Research and the Center for Fuel Cell Research. Advanced materials and nanotechnology, biomechanics, and robotics and controls are all part of a wide-range curriculum designed to help tomorrow's leaders solve society's greatest challenges.

The department's success, however, is the result of the combined efforts between dedicated faculty and staff, and our generous donors. The first alumni contributions to the department were recorded many years ago. With it began a long history of voluntary alumni support. From the first gift through year-end 2010, the department has received $5.1 million in contributions. Viewed cumulatively over many years, this impressive figure illustrates the point that many gifts by many donors significantly impact the department.

A Rich History

Throughout its history, ME has continued to provide students a strong technical foundation preparing them to meet the changing needs of industry. The department first began preparing students for jobs in steam engineering.

In the 1930s, courses such as surveying, chemistry of combustion and technical motion pictures were dropped to make way for thermodynamics, industrial management and government. By the early 1970s, the department was engaged in a major thermal sciences research project for the U.S. Department of Defense, and had developed an extensive aeronautics program to serve Delaware's growing aerospace industry. UD's mechanical engineering faculty were among the first in the country to teach courses in composite materials and led the way in creating the University's world-renowned Center for Composite Materials in 1974.

Alumni Support

It is difficult to quantify all the good that results from charitable giving. From the numerous students that receive scholarship aid, graduate fellowships and research opportunities, to experimental equipment purchased to fuel technological innovation, to the recruitment of excellent faculty—alumni support is a large part of an improved Delaware education.

Higher education is expensive, yet it is essential that access to new knowledge is sustained. We encourage you to make an impact with your annual contribution and support the Department of Mechanical Engineering.

Your gift does make a difference when combined with the support of others. To make an immediate impact, we invite you to visit www.udel.edu/development/makingagift and make your contribution today!

Q&A with alumnus donor James B. Foulk, BME '59

James B. Foulk earned his bachelor's degree in mechanical engineering in 1959 and is now chief executive officer of the SURVICE Engineering Company and president and CEO of Chesapeake Defense Services, Inc. In April 2007, Foulk was a recipient of the Department of Mechanical Engineering's Distinguished Career Alumni Award. He shares his memories from UD and his recent support for the new Interdisciplinary Science and Engineering Laboratory.

What do you remember most about your undergraduate experience? Was there anyone who had a significant influence in your education?

My early undergraduate experience was somewhat different from others, changing from the arts and science track to mechanical engineering. My father, Robert Foulk (BAAS '22), who was an educator throughout his entire career, was influential in helping me find my way. I think my UD engineering experience, especially the interaction with the late Professor W. Francis Lindell, helped me to be more solution oriented in solving problems. He also gave me a better vision and purpose about what I wanted to do after graduation. Other opportunities and practical experiences at UD also helped shape my career; and personally, I met Nancy (BSED '60) and we were married soon after graduation.

How did your career path lead you to become CEO of SURVICE Engineering Company?

After working for Standard Oil Company and the Army Research Laboratory, I joined Sikorsky Aircraft in 1974 as head of Safety and Survivability. In 1976, I was promoted to manager of System Engineering for the UH-60 Black Hawk helicopter development program. In 1978, I moved to Science Applications, Inc. (now SAIC), eventually opening an office for SAI in Bel Air, MD. Nancy and I decided to pursue our dream of establishing our own business and started the SURVICE Engineering Company in the basement of our home. Our son Jeff (BME '82) joined us after graduation and is now president of SURVICE Engineering.

Tell us briefly your perspective to managing your own business.

Since SURVICE's inception, and more recently with CDS, my business philosophy has been to bring talented subject matter experts together with bright young engineers and analysts, allowing them to grow and mature the survivability discipline. Today, SURVICE and CDS have over 300 employees with offices at ten locations throughout the United States, providing engineering and testing services to help make safe, survivable and effective weapon systems for the nation's warfighters.

Your recent gift provides leadership support for the College of Engineering and the new Interdisciplinary Science and Engineering building. What motivated you (and your family) to make this gift to UD engineering?

We know from our own experience of hiring and employing UD engineering interns and graduates that the College of Engineering develops students who are well equipped for today's business demands. We believe the recent decision to establish the new Interdisciplinary Science and Engineering Laboratory (ISE Lab) will interest and excite even more students to consider the science and engineering path, and hopefully help close the technology gap with foreign countries. We have been active for some time in support of Science, Technology, Engineering & Mathematics (STEM) programs at our local high schools and community college. However, we believe that the ISE Lab is a great opportunity to essentially take the STEM approach to a new level. We are very excited to be a part of this innovative project and encourage others to seriously consider providing their support to ensure that the ISE Lab is an early and sustainable success.

What are your hobbies or special interests?

When not working on one of the businesses, we enjoy a little golf, keeping up with our eight young grandchildren, supporting and encouraging a few unsuccessful thoroughbred race horses and best of all, relaxing at our beach house in Lewes, Delaware.

Thank you alumni donors!

We wish to thank the many ME friends and alumni who have made generous contributions over the past year. Your gifts are used for many worthwhile purposes, including support of our research and educational programs. To make a donation, please visit UD Connection (www.udconnection.com) and click *Donate Today*. If you wish to give designate your gift to ME, select *other* from the list provided, then specify Mechanical Engineering.

July 1, 2009–June 30, 2010 | Donor's initial class year (if ME alum) indicated.

Names written in blue represent gifts made specifically to ME.

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