2012-13
NEWS

The Department of

Mechanical Engineering

inside

Featured research:

- biomedical
- clean energy & environment
- composites & nanotechnology
- robotics & control

Distinguished Career Awards | pg 26

MARK YOUR CALENDAR
Mechanical Engineering
Career Celebration
June 1

University of Delaware | College of Engineering

MESSAGE FROM THE CHAIR

Welcome to the 2012-2013 Mechanical Engineering news magazine.

I am excited to report that our department continues to grow in response to the global need for engineers. Mechanical engineering is the largest enrolled department in the college, with more than 500 undergraduates and over 100 graduate students.

Over the last few years, we have made significant improvements in our education programs, including introducing a novel technique developed by Assistant Professor David Burris to improve our students' writing skills. We also have significantly improved the lab experience for the students and enhanced the design curriculum. Additional improvements to the design curriculum for undergraduate students are underway, with plans to develop a "design studio" in Spencer Laboratory coming soon. Look for more on this next year.

To meet industry demands and student requests, we recently implemented a 4+1 MS degree program, where undergraduates can enroll in an expedited program to earn both a bachelor's and a master's degree in just five years. This has become a very popular program, helping our graduates to become even better engineers.

Departmental research funding increased nearly seven percent this past year and has increased over 20 percent since 2009. In this issue, we highlight some of the interesting research emerging from UD's mechanical engineering department; work that shows potential to enhance and improve our world.

Likewise, the department has developed two exciting collaborations with Tsinghua University and Peking University, the two top engineering schools in China, to foster undergraduate research and educational opportunities, and support faculty research initiatives.

Many of these initiatives are only possible thanks to the generous contributions of alumni, friends, faculty and staff. You support enables educational programming improvements, top student awards and graduate fellowships. Thank you for supporting our department.

Best regards,
Anette Karlsson

P.S. Don't forget to mark your calendar for **Alumni Weekend June 1-3, 2012**. We look forward to seeing you at the 8th Annual Mechanical Engineering Alumni Career Celebration and Reunion.

IN THIS ISSUE...

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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!

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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

Faculty	Biomedical Engineering	Clean Energy and Environment	Composites and Advanced Materials	Nanotechnology	Robotics and Controls
Suresh Advani		•	•		
Sunil Agrawal	•				•
Thomas Buchanan	•				
Jenni Buckley	•				
David Burris	•	•	•	•	
Tsu-Wei Chou			•	•	
James Glancey			•		
Joshua Hertz		•		•	
Jill Higginson	•				
Anette Karlsson		•	•		
Michael Keefe			•		
X. Lucas Lu	•				
Kurt Manal	•				
Ioannis Poulakakis					•
Ajay Prasad	•	•		•	
Charles Price	•				
Valery Roy		•			•
Michael Sabtare		•	•		
Leonard Schwartz		•			
Jonghwan Suhr			•	•	
Herbert Tanner					•
Erik Thostenson			•	•	
Lian-Ping Wang	•	•		•	
Liyun Wang	•				
Bingqing Wei		•	•	•	

A powerful tool
Mathematical Modeling

Powerful new tools such as cryo electron microscopes, laser scanning and atomic force microscopes allow biomedical researchers to see, touch and feel cells, tissue and the body. For things too small to see or measure, the science of mathematical modeling helps fill in the equation.

DETECTING EARLY STAGE OSTEOARTHRITIS

Osteoarthritis is a silent disease. By the time a patient seeks medical help for treatment due to pain or immobility, the disease typically has worsened to severe stages where cartilage has degenerated and damage is irreversible. Current clinical practices usually involve pain management and modification of the mechanical environment to delay progress.

Prof. Lu uses biomechanics to detect cartilage degeneration at an earlier and potentially stoppable stage.

He explains that loss of the fluid-attaining proteoglycans (PG) inside the cartilage collagen network is the earliest indicator of osteoarthritis. Loss of PGs increases the water permeability of cartilage and decreases the tissue stiffness, leading researchers to propose proteoglycans as an important marker for the early detection of osteoarthritis. To precisely determine the PG content in cartilage, Lu is investigating a mechanical testing approach with the aid of advanced theoretical modeling. The unique feature of Lu's research is his expertise in measuring the chemical composition (PG content) of cartilage using indentation data. His secret weapon is the tri-phasic mixture theory, originally developed by his doctoral mentor, Prof. Van Mow at Columbia University. Tri-phasic theory is a unified biomechanical model for cartilage that treats the tissue as a mixture of negatively charged solid matrix, water and ions.

This novel modeling technique provides a powerful new tool for tissue evaluation in osteoarthritis research, cartilage tissue engineering and related animal studies. Once the approach is fully validated against the gold standard (PG chemical assays), Lu plans to migrate the current table-top indentation setup to a handheld micro-indentation platform. Combined with clinical arthroscopic devices, this is inserted inside a knee joint to determine both mechanical properties and proteoglycan content under single indent test, offering surgeons a versatile tool in detecting osteoarthritis at an early stage.

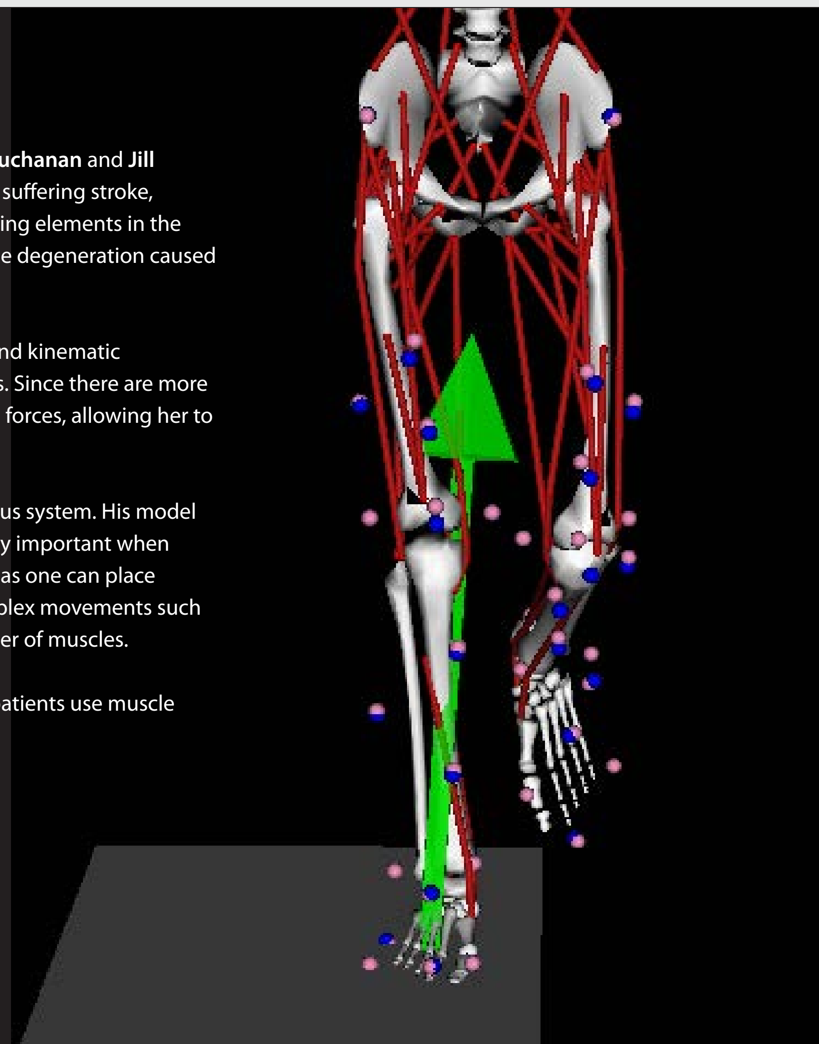
HELPING PATIENTS WALK AGAIN

A hybrid model estimating muscle force developed by Professors **Thomas Buchanan** and **Jill Higginson** helps clinicians find new and better ways to rehabilitate patients suffering stroke, osteoarthritis or sports injuries. Because muscles are the main force-generating elements in the body, studying muscle force gives researchers greater knowledge of cartilage degeneration caused by overuse.

Higginson's computational optimization portion of the model uses kinetic and kinematic information to estimate muscle force needed for certain movement patterns. Since there are more muscles than degrees of freedom, her approach relies on patterns of muscle forces, allowing her to estimate forces in all of the body's muscles.

Buchanan's work estimates muscle force by measuring input from the nervous system. His model takes into account the way specific people activate each muscle — especially important when studying impairments. While this approach can only study as many muscles as one can place electrodes on (typically about a dozen) and may not allow the study of complex movements such as human gait, it does provide highly detailed information on a select number of muscles.

Their hybrid approach offers exciting and valuable information about how patients use muscle force when re-learning to walk after illness or injury.



EXPLAINING FLUID'S IMPACT ON TISSUE STRENGTH

Fluid not only hydrates the body, provides nutrients and carries away waste, it plays an unlikely, yet equally important role in making tissues such as bone and cartilage stronger. Because dry bones are more brittle and easier to fracture than wet ones, losing fluid-retaining capability is the first step in developing osteoarthritis in cartilage.

Prof. **David Burris** is studying cartilage tissue's load-bearing and lubrication functions and how and why these functions decline in osteoarthritis. Using a sophisticated indentation and sliding testing mathematical model to gain deeper understanding of how fluid makes tissues strong and long-lived, he has discovered a surprising connection between the amount of fluid in cartilage and increasing stiffness and lubrication (lower friction) under dynamic loading.

Cartilage provides our joints with load support and lubrication for decades of continuous use with minimal friction or damage. These unusual bearing properties are in fact due to a biphasic tissue structure (containing both fluid and solid matrices) and the pressurization of interstitial fluid during dynamic deformations. Despite the fact that the pressurization of the interstitial fluid is transient and would be relaxed to baseline depending on the permeability of the tissue, this initial load bearing from the fluid can be as high as 90 percent, greatly reducing the stress acted on the solid matrix and thus the frictional force tearing the solid.

Burris is collaborating with Professors **Liyun Wang** and **X. Lucas Lu** to further study how alterations in solid matrix, such as loss of the fluid-attracting proteoglycans and disruption of collagen network, diminish the fluid support, accelerating further matrix damage as the solid assumes more stress, leading to osteoarthritis.

EXPLORING BONE CELLS USING BIOIMAGING

Prof. Wang is studying how bone cells sense external mechanical forces, which allows living bone tissue to adapt to its mechanical usage. With the absence of mechanical stimulation (such as the microgravity for astronauts) and loss of sensitivities of detecting the loads (such as during aging), bone mass decreases and bone structure degenerates, eventually leading to bone fracture. Recent studies have found that osteocytes—the most abundant cells buried inside the mineralized matrix—serve as sensors that orchestrate bone adaptation.

The key component of osteocyte's mechanosensing apparatus is the pericellular matrix. Limited electron microscope studies reveal that this fluffy "jungle" consists of nanoscale fibrous structures, (about 100nm thick), filling the tiny gap between the cell membrane and the bone matrix. Mechanically, it controls the hydraulic permeability of the bone tissue, determining how easy fluid flows around the cells under external loading. Biologically, the fluid flow passing the fluffy layer deforms the transmembrane components, allowing cells to sense and respond to external forces.

Despite its significant role in bone adaptation, its detailed structure remains elusive: light microscopy can barely detect the entire jungle at the best resolution, let alone individual fibers in the matrix surrounding the cell. Wang's team relies on a bioimaging approach called Fluorescence Recovery After Photobleaching to measure how fast a small fluorescent dye and a relatively large protein move through the pericellular matrix. The researchers record differential speeds of the large and small molecules. Although scientists cannot see the jungle, they are able to measure the sieving effects of the pericellular matrix. Using mathematical models, Wang's team further estimates that 1-10 percent of the jungle space has to be occupied by solid fibers.

These four examples, as well as many others, demonstrate the power of mathematical modeling in scientific discoveries and engineering applications.

Article by Liyun Wang

Rechargeable and efficient

Flexible technology

Scanning Electron Microscope image of a buckled SWNT macro-film, the buckled SWNT macro-film/PDMS substrate interface, and Atomic Force Microscope image of the buckling profile of the SWNT macro-film.

Powering modern-day devices

In the quest for high-energy storage devices, stretchable supercapacitors and rechargeable batteries will likely emerge as the primary power source for modern-day portable electronic devices, satellites and even electric vehicles. At UD, faculty members in mechanical engineering are prompting new technologies to meet this growing demand.

Deformable energy storage devices

Advances in flexible electronic technology are inspiring UD researchers to create novel electronic devices that can bend, stretch and deform for a broad range of applications, impeded only by the lack of available flexible power sources.

Supercapacitors are attracting attention for their ability to generate energy and power densities higher than conventional dielectric capacitors and lithium ion batteries, respectively. Lightweight and flexible carbon nanotubes, in the form of free-standing thin films, are favored for their high surface area, efficient charge storage and excellent electrical conductivity for high rate operation.

Professor **Bingqing Wei** and his research team, in collaboration with Professor Hanqing Jiang of Arizona State University, are developing a reversibly stretchable supercapacitor capable of integrating into any flexible and stretchable electronic device, and able to withstand a tensile strain of up to 30 percent.

The design involves impressing single-walled carbon nanotube (SWNT) macro-films onto pre-strained polydimethylsiloxane films. Once the strain is released, the SWNT film assumes a reversibly stretchable periodically sinusoidal shape. Electrochemical characterizations performed under normal and strained conditions indicate energy and power density values comparable to supercapacitors assembled with pristine SWNT films.

High-temperature supercapacitors

Electrochemical power sources with high energy and power densities, that can withstand harsh temperatures, are desirable for applications ranging from civilian portable electronic devices to military weapons. One promising application, when coupled with supercapacitors, is for hybrid electric vehicles. Together, they deliver the high power and long cycle life needed for vehicle start-up or acceleration, and for energy recovery during braking.

Wide-temperature-withstanding supercapacitors developed by Wei's team can be stably operated between room temperature and 100 degrees C and within a voltage window of -2 V to 2 V. This ultra-light power source can withstand current densities as high as 100 A/g, yielding specific power density values on the order of 55 kW/kg. An ultra-long galvanostatic charge-discharge cycling up to 200,000 cycles at both room temperature and 100 degrees C, shows excellent stability in capacitance with high efficiency.

High-performance li-ion batteries

On another front, Silicon (Si) is now being considered for Li-ion batteries based on its low discharge potential and high theoretical charge capacity (4,200 mAh/g). The second most abundant element on earth, it's also recyclable, suggesting a sustainable solution to our energy needs.

Yet development of Si-anode Li-ion batteries lags due to large volumetric change (400 percent) upon insertion and extraction of lithium, resulting in pulverization and early capacity fading. Wei's team is tackling this hurdle by depositing silicon films on "soft substrates," such as carbon nanotube films or elastomeric polydimethylsiloxane layers, capable of releasing the high stress induced during lithium ion insertion and extraction. Collaborating with UD Prof. **Joshua Hertz** and researchers at ASU, the team is realizing long-cycle life batteries with exceptionally high discharging capacity and better capacity retention.

These National Science Foundation-funded research projects demonstrate new concepts in creating different types of stretchable power sources, including rechargeable lithium ion batteries with flexible electrode materials.

Powering electric vehicles

In the automotive industry, lithium-titanate batteries show promise as a power source due to their long lifetime, good energy density and ability to withstand large charge/discharge currents. But an active thermal management system is required to maintain a safe operating temperature and prevent battery degradation.

Professors **Ajay Prasad** and **Suresh Advani's** team has designed two battery cooling systems -- one water-cooled, the other cooled by air. While both perform effectively, the air-cooled system, which consumes less parasitic power, is more efficient, indicating that ambient air can be used as the active fluid to cool the cells through proper heat exchanger design.

Metal hydride-based hydrogen storage

Prasad and Advani are also exploring the use of metal hydrides to safely and cost-effectively overcome on-board storage challenges associated with hydrogen as an automotive fuel source.

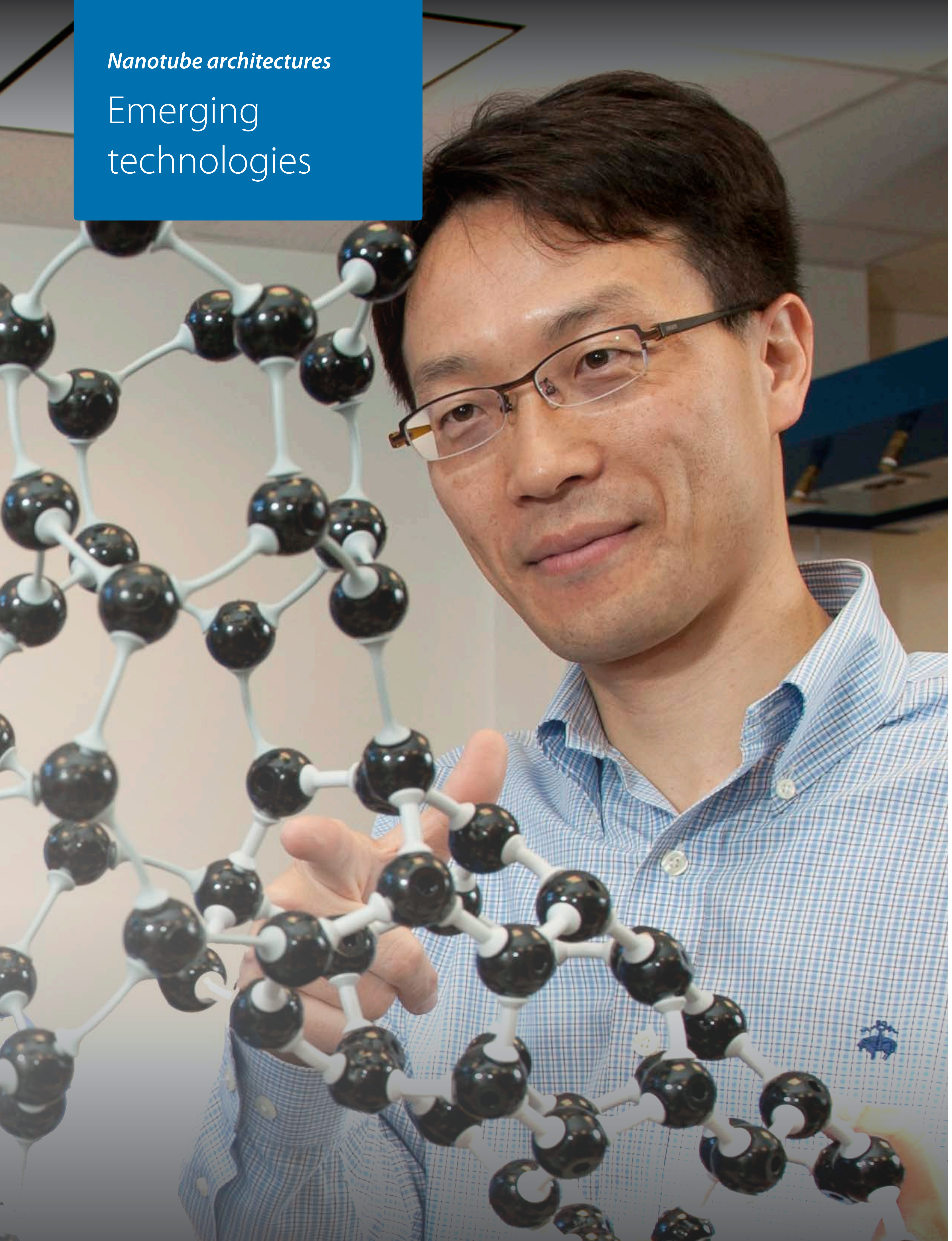
Typically, hydrogen is stored in tanks at pressures of 5,000 or 10,000 psi, or as a cryogenic liquid. Even at such extreme pressures and temperatures, the fuel occupies too much volume. A promising alternative is solid-state hydrogen storage, which uses metal hydrides to absorb/desorb hydrogen at relatively low pressure, offering safety and cost advantages with potentially unparalleled hydrogen storage density.

Hydrogen storage in porous metal hydrides beds is a complex problem involving compressible gas flow in porous media, heat transfer and reaction kinetics. Heat transfer is the key obstacle because the charging time of hydrogen in metal hydride tanks is strongly influenced by the rate at which heat can be removed from the reaction bed. Through numerical simulations, the researchers continue to optimize system design.

Article by Bingqing Wei

Nanotube architectures

Emerging technologies



Both light and strong, carbon nanotubes (CNTs) are considered a revolutionary material with many useful applications due to their unique shape and excellent mechanical, electrical and thermal properties. Over the past 20 years, researchers have explored their use in advanced electronics, optics and structural materials such as composites.

While many scientists have studied carbon nanomaterials in one- and two-dimensional forms for CNTs and graphene, respectively, a team of three UD mechanical engineering professors are the first to attempt to create and use three-dimensional (3D) carbon nanotube solid networks.

Led by Rice University, the $7.5 million grant from the Department of Defense (DOD) is funded through the Multidisciplinary University Research Initiative (MURI). The project includes teams of researchers from UD, Pennsylvania State University and the University of Texas, Dallas.

Jonghwan Suhr, assistant professor of mechanical engineering, is the UD lead principal investigator on the project. Professors **Bingqing Wei** and **X. Lucas Lu** serve as key investigators. Other partners in the research are Boeing, the Wright Patterson Air Force Research Laboratory and the Army Research Laboratory.

Each member of the UD team brings unique knowledge to the project. Suhr's expertise lies in nanocomposites and composite structures, while Lu's knowledge is in biomechanics. Wei specializes in the synthesis of nanomaterials and energy storage. Total funding to UD is $1 million over five years.

"In order to apply carbon nanotube technology in macroscopic or large-scale applications, we must first synthesize and characterize a robust, structurally sound 3D carbon nanotube," explained Suhr.

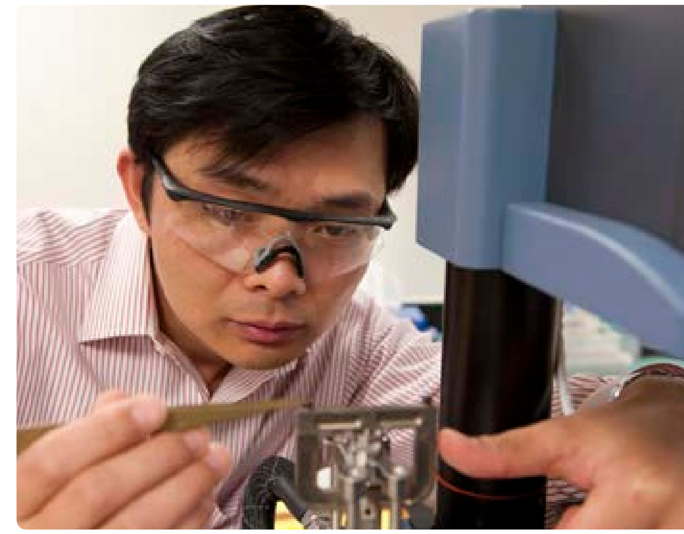
While challenging, he believes a 3D architecture will make CNTs more versatile and may lead to new applications in lightweight structural materials, energy storage and thermal management.

A key issue impeding their advance is joint failure. CNTs are made from an intricate arrangement of synthetic carbon atoms connected by joints. Transitioning from a one- or two-dimensional architecture to a three-dimensional architecture is fundamentally difficult because researchers must introduce atomic-scale junctions or joints between individual nanoscale elements so that they can be organized in a strong 3D network.

Suhr and his UD colleagues plan to overcome this limitation using novel nanomaterial synthesis techniques and evaluating the new 3D nanomaterial using biomechanics theories typically applied to cartilage or bone.

"Three dimensional carbon nanotubes are porous and viscoelastic, similar to human tissue. While human tissue is a combination of tissue and fluid, carbon nanotubes are a combination of structural material and air," said Lu.

Once created, the UD team will study the nanotube's electro-mechanical response using acoustic emissions, sounds waves made by the structure, to test the strength of the three dimensional architecture. After determining at what load the joint fails, the team can engineer a way to overcome this shortcoming.



"The goal is to create solid materials by the controlled assembly and atomic-scale bonding of nanoscale elements, thereby leading to network solids with remarkably improved thermo-electro-mechanical properties," said Suhr, who is also affiliated with UD's Center for Composite Materials.

If the project is successful, Suhr noted, researchers will develop a deeper understanding of the structure-property relations needed to optimize and ultimately commercialize 3D carbon nanotube architectures for industrial applications. Truly interconnected 3D nanostructured materials will also provide exceptional property improvements for applications that support strategic DOD initiatives.

"This prestigious grant offers an excellent opportunity for Jonghwan and his team to create fundamental new breakthroughs in the use of carbon nanotubes," remarked Anette Karlsson, department chair.

Article by Karen B. Roberts

Systematic control

Elegant robots

Poulakakis is investigating control strategies in four-legged running robots as part of a new National Science Foundation grant.

Running Robots: Systematic control strategies for four-legged machines

A cheetah running in its natural environment is an elegant, fluid display of biomechanics. What if robots could run the same way, and be deployed for search and rescue operations in areas where conventional vehicles cannot go?

According to Professor **Ioannis Poulakakis**, a large fraction of the earth's surface remains inaccessible to conventional wheeled or tracked vehicles, while animals and humans traverse such terrain with ease and elegance. He believes that legs have the potential to extend the mobility of robots, enabling them to become useful in real-world situations, such as search and rescue.

Poulakakis is developing a family of systematic control strategies that work together with the robot's natural dynamics to generate fast, reliable and efficient running motions. His work proposes to shift the focus from ad hoc heuristic control procedures to systematic controller design algorithms that combine physical intuition with analytical tractability to stabilize running gaits on robotic quadrupeds keeping unnecessary trial-and-error experimentation at a minimum.

Funded through a grant from the National Science Foundation's Division of Civil, Mechanical and Manufacturing Innovation (CMMI), the project focuses on the running motion of quadrupeds (four-legged robots) with elastic energy storage elements such as springs.

"Biomechanics research demonstrates that springs and running are intimately related. When you run," he explained, "the knee of the leg that is on the ground initially bends and then extends to prepare the body for take-off. During knee bending, energy is stored in elastic elements such as tendons or muscle fibers. Then, this energy is released during knee extension, pushing the body upward and forward."

In other words, when animals run, they "tune" their musculoskeletal system so that their center of mass appears to be moving as if following the motion of a pogo-stick.

The complexity of the mechanisms underlying the capacity of biological legged systems to generate and support their movement can be daunting. Nonetheless, on a macroscopic level, legged locomotion can be understood through the introduction of archetypical reductive models, whose purpose is to capture the salient features of the desired gait behavior without delving into the fine details of the animal's (or robot's) structure and morphology. Such reduced-order dynamical systems can serve as literal behavioral target models to inform the design of control laws capable of stabilizing highly agile running gaits in legged robots.

Poulakakis' objective is to propose models of this kind for quadrupedal locomotion, and to offer a theoretical framework that will enable analytically tractable characterizations of their dynamic properties by dealing directly with their nonlinear and hybrid nature.

"At the core of our proposed control approach is the idea of encoding the desired locomotion behaviors via suitable reduced-order, hybrid, dynamical systems. These models formalize the underlying common biomechanical principles governing agile quadrupedal locomotion, without explicitly relying on the morphological details of the robot platform," Poulakakis said.

Thus, they provide unified, platform-independent descriptions of the desired task and they can serve as behavioral control targets. If successful, the work would enable quadrupeds to move reliably at high speeds, self-correct to prevent falls and mimic their animal counterpart's running motion.

Robotic quadrupeds offer unique advantages due to their enhanced stability, high-load carrying capacity and low mechanical complexity. Their ability to travel to areas deemed unsafe for humans, Poulakakis noted, may also enable legged robots to provide critical assistance in search and rescue operations, and may have potential applications in industrial, agricultural and military industries.

Significantly, the fundamental results of this work are expected to apply to dynamically-stable legged robots with different leg numbers and postures. The control algorithms will be derived based on first principles that do not depend on the structural specifics of the system at hand. As a result, the proposed control design methods will be versatile and easily adaptable to accommodate diverse running tasks on robot platforms that may differ in morphological details.

In a complementary project, funded by the U.S. Army Research Laboratory, Poulakakis is investigating the contribution of torso flexibility to performance in quadrupeds.

"If successful, these research efforts will impact the study of many other engineered and biological systems which, like legged robots, accomplish their purpose through forceful, cyclic interactions with the environment," he said.

Article by Karen B. Roberts

"This work may ultimately change the way we view and use materials, in that a structure may provide advanced warning that it is about to fail, and may even be able to heal itself."
-- *Anette Karlsson, department chair*

UD researcher continues nanotechnology collaboration with Koreans

Researcher **Tsu-Wei Chou** continues to advance understanding of hybrid micro- and nano-composites as part of a collaborative research partnership between UD's Center for Composite Materials (UD-CCM) and the Korean Institute of Materials (KIMS) on nanotechnology.

First initiated in 2007, the nine-year research grant totaling $5 million is funded under the Global Research Laboratory (GRL) program of the National Research Foundation of Korea (NRF). The GRL program, established by the Korean Ministry of Education, Science and Technology (MEST), is now in its second three-year phase.

Chou, Pierre S. du Pont Chair of Engineering, is the foreign principal investigator for the grant.

In the past three years, 35 international research teams have been established under the GRL program with major focus in the areas of nanotechnology, biotechnology, information technology and environmental sciences, according to Joon-Hyung Byun, Korean principal investigator at KIMS. Byun is a UD alumnus who completed his doctorate in mechanical engineering in 1992 under Chou's supervision.

The UD-KIMS team is one of the teams awarded GRL funding in the nanotechnology area. UD-CCM and KIMS investigators have focused on developing advanced fiber composites capable of sensing the initiation and growth of microscopic damages, such as minute matrix cracking and delamination, using carbon nanotubes.

This method of electric resistance-based damage sensing affords a unique opportunity to also sense the effectiveness of autonomous repair, also known as self-healing, in fiber composites, said Chou.

During the second phase of the GRL program, the UD-KIMS team will explore these sensing capabilities with particular focus on three-dimensional textile composites.

"Tsu-Wei's work on the use of carbon nanotubes as an integrated sensing system for composites exemplifies the potential for embedded multi-functionality offered by advanced materials," said Jack Gillespie, CCM director and Donald C. Phillips Professor of Civil and Environmental Engineering. "The research is establishing the foundation for structural health monitoring for composites in a wide range of applications."

"This work may ultimately change the way we view and use materials, in that a structure may provide advanced warning that it is about to fail, and may even be able to heal itself," added Anette Karlsson, department chair. "Such advance concepts can only be accomplished by collaborating with first class researchers and the UD-KIMS collaboration is an important part of Dr. Chou's efforts."

Article by Karen B. Roberts

In 2011, **Times Higher Education** named Tsu-Wei Chou, Pierre S. du Pont Chair of Engineering, among the top 100 materials scientists of the past decade. He was also honored as a World Fellow of composites at the 18th International Conference on Composite Materials (ICCM), an achievement held by fewer than 20 ICCM members since 2001. He was named a life member of ICCM in 2009.

Robots

Helping toddlers avoid obstacles

Force feedback joysticks help toddlers using mobile robots avoid obstacles

Prof. **Sunil K. Agrawal**, has co-authored a paper that explores how toddlers can be trained to avoid obstacles using mobile robots with force feedback joysticks.

Agrawal's paper, entitled *"Training Toddlers Seated on Mobile Robots to Drive IndoorsAmidst Obstacles,"* appeared in IEEE's Transactions on Neural Systems and Rehabilitation Engineering journal. Co-authors include Cole Galloway, associate professor in the Department of Physical Therapy, and graduate students Christina Ragonesi and Chen Xi. This work is funded by grants from the National Institutes of Health and the National Science Foundation.

"This is a landmark study where a group of toddlers were trained to drive mobile robots within an environment simulating clutter within the workspace," said Agrawal. "The technology and algorithms were developed in my laboratory by doctoral student Xi Chen and tested at UD's Early Learning Center, with the results displaying overwhelming support that this 'assist-as-needed approach' yields faster learning than a conventional joystick."

The paper explains that mobility is a causal factor in development. In typically-developing toddlers, for example, the onset of crawling and walking has long been associated with developmental changes in perception, cognition and socialization.

Toddlers born with significant mobility impairments often experience developmental delays due to lack of environmental interaction.

Previous studies by Agrawal and his research team have shown that, with several months of training, toddlers can learn to drive directly to a goal using a conventional joystick mounted on a mobility device. Higher-level skills needed to navigate around obstacles or turns, however, are not learned in the same time frame.

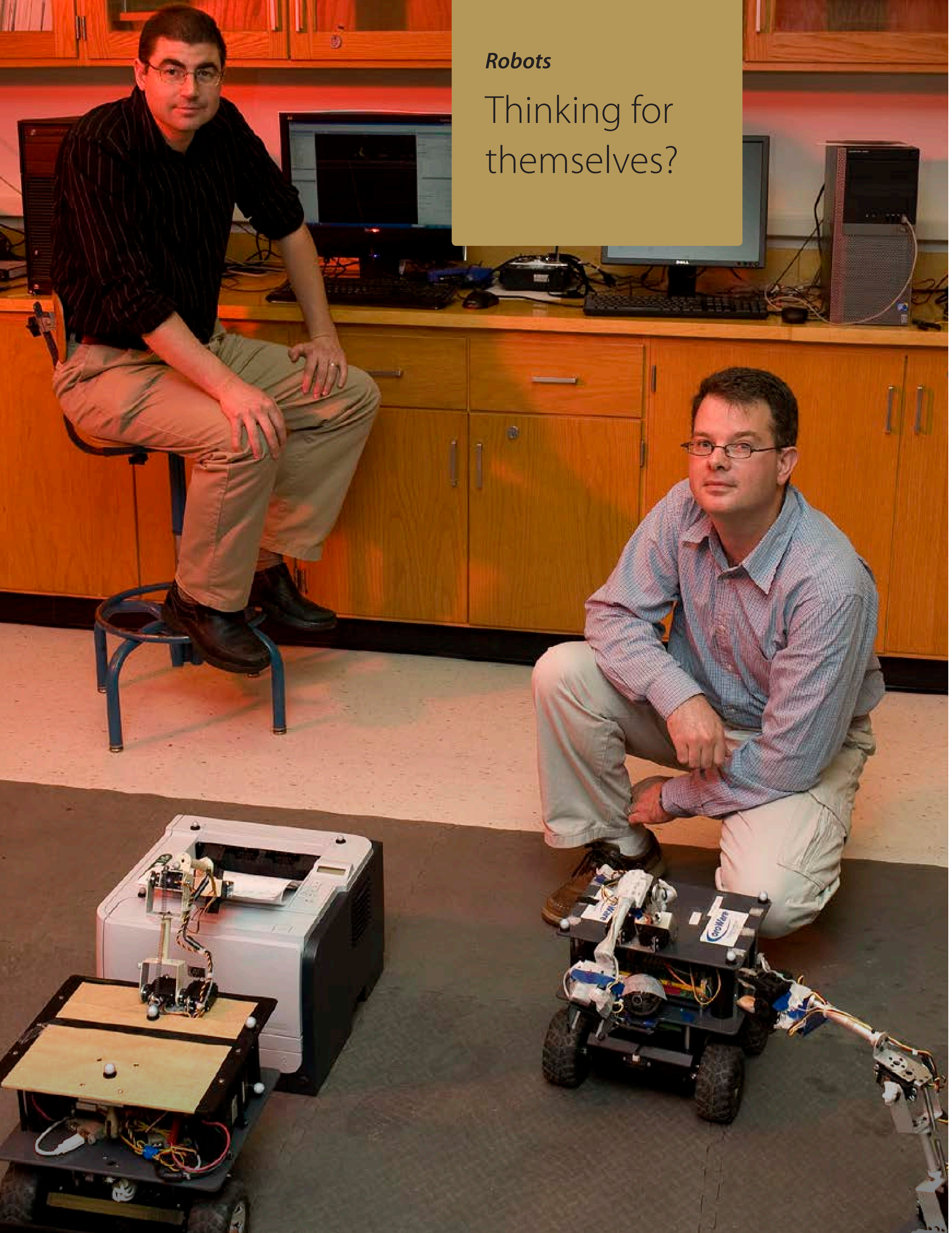
The algorithms developed by Agrawal's research team employ haptic rendering -- or sensory touch -- to speed learning in this young population by creating a force field on the joystick. If the child steers the joystick outside a force tunnel centered on the desired direction, the driver experiences a force bias on the hand. This feedback provides helpful sensory cues that quickly train young drivers.

During the study, 10 typically-developing toddlers with an average age of 30 months were trained to drive a robot within an obstacle course. A toddler unable to walk independently due to spina bifida was also taught. Results on robot position and travel time were recorded, as well as the number of obstacle collisions.

The group study results indicated that the force field algorithm helped very young children learn to navigate and avoid obstacles faster, more accurately and with greater safety. The results from the child with spina bifida showed positive effects during practice with a child with mobility impairments. Study subjects were retested one week after training and early measures indicate the toddlers retained the learned behaviors at least one week following training.

"In the future, we hope to extend this novel application of technology and training to allow young children with special needs to explore and acquire other functional skills using power mobility devices in real environments such as their home or classroom," concluded Agrawal.

Article by Karen B. Roberts



Robots

Thinking for themselves?

Combining engineering and linguistics leads to new discoveries

Babies learn to talk by listening intently to those around them. They observe which sounds come naturally together, intuitively building rules as to what fits and what does not. **Herbert Tanner** believes similar rules exist in robotics, when it comes to deciding the sequence of actions a robot can execute.

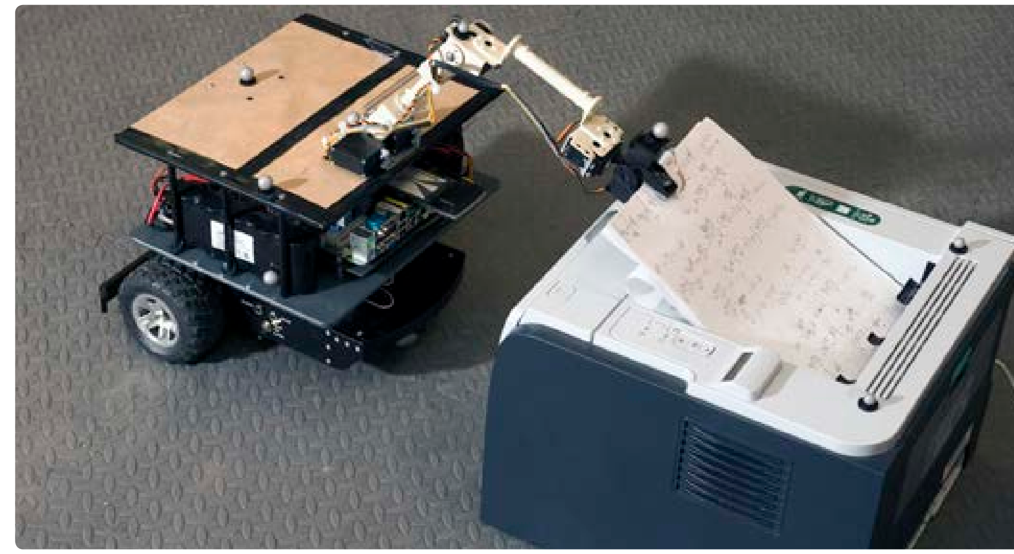
Tanner, an assistant professor of mechanical engineering, and fellow researcher **Jeffrey Heinz**, are applying formal language theory and linguistics algorithms to design robots that can "think for themselves."

"Amazingly, we can use insights from how children learn language to design robots which can likewise learn from their experience," said Heinz, an assistant professor of linguistics and cognitive science.

This is accomplished through a theoretical modeling and analysis framework that uses a combination of logic (the language of computer science) and differential equations (the language of traditional engineering). The new algorithms will give the robot the tools to devise plans on its own, based on its environment.

Currently, human designers pre-program robots to complete actions in a certain sequence. This is because while planning is easy for humans, it is analytically and computationally challenging for robots.

In one example, a robot is asked to pick up and deliver a computer printout. The robot uses high frequency wireless



communications and a network of eight cameras to triangulate its location and its destination. The cameras offer pinpoint accuracy – within one millimeter –measuring the robots' location one hundred times per second using reflective markers. The sequence of maneuvers involved is currently pre-programmed, but Tanner has a plan to enable the robot to "program" itself.

"We want our robots to learn both from a human instructor and from their environment how to plan their actions," said Tanner.

In the future, he hopes to include multiple robots, potentially using a combination of both ground and aerial machines.

"A team of robots that exploits the strengths of each member is more valuable than adding new capabilities to a single robot," he added.

If successful, Tanner's research will allow robots to observe the behaviors around them and adapt their actions according to their surroundings. He believes this could be useful in emergency response to automatically generate an action plan for how first responders can quickly coordinate relief efforts.

Medics, for example, cannot reach victims unless engineers have cleared the rubble; meanwhile, engineers need to wait for firefighters to put out the flames before they can work.

"It becomes a problem of planning, scheduling and resource allocation," explained Tanner.

"Having an automated planning tool generated by the robots can eliminate uncertainty and confusion and get things going."

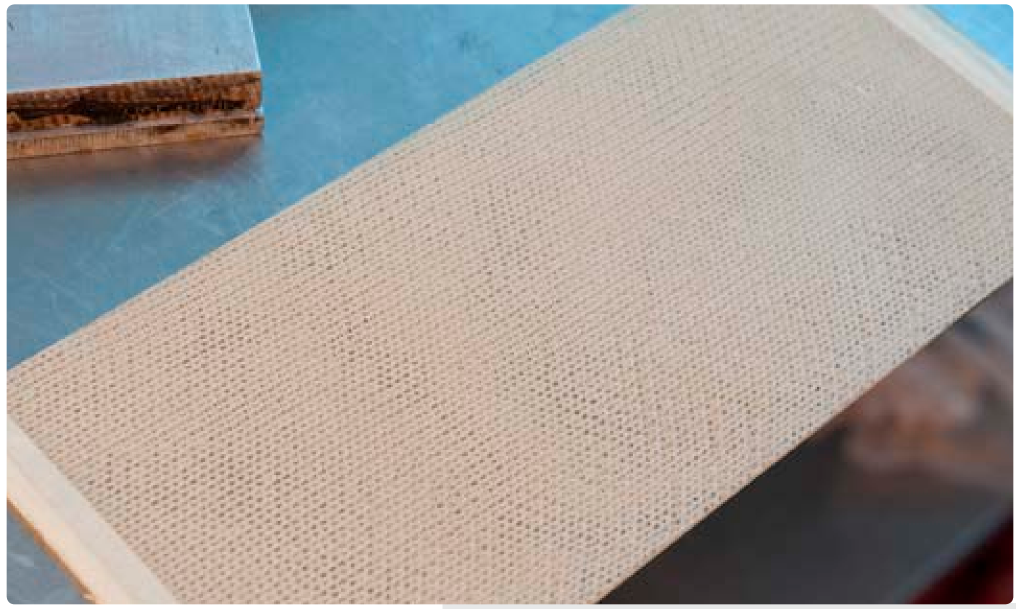
The research is funded by the National Science Foundation's Cyber-Physical Systems program. Tanner is the principal investigator on the grant, which totals $1 million. Heinz and Calin Belta, a mechanical engineer at Boston University, serve as co-principal investigators on the project.

Article by Karen B. Roberts

Size matters

Mighty nanomaterials

UD receives grant to enhance infrastructure for nanomaterials research, education



Nanomaterials are tiny but mighty, offering the potential for use in a vast array of applications from fuel cells to drug delivery systems. Their size—the diameter of a nano-fiber is approximately one-thousandth that of a human hair—underlies both their power and the challenge of harnessing that power.

"Strange things happen when materials get that small," said Professor **Erik Thostenson**. "Exploiting the unique properties of nanomaterials requires a highly integrated approach involving scientists and engineers from diverse fields. For engineers to be well versed in nanotechnology, it's crucial to introduce the topic early."

Thostenson is leading a team that recently received a $200,000 grant from the National Science Foundation's Nanotechnology Undergraduate Education (NUE) in Engineering program. The grant will support research-based educational opportunities for undergraduate students in a number of areas, including energy applications and sensing and actuating devices for smart multifunctional materials. UD's (CCM) will serve as a focal point for active exchange and interaction in the program.

"We need to provide our students with a solid scientific and technical base as well as an understanding of emerging technologies and the unique properties of nanomaterials if we want to prepare them to engineer new smart structures and devices at the nanoscale," Thostenson said.

Specific objectives of the program include developing new course materials as an outgrowth of the research, as well as actively involving students in project-based activities to generate excitement about nanotechnology and promote interdisciplinary collaboration.

"We have a strong infrastructure in place at the center for these types of interdisciplinary projects through our high level of student involvement in professional organizations like SAMPE and ASME," said CCM director John W. (Jack) Gillespie Jr. "These kinds of activities are a great way to build scientific leadership skills and teach students how to effectively work in teams."

The NUE grant will also facilitate the involvement of underrepresented minorities in engineering through UD's Resources to Insure Successful Engineers (RISE) and Women in Engineering (WIE) programs.

About the research team

The UD NUE team encompasses expertise in all aspects of nanoscale materials, including synthesis, manufacturing, modeling, processing and characterization. Faculty members include Erik Thostenson, assistant professor in the Department of Mechanical Engineering; Jack Gillespie, CCM director and Donald C. Phillips Professor; Joshua Hertz, assistant professor of mechanical engineering; and Bingqing Wei, professor of mechanical engineering.

Article by Diane Kukich

UD and Peking University advance engineering exchange program

A novel exchange program in engineering research and education will launch between the UD and Peking University (PKU) this July, expanding the world view of students at both universities and providing opportunities for faculty to collaborate.

Faculty and undergraduate students from UD will travel to Beijing-based PKU, known as China's Harvard, for an intensive six-week summer program, while PKU undergraduate students will spend a semester at UD.

Advanced through the Global Educational Exchange Initiative (GLOBEX) recently signed by the two universities, the program will "allow exceptional students and faculty from the two colleges to attain a global educational, research and professional experience," according to Pingchou Han, assistant dean for global education in PKU's College of Engineering.

Han visited UD on Feb. 8 to meet with engineering faculty and students. A formal ceremony with University President Patrick Harker was held to initiate the signing of the institutional partnership agreement. He also presented the seminar "Engineering Your Future in a Globalized World."

Han's visit was a follow-up to the initial agreement signing this past December between Babatunde A. Ogunnaike, UD's interim dean of engineering, and Shiyi Chen, dean of engineering at PKU.

The GLOBEX initiative provides for both undergraduate student exchange and faculty research collaboration, with the participation of a maximum of 12 students and two faculty members per year from the two universities.

According to Ogunnaike, UD faculty will teach specific courses in engineering at PKU, which will be open to students from both universities. The PKU students traveling to Delaware will take regular UD courses. Faculty research collaborations will span the entire discipline of engineering.

The reciprocal cultural awareness fostered through the exchange program also will be an important benefit, Ogunnaike said, as American students and Chinese students learn about each other's cultures.

"The globalization of science and engineering makes it imperative that we train our students to function effectively in a multicultural world," Ogunnaike said.

"The GLOBEX exchange offers a platform that is the first of its kind for our faculty and students," noted the program's coordinator at UD, Lian-Ping Wang, professor of mechanical engineering and physical ocean science.

"The long-term benefits include a better mutual understanding of culture and people, global research collaboration between faculty members at the two institutions and attracting the best students from China to UD for graduate study in our world-class research," Wang said.

ABOUT PEKING UNIVERSITY'S COLLEGE OF ENGINEERING

Established in 1898, Peking University (PKU) is the first national comprehensive institution of higher learning founded in China. Also known as the Chinese Harvard, PKU is a strong educational and research university that uses its traditional strengths in the natural sciences, social sciences and humanities to make further progress in engineering, applied sciences, education and numerous other interdisciplinary fields of study. The 105 faculty and teaching and research staff of PKU's College of Engineering are conducting cutting-edge research in fields ranging from physical sciences and medicine to public health and industrial management.

Article by Fariba Amini

Nanotechnology workshop expands UD's international reach

Engineers from Tsinghua University in Beijing, China, traveled nearly 7,000 miles across three continents to share their research with University of Delaware faculty at a joint nanotechnology workshop held on campus April 27-28, 2011.

Tsinghua University is one of China's top universities. UD formed a mutual agreement with the academic institution in 2008 to foster research and educational collaborations among faculty, especially in engineering.

According to Provost Tom Apple, the workshop illustrates several of the University's most important goals: to expand international reach and amplify impact; to strengthen global partnerships; and to develop collaborative initiatives in international and transnational issues.

"These are key priorities in our strategic plan -- our Path to Prominence™ -- and we are committed to ensuring that UD plays a significant role in the global community," Apple said.

Advances in nanotechnology -- the science of the very small -- have direct implications in computing, communications, the environment, security, energy independence and health, according to workshop organizer **Bingqing Wei**, associate professor in the mechanical engineering.

Keynote speakers **Tsu-Wei Chou**, Pierre S. du Pont Chair of Engineering at UD, and Feiyu Kang, materials science professor and supervisor of the New Carbon Materials Laboratory at Tsinghua University, discussed some of the challenges facing today's scientists.

Chou shared recent advances in carbon nanotubes, while Kang addressed new technologies in energy storage devices that use nano-sized materials. Faculty presentations, a poster session and a tour of UD laboratories rounded out the two-day conference

"Partnerships such as this are critical to UD establishing a presence on the worldwide stage and enhancing its global impact," said Babatunde Ogunnaike, interim dean of the College of Engineering.

Article by Katie Galgano

Alumni Weekend

Distinguished Career Award Alumni will be honored June 1

Mechanical Engineering Alumni Career Celebration

8th annual ME Alumni Career Celebration set for Alumni Weekend, June 1 – 3

Reconnect with classmates and faculty during ME's alumni career celebration, Friday afternoon, June 1, as we explore the life-impacting capabilities of Biomechanical Technology – Medical Devices. Department Chair Anette Karlsson will kick off the event with an overview of department activities and ongoing research, followed by recognition of four ME alumni selected for this year's Distinguished Career Award.

Don't miss this opportunity to network with ME faculty and fellow alumni representing some of the most progressive and influential companies in the industry today. Lynn Sydnor-Epps, associate director, Employer Relations, with UD's Career Services Center will also be on-hand to discuss career related services available to UD graduates.

Continue the celebration on campus with fellow Blue Hens for a weekend filled with programs and activities.

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

University of Delaware
ALUMNI WEEKEND
JUNE 1–3, 2012

ME program highlights

June 1, 2012

Biomechanical Technology – Medical Devices

Adventures in Ortho Land
Dr. Jenni M. Buckley, assistant professor, UD Department of Mechanical Engineering

Mechanical Engineering in Othopaedics
Michael J. Axe, M.D., orthopaedic surgeon and clinical professor in UD's Department of Physical Therapy

Marketing and Regulatory Environment in the Medical Devices Industry
Ken Ryder, BME '86, VP of Research & Development, Cordis Corporation, Johnson & Johnson

Intradermal Drug Delivery Adaptor
2011 Mechanical Engineering Senior Design Team representing West Pharmaceuticals

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

Distinguished Career Awards

Four distinguished alumni will be honored at Alumni Weekend on June 1, 2012. Alumni are selected for recognition based on several criteria, including achievement, impact, uniqueness and interest.

Ernest Emerson Jones, '92

Ernest Jones is the director of worldwide sales for Tivoli Software, IBM Software Group. He is accountable for sales, product development and the "Go To Market" strategy for Tivoli's software solutions, which enable clients to centrally manage their infrastructures, improving overall service, including security and storage, while significantly reducing operating expenses through automation and managing critical assets.

In 1996, he joined IBM as a technical sales specialist and quickly moved first into brand management and then was promoted to business unit executive for the iSeries East Region STG sales organization. He later led the Southeast channels organization and was responsible for the Systems and Technology group's largest business partners and distributors. In 2004, he worked in IBM's North American Communication Sector focusing on the Energy and Utility Industry, and, as client director, he managed IBM's largest E&U clients, including Southern Company and Florida Power and Light. Prior to his current assignment, Jones worked in Somers, NY, as executive assistant to the general manager of Tivoli Software. He also resided in Dubai, UAE, while serving as the director of Tivoli Software, CEEMEA, which included Russia, Central and Eastern Europe, the Middle East and Africa.

This 1992 UD undergraduate in mechanical engineering who earned his masters in business administration from the University of North Carolina at Chapel Hill, Kenan-Flagler Business School, recalls that the best advice he ever received is "Don't be afraid to make difficult decisions." In turn, he advises others, "Do your best, be yourself and don't be afraid to be innovative. Transformation is the only constant in business."

Former Blue Hen catcher for legendary coach Bob Hannah, Jones serves on the board of directors for The Ernann Corporation, which supplies specialized student housing developments featuring emerging technologies; the Seminole County (Florida) Public School Foundation; and as the president of the Board of TeeLo Golf; and is intimately involved with the Cystic Fibrosis Foundation.

Ken Ryder, '86

Ken Ryder has 25 years of research and development and medical device experience in mission-critical and life-sustaining products and technologies. In 2003, he joined Johnson & Johnson as director of research and development for Cordis Corporation in Miami Lakes, Florida. He relocated to the San Francisco Bay area in 2008, upon promotion to his current position as vice president of research and development, where he oversees medical device R & D for Cordis.

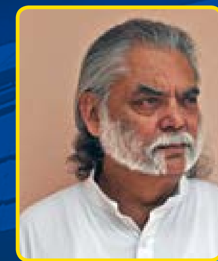
Ryder's leadership is credited with bringing exciting new platform technologies, such as the Exoseal™ vascular closure device, the SLEEK® OTW peripheral balloon catheter, and the EMPIRA™ coronary balloon catheters, into global markets; as well as bringing new platform technologies, such as the INCRAFT™ abdominal aortic aneurysm stent graft, into clinical trial. He is the Johnson & Johnson representative for the Silicon Valley Leadership Group (an industry/government cooperative addressing major public policy issues affecting business health and quality of life) and is actively engaged in Johnson & Johnson's California government affairs programs.

Prior to joining Johnson & Johnson, Ryder was the director of research and development for Carbomedics, where he developed and commercialized many new heart valve and repair products into global markets. He served six years as an Officer in the United States Air Force in areas of Intercontinental Ballistic Missile Program Management and Fatigue, Fracture and Reliability Research.

He holds a bachelor of mechanical engineering degree from UD, a master of science degree in systems management from the University of Southern California, and a master of science degree in aeronautical engineering from the Air Force Institute of Technology.

"UD provided me with a nice blend of theoretical and practical, and this proved to be very helpful in my career pursuits," recalls Ryder. "I gained confidence very quickly in the professional ranks when I realized how strong the education was from UD compared to the top tier engineering schools."

Ryder was recently appointed to the Mechanical Engineering Chair's Advisory Council here at UD and is an active alumni contributor.



Dinesh Mohan, '70 MMAE

Dinesh Mohan is one of the world's leading experts on traffic safety issues and human tolerance to injury. His work has significantly advanced motorcycle helmet design, pedestrian and bicyclist safety and child restraint regulations, and helped develop safer ways for various modes of transportation to safely share the roadways.

While a UD graduate student in mechanical and aerospace engineering between 1967 and 1970, he studied under JL Nowinski, Jack Vinson, Herbert Kingsbury and Barry Schneider, who, he said, each left an indelible mark on the importance of fundamental understanding of engineering principles. He credits the foundation he gained at UD in solid mechanics for influencing his career in biomedical engineering, especially his work on the mechanical properties of hard and soft tissues. Both, he underscores, require strong background in non-linear anisotropic materials and dynamic impacts.

Mohan, who is now the Volvo Chair for Transportation Planning and Safety, professor emeritus, with the Indian Institute of Technology Delhi, launched his career as a senior bioengineer with the Insurance Institute for Highway Safety in Washington D.C. There, he conducted and published the first real-world assessment of airbag effectiveness in frontal crashes of General Motors cars. His work there also impacted the evolution of regulations requiring children to be secured in a back seat.

He moved to India in 1979 to join the Indian Institute of Technology Delhi, where he served as State Bank Chair for Biomechanics and Rehabilitation between 1981 – 1991; became professor in 1985, and headed the Centre for Biomedical Engineering between 1991 – 1996. He then served as the Henry Ford Chair for Traffic Safety Biomechanics until assuming his current position in 2007.

In 1997, he helped establish--and coordinated until 2010--the Transportation Research and Injury Prevention Programme (TRIPP), which presents a replicable model for creative interaction and cross-divisions problem solving for research, academia and other groups in cities worldwide.

Among his many honors are the 2001 Bertil Aldman Award for outstanding contribution to the subject of impact biomechanics, International Research Council on Biomechanics of Impacts; and the 2000 International Distinguished Career Award from the American Public Health Association.

Ann Marie Sastry, '89

Ann Marie Sastry, a 1989 UD Mechanical Engineering Undergraduate DuPont Scholar, is CEO of Sakti3, a Michigan-based company developing an advanced solid-state rechargeable lithium-ion battery technology. Sakti3 was honored by MIT's *Technology Review* as one of the Top 50 Most Innovative Companies of 2012 for its technology and team. Their battery technology was also named one of the 2011 World's Top Ten Technologies, representing the "energy" category globally, by *Technology Review*.

She earned her doctoral degree in mechanical engineering in 1994 from Cornell University, where she was a National Science Foundation (NSF) graduate fellow. Before joining the University of Michigan she served as senior member of technical staff, Sandia National Laboratories.

Sastry is on leave from the University of Michigan, as an Arthur F. Thurnau Professor of Engineering. Her credentials include several of the highest honors in her field, including the 2011 ASME Frank Kreith Energy Award, the 2007 ASME Gustus Larson Award and the NSF's Presidential Early Career Award for Scientists and Engineers (1997). From 2007-2010, she served as the founding Director of the Energy Systems Engineering Program, growing enrollment to more than 150 students. She founded two research centers at UM, one in intracellular signaling (Keck Foundation) and the other in battery technology (GM / UM Advanced Battery Coalition for Drivetrains).

There is "no contest" for Sastry on her favorite memories while at UD. "They're all with my wonderful husband, Christian Lastoskie (BS ChE '89 & DuPont Scholar)," she acknowledges. "He and I have been lab partners, professional collaborators, and most importantly, parents to our two amazing kids, Katie and Peter. Meeting him was enough reason to always be glad I went to UD."

She added, "I also got a wonderful education at UD, and met my great friend and mentor, Professor Byron Pipes, who let me join his research group as a freshman - an experience that really shaped my professional future."

Faculty Highlights

New addition

Jenni Buckley has joined the Department of Mechanical Engineering as an assistant professor.

A UD alumna, Prof. Buckley received her bachelor's degree in mechanical engineering from UD in 2001, and her MS (2004) and PhD (2006) in Mechanical Engineering from the University of California, Berkeley, where she worked on computational and experimental methods in spinal biomechanics. Professor Buckley's research efforts focus on the development and mechanical evaluation of medical devices, particularly orthopaedic, neurosurgical and pediatric devices. She teaches a range of courses as part of the department's undergraduate curriculum, including biomedical engineering and senior design. Additionally, Prof. Buckley serves as the chief scientific officer for The Taylor Collaboration, an orthopaedic biomechanical testing laboratory and she is the executive director of The Perry Initiative, which sponsors outreach programs to inspire young women to pursue careers in orthopaedic surgery and engineering.

Lian-Ping Wang honored for pioneering fluid mechanics research

Lian-Ping Wang, has been elected a fellow of the American Physical Society (APS).

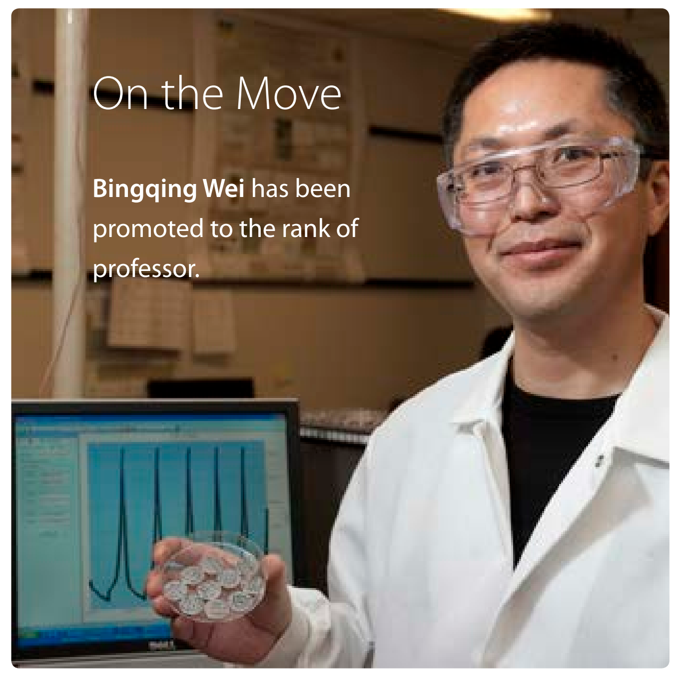
Designation as an APS Fellow places Wang among the top one-half of one percent of APS members, an elite appointment that recognizes his pioneering research on the theory and computation of turbulent particle-laden flows and their application to engineering and environmental processes.

Wang's work involves creating advanced simulation tools to study and predict physical processes at small scales, and the development of statistical descriptions of these processes that enable scientists to better formulate large-scale models. His research focuses on diverse environmental processes that show potential in perfecting existing prediction methods and reducing uncertainties in weather and climate models.

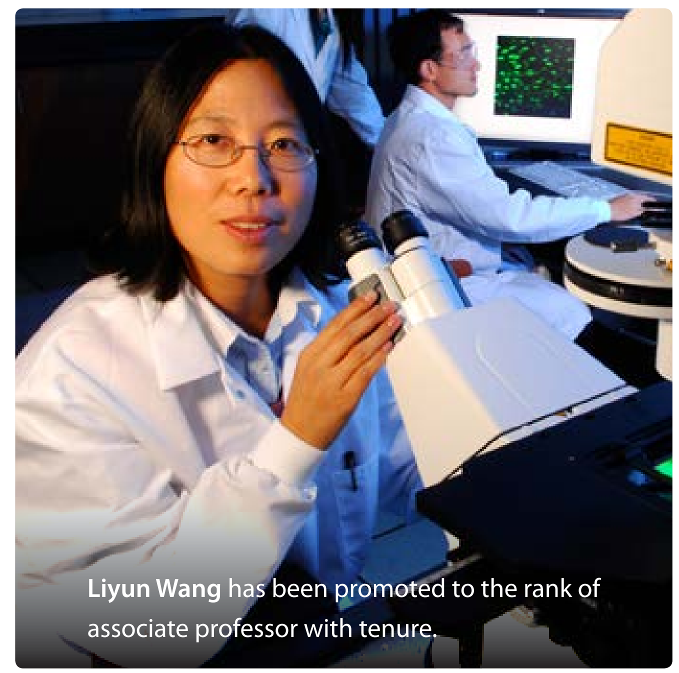
A critical step towards solving the global warming debate is understanding the microphysical development of clouds, said Wang. His group uses rigorous computer simulations to quantify how air turbulence can enhance the collision rate of droplets in atmospheric clouds. Their pioneering research in this area contributes to the improved accuracy of large-scale models used to predict weather phenomena and climate changes.

Wang's research group also studies nano-particle transport in ground soil. They are developing a revolutionary bottom-up simulation tool to help scientists predict the passage and retention of nano-particles in soil. This work is literally "groundbreaking," as little is known about the progression of these particles and their effect on the environment.

On the Move



Bingqing Wei has been promoted to the rank of professor.



Liyun Wang has been promoted to the rank of associate professor with tenure.

Beyond the classroom

Senior Design students tackle real-world engineering challenges; sponsors appreciate fresh approach.

Senior Design is the six-credit capstone design course structured to imitate industry scenarios that young engineers may experience while working on a design team. First, design teams select a project, discover customers' wants, benchmark the best practices for each desired function, generate design concepts and select the best concept. Then, teams build a prototype, test it and improve their designs. The course provides a realistic industrial management structure and professional background for the design project activities.

Sponsors provide real-world engineering challenges for the students to solve, and also guide and mentor the team throughout the process, often hosting students at company facilities to expose them to the work environment. In return, sponsors appreciate the "fresh look" that the students bring to an "old" engineering problem.

2011 senior design teams

AMSAA // DIESEL ENGINE EXHAUST BRAKE

Carolyn Dippold
Eric Brixen
Matthew Figueiredo
Kyle Chaires

ALCORE // JET ENGINE BLOCKER DOOR

John D. Matthews
David Chun
Eric Wurtzel
David McNamara

CHESAPEAKE TESTING // BALLISTIC CONDITIONING CHAMBER

Zachary Anderegg
Marra-Powers
Christopher Weidner

1982 senior design team redesigned a sled for top Olympic luger **Frank Masley** (kneeling, left). The team tested the aerodynamics of their designs in a wind tunnel at Aberdeen Proving Ground. *Standing*: **D. Michael Brown**, **Charles Vinning**, **Dale Moore**, **Jeff Foulk.** *Kneeling*: **Frank Masley** and **Ken Yearwood**

It's all in the (UD) family for Team SURVICE sponsors

SURVICE Engineering Company of Belcamp, Maryland, which specializes in engineering measurements and dimensional inspections for national defense systems, has completed its fourth year as a UD Senior Design sponsor. At the company's helm is President and CEO, **Jeffrey W. Foulk** (BME '82), who fondly recalls memories of his own days at UD, and specifically his own Senior Design project to redesign a luge sled for Olympic luger Frank Masley of Newark, DE. Jeff's father, **James B. Foulk** ('59), 2007 recipient of a Distinguished Career Alumni Award from Mechanical Engineering, is founder of SURVICE Engineering Company and president and CEO of Chesapeake Defense Services, Inc.

Jeff notes, "I think it's great for alumni to give back to the university and to the students. The senior design project is a win-win for all involved."

Team **SURVICE** — explores ergonomics

Team **SURVICE** took on the challenge of conceptualizing and fabricating a prototype equipment vest that allows aircraft inspectors to efficiently and ergonomically carry such necessary items as a central processing unit, operator control unit, battery packs, a display unit, interface units and associated cabling. The design had to take into account operator comfort, ease of access to mission-critical components, durability and maintainability. It also required a novel approach to equipment and cabling integration.

Working with team sponsor John Hersey, Research and Technology Team Lead for the Applied Technology Operation of SURVICE Metrology, the team came up with several novel approaches, most notably integrating a passive phase-changing cooling system into the vest panels for cooling the operator.

The students spent a combined 1,300 hours creating a functional prototype addressing wiring and computer overheating issues; ergonomic weight distribution for user comfort; and integration of both a user cooling system and an on/off switch more readily accessible to the user.

Team advisor, Professor Michael Keefe, remarked, "I was impressed by how far the team delved into the ergonomics of the vest affecting the individual, and also by how they engaged the bioengineering experts on campus to understand the impact of various design concepts."

2011 Sponsors

- Alcore
- AMSAA
- Chesapeake Testing
- CNH America
- Comar Inc
- Dupont
- ESCO
- GGB
- ILC
- MEI, Inc
- Omega Design
- Precision AirConvey
- Schiller Grounds Care
- Sensing Devices
- Southco
- Speakman Safety Products
- Sun Edge
- Superior Tube
- SURVICE Engineering
- Synthes
- Testing Machines
- W.L.Gore
- West Pharmaceutical

Team **Sensing Devices** — from R&D to production

As technology advances, so, too, does the need for platinum sensors, along with robust housing designs. **Sensing Devices, Inc.**, of Lancaster, Pennsylvania, has manufactured and designed platinum resistance thermometers, aerospace assemblies and custom resistors/heaters since the early 1980s. They recently signed on as a Senior Design sponsor seeking a more progressive approach to their assembly operation. The objective was to employ a Resistance Temperature Detector (RTD) design referred to as "mandrel wound," a resistor manufactured by wrapping the sensing wire around the outside of a ceramic body. This provides a robust body to support and protect the wire from shock and vibration, as well as improved response time compared to other RTD designs.

UD's senior design Team Sensing Devices stepped up to the task of using current sensor specifications to achieve a more reproducible, tighter resistance tolerance RTD for tomorrow's environmental challenges, and keeping the product competitive in global markets. Sensing Devices Senior Engineer Chris Albert was impressed with the students' smooth, decisive approach and ability to adapt midstream as parameters changed in the course of taking product assembly from research and development to production.

Advised by Professor James Glancey, the team reviewed the performance of different RTD designs and assessed SDI's current assembly procedure pertaining to production time per piece and material cost. The result is a more aggressive and efficient manufacturing method addressing Sensing Device's production needs.

Based on the team's performance last fall, two members remained with Sensing Devices through the spring semester, earning credits as they focused on design changes to test and evaluate product coatings to further improve performance and simplify manufacturing.

Article by Martha Lodge

CNH AMERICA // BALER NET WRAPPING SYSTEM

Kyle Doolin
Ryan Klusty
Jeffery Hawk
Allan Arisi

DUPONT // CONTINUOUS COMPRESSION MOLDING SYSTEM

Michael Yeager
Brien McCormick
Alistair Tolosa
Danielle Abell

COMAR INC. // COSMETIC DROPPER ASSEMBLY SYSTEM

Mark Oteiza
Neil Donnelly
Jillian Silver
Stephen Mulligan

ESCO // AIRCRAFT ARRESTING BLOCK DRAIN SYSTEM

Alex Levin
Ross Megargel
Michael Falduto
Antonio Fascelli

GGB // BEARING LINER QUALITY IMPROVEMENT

Jason Silinger
John R. Matthews
Anthony Loccisano
Andrew Whitehead

MEI INC. // COIN ACCEPTOR RELIABILITY TESTER

Michael Cayne
George Ferguson
Brian Lifvergren
Dylan Novak

ILC // SOFT-GOOD LEAK TESTER

Thomas Ford
Charles Andersen
Joseph Walsh
Anthony Battaglia

OMEGA DESIGN // FLEXIBLE CONTAINER HANDLING SYSTEM

John Delucca
Scott Fritsch
Dan Marchegiano
Jeffrey Ulchak

ALUMNI:

Build relationships with some of the brightest, most creative young minds in the industry by encouraging your company, corporation or engineering firm to sponsor a UD Senior Design team.

Contact:
Nate Cloud at
cloudn@udel.edu
to learn more.

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

PRECISION AIRCONVEY // VENTURI WASTE SYSTEM OPTIMIZATION

Brandon Baetz
Phil Guerieri
Travis Krell
Theo Roustopoulos

SCHILLER GROUNDS CARE // MANTIS TILLER BROOM ATTACHMENT

Tyler Rodgers
Brandon Pastor
Scott Heller
Christopher Csoboth

SENSING DEVICES // RESISTANCE TEMPERATURE DETECTOR ASSEMBLY

David Eisensmith
Laura Quinn
Brett Davis
Stephen Schafer

SOUTHCO // FRICTION AND WEAR TEST SYSTEM

James Kersch
Alexander Szela
Andrew Varney
David Ly
Milos Kukoleca

SPEAKMAN SAFETY PRODUCTS // SAFETY EYE/FACE WASH SYSTEM

Morgan Pollard
Christopher Reese
Rhys Ainsworth
Sean Laflam

SYNTHES // ORTHOPAEDIC SCREW INSPECTION STATION

Chanel Aldrich
Andrew Loftus
Amy Bucha
Peter Fenimore

SUN EDGE // CONCENTRATING SOLAR MODUL COOLING

Theodore Eccleston
Meaghan Kearney
Thomas Missimer
Robert Amabile

TESTING MACHINES // NOTCH CUTTER TESTER RE-DESIGN

Abdullah Baaqeel
John Berting
Justin Koniuk
Steven Simpers

SUPERIOR TUBE // PLASTIC COATING APPLICATOR SYSTEM

Nick Bessman
Thomas Dodge
Kevin Sadeghipour
Joshua Martin

W.L. GORE // ROLL CORE REMOVAL SYSTEM

Eric Ferguson
Shaun Staley
Matthew Kelly
Glenn Stearns
Shawn Olsen

SURVICE ENGINEERING // AIRCRAFT INSPECTION EQUIPMENT VEST

Kevin Schiff
Sean Rodammer
Thomas Perry
Daniel Buesking

WEST PHARMACEUTICAL // PHARMACEUTICAL COMPONENT SILICONE APPLICATOR

Timothy McCaslin
Brennan Blumenthal
Nicole Sermabeikian
Timothy Kutchen

Senior Design ADVISORS

Jenni Buckley
Nate Cloud
Bill Fagerstrom
Jim Glancey
Dyer Harris
Mike Keefe
Steve Timmins

PHOTO BY DAWN FIORE

Sampling SAMPE

UD students have strong presence at international materials conference

A group of UD engineering students returned from the SAMPE 2011 International Conference in Long Beach, Calif., with eight awards as well as valuable exposure to the global composites industry and career opportunities.

Eighteen students affiliated with UD's Center for Composite Materials (CCM) attended SAMPE 2011 in Long Beach, Calif., from May 23-26. The international conference and exhibition has been hosted annually for more than half a century by SAMPE, the Society for the Advancement of Material and Process Engineering.

At the 14th annual SAMPE Student Bridge Contest, held in conjunction with the conference, UD submitted entries in six of seven contest divisions, winning a top award in one category and placing in the others in competition with schools around the world.

In addition, Zach Melrose and Sarah Friedrich, both UD mechanical engineering majors advised by assistant professor Erik Thostenson, received first and second place, respectively, for their undergraduate research on the use of carbon nanotubes for in-situ damage sensing in composites.

According to Ph.D. student John Gangloff, Jr., who has been involved as a SAMPE chapter leader at UD for the past several years, the bridge contest requires students to design and build a two-foot-long model of a composite bridge, including documenting the materials used and the manufacturing method employed. Categories cover a range of materials—glass, carbon and natural fibers—and cross sections—square beams, I-beams and box beams.

"The contest enables engineering students to learn and expand their abilities in manufacturing and design," Gangloff said. "It helps reinforce and apply the theories that we learn in class and provides a great opportunity for us to interact with and learn from other teams."

Melrose, who graduated from UD in January 2011 and is now working for the Army Research Laboratory at Aberdeen Proving Ground, Md., said his first-place research award solidified his decision to continue his research with Thostenson as a graduate student at UD, beginning in the fall.

"Dr. Thostenson's guidance allowed me to further my education beyond the textbook and granted me hands-on access to begin my nanomaterials research," Melrose said. "I am really excited to begin my graduate studies at UD knowing that our school brought home first- and second-place honors in composite research.

"As a finalist in the competition," he added, "I was invited to partake in technical lectures, broaden my networks by meeting other student and professional researchers, and present my research and findings to one of the largest and most influential audiences in the country," he said. "I valued this once-in-a-lifetime offer as the true award of the competition and took full advantage of the lectures and opportunities at my fingertips."

Thostenson credits SAMPE with hosting an excellent student program and helping to develop future leaders.

"Both Sarah and Zach have been involved with SAMPE for the past several years, and Sarah served as secretary of the UD chapter during the 2010-2011 academic year," he said. "Both of them have also made outstanding progress in their undergraduate research over the past two years. They started working in my laboratory after their sophomore year as Science and Engineering Scholars in UD's Undergraduate Research Program."

As well as being advised by Thostenson, the students were mentored by Amanda Wu, a postdoctoral researcher at CCM. In an interesting twist, both Wu and Thostenson participated in the Ph.D. portion of the SAMPE symposium when they were students and won first place in that competition, Thostenson in 2002 and Wu in 2008.

Gangloff, who has been president of the UD chapter during the past year, said he is grateful to the College of Engineering and to CCM and director John W. (Jack) Gillespie for supporting the students' ongoing involvement in SAMPE and their attendance at the international symposium.

"Dr. Gillespie is very forward-thinking in his understanding of this competition and what it means to us as students and future employees in the composites field," he said. "The meeting showed us that the future really is composites."

Article by Diane Kukich

CCM Awards

STUDENT SYMPOSIUM:

1st place B.S. category: **Zach Melrose**, "Damage Sensing in Adhesively Bonded Composite/Steel Joints Using Carbon Nanotubes"

2nd place B.S. category: **Sarah Friedrich**, "The Influence of Calendering on Carbon Nanotube/Polymer Composites for In-Situ Damage Sensing"

BRIDGE CONTEST:

1st place: Natural Fiber Square Beam

2nd place: Natural Fiber I-Beam

3rd place: Glass Fiber Box Beam

4th place: Glass Fiber I-Beam and Glass Fiber Box Beam (two entries)

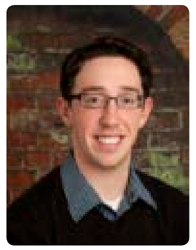
6th place: Carbon Fiber Box Beam

9th place: Carbon Fiber I-Beam

Undergrad spotlight

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.

Article by Janie Sikes



Michael Cayne likes to give prospective students fair warning. During Blue and Gold days, he explains that being a mechanical engineering student is no "walk in the park." However, he is also quick to express the benefits of studying ME at UD.

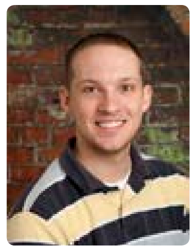
"I've gone through this experience because I enjoy engineering and all of the exciting opportunities that come along with it," Cayne said.

As president of ASME at UD, Cayne's enthusiasm for mechanical engineering is evident. He is dedicated to fulfilling the organization's goal of creating opportunities that expose students to the possibilities found in mechanical engineering. Currently, the chapter is assembling a team to compete in the Collegiate Challenge Punkin Chunkin Competition this November. He was also involved in planning Engineers Week 2012 activities.

Cayne is very involved in Habitat for Humanity at UD and serves as the chapter's co-president. He is also a teaching assistant for a thermodynamics lab and a member of the department's student advisory committee. He is a member of Tau Beta Pi and served as a team leader for UD's Alternative Spring Break Program.

His senior design team worked with MEI to develop a reliability demonstration system that enables product testing of the company's various coin acceptors for functionality and reliability.

Following graduation, Cayne will join Air Products and Chemicals Inc.'s rotational CDP Program.



As president of Tau Beta Pi, **Philip Guerieri's** leadership fostered a significant increase in student involvement, leading the chapter to co-sponsor the inaugural College of Engineering Core Cram and facilitate Engineering Futures Sessions. He is also a member of ASME and served as a co-convener of Engineers Week 2012.

A Blue Hen Ambassador Student Coordinator, Guerieri is a member of the ME department's student advisory committee, serves as a TA for several engineering courses and recently served as a site leader for a New Orleans Disaster Relief Trip during UD's Alternative Spring Break program.

Last fall, Guerieri's senior design team successfully redesigned and optimized the Venturi conveyors used at Precision AirConvey (PAC) to increase their efficiency. The team continued their work this spring to further improve the design.

Guerieri is grateful for his early exposure to research, which he feels is unique to UD. He has conducted extensive research into the optimization and reliability of proton exchange membrane fuel cell electrodes with UD Professors Valery Roy and Ajay Prasad in the Center for Fuel Cell Research. An Honors Program student, Guerieri's independent study couples his past research with current work on novel electrodes composed of platinum atomic monolayers deposited on carbon nanostructures.

"When reflecting over the past four years, I am most proud of the changes I've helped facilitate in Tau Beta Pi. We've been able to revamp the chapter considerably, and I feel much more connected to the College of Engineering."

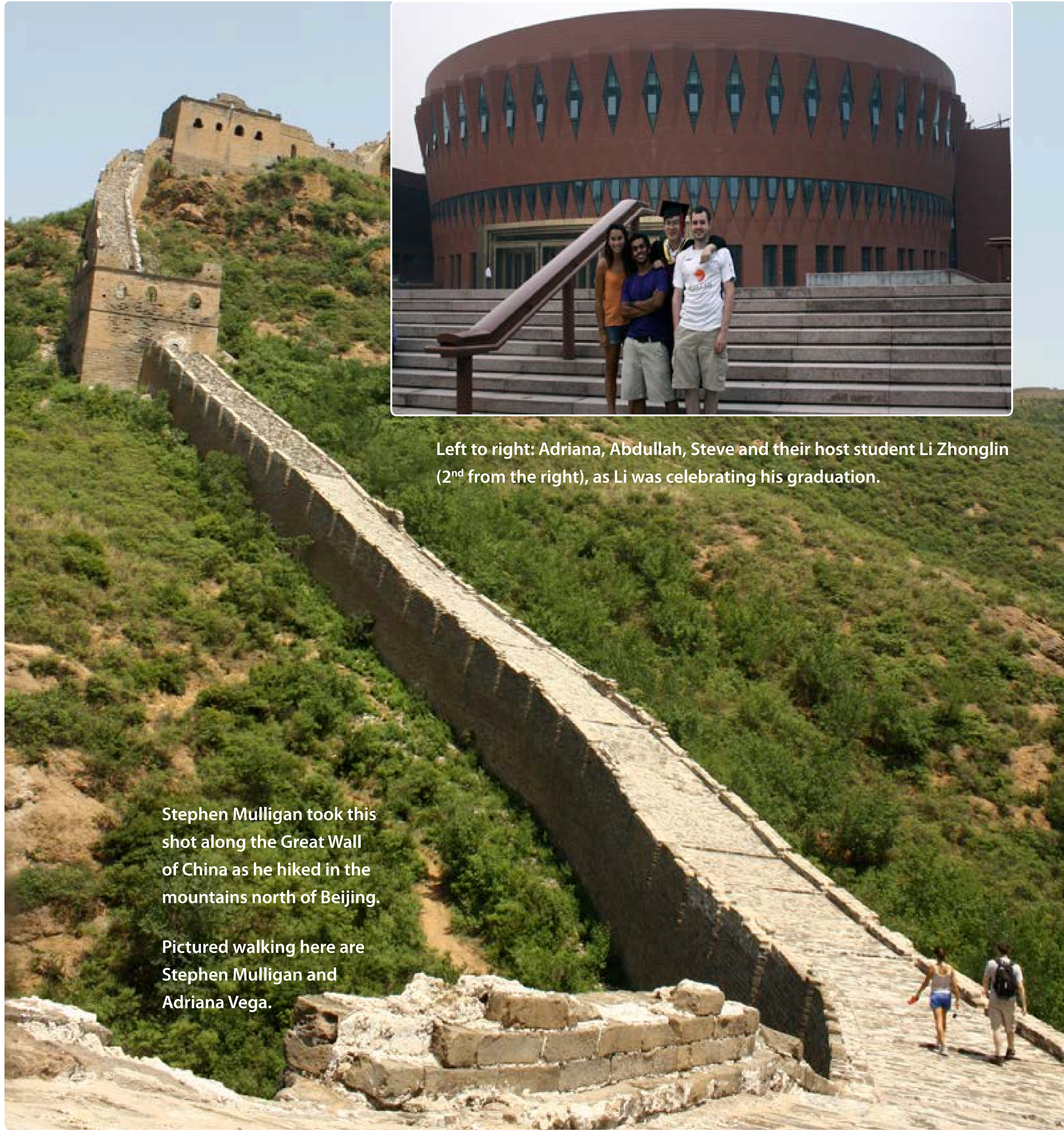
Following graduation in May, Guerieri will continue investigating nanomaterials for energy applications while pursuing his doctoral degree. He also hopes to learn political and sociological issues related to alternative energy technologies.

Giving is just a natural part of **Anthony Loccisano's** nature. He recently traveled to Cameroon, Africa, as part of UD's student chapter of Engineers Without Borders (EWB-UD), for which he serves as secretary. His team implemented a water distribution system, making improvements from previous trips and installing solar panels to power the new pump.

Currently serving as the president of the Bioengineering Interest Group, as a member he helped organize a trip to the Applied Physics Laboratory at Johns Hopkins University and worked with Tau Beta Pi's student chapter to successfully implement the College of Engineering Core Cram. He enjoys serving as a TA for Statistics.

Loccisano is also a strong organizational leader. He serves on the ME student advisory committee, and was team leader for his senior design project, organizing meetings, outlining tasks and reports and conceptualizing the structure of the team's final presentation. Working for GGB in Thorofare, New Jersey, the team detected and prevented part defects on a bearing manufacturing line. Also an Honors Program student, Loccisano drew preliminary designs for an automatic coolant refilling system.

In May, Loccisano will graduate with a mechanical engineering degree and minors in biomedical engineering and sustainable energy technology. He is considering several career options, including Teach For America, a doctoral degree in biomedical engineering, or an alternative energy career within the energy sector.



Left to right: Adriana, Abdullah, Steve and their host student Li Zhonglin (2nd from the right), as Li was celebrating his graduation.

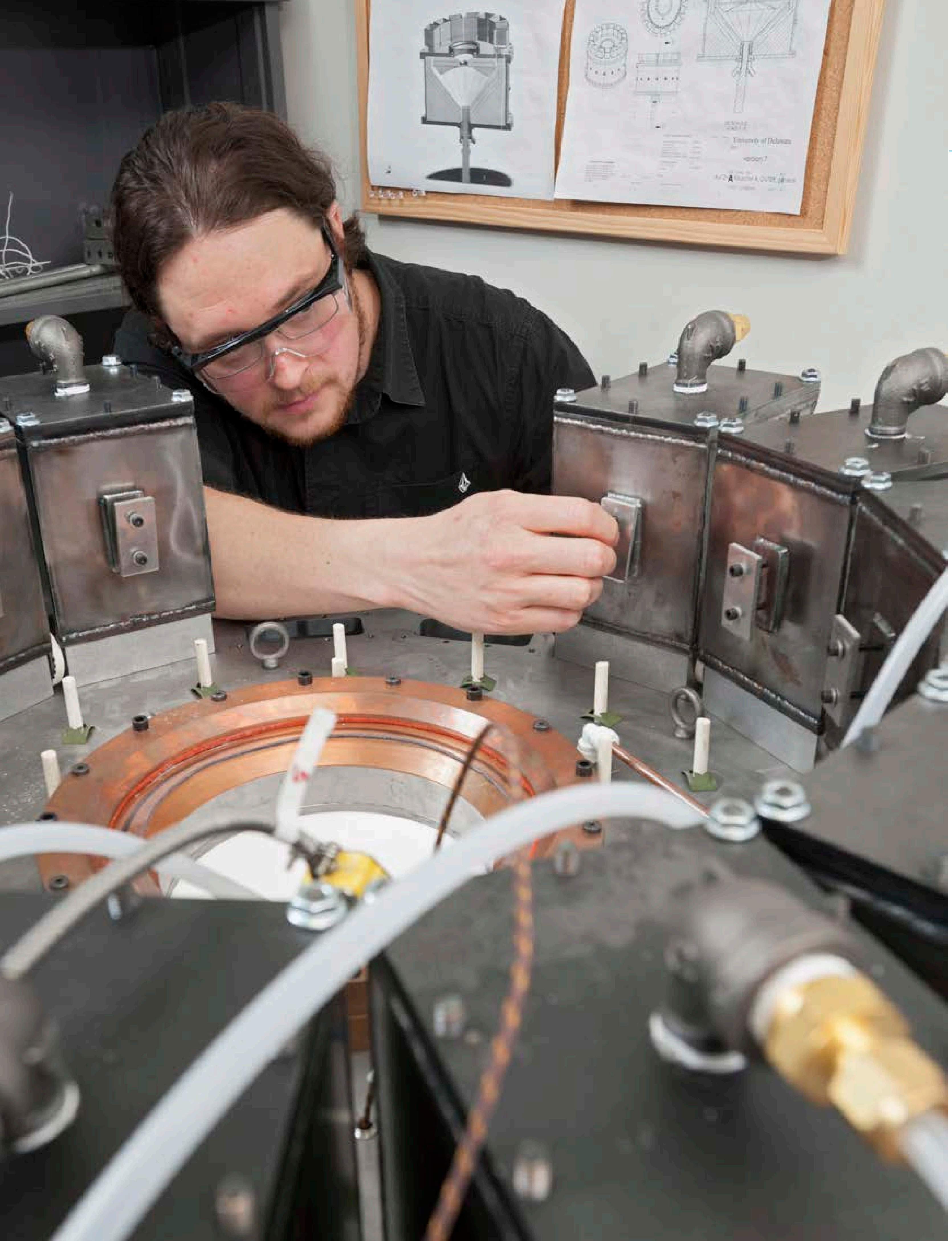
Stephen Mulligan took this shot along the Great Wall of China as he hiked in the mountains north of Beijing.

Pictured walking here are Stephen Mulligan and Adriana Vega.

Undergrads to China

Three undergraduate students conducted research at Tsinghua University last summer as part of student exchange program between UD and Tsinghua University. Abdullah Baaqeel, Stephen Mulligan and Adriana Vega were selected based on their academic standing, demonstrated research aptitude and strong interest in experiencing research in a different culture. The students conducted research in nanomaterials, biomaterials and robotics. Professor Bingqing Wei is the lead faculty member for the inter-university collaboration at UD.

Abdullah Baaqeel, an international student studying at UD, worked with Tsinghua University Prof. Wenzeng Zhang to develop a new design for a humanoid robot hand. Stephen Mulligan worked with nanomaterials under Professor Zhu Hongwei. He conducted research on electrodeposition of bismuth telluride and also worked with air flow over graphene photo cells. Adriana Vega conducted biomaterials research with Professor Xiaohui Wang. Her research included working with PU scaffolds to replicate the geometry of blood vessels. These scaffolds were eventually implanted into albino rats to observe cell growth patterns.



Doctoral student's novel solar reactor may enable clean fuel derived from sunlight

Producing hydrogen from non-fossil fuel sources is a problem that continues to elude many scientists but University of Delaware's Erik Koepf thinks he may have discovered a solution.

Hydrogen is traditionally made from natural gas. Unfortunately, natural gas is a fossil fuel that releases carbon dioxide, a greenhouse gas, when converted to hydrogen.

Koepf, a doctoral candidate in mechanical engineering, has designed a novel reactor that employs highly concentrated sunlight and zinc oxide powder to produce solar hydrogen, a truly clean, sustainable fuel with zero emissions.

His advisers are Ajay Prasad, professor of mechanical engineering and director of UD's Center for Fuel Cell Research, and Suresh Advani, George W. Laird Professor of Mechanical Engineering.

"People have been trying for years to generate hydrogen renewably from sunlight, and Erik's reactor takes us closer to that goal," explained Prasad, principal investigator of the University's fuel cell bus project, which uses hydrogen fuel to power its fleet.

A UNIQUE DESIGN

The reactor, which resembles a large cylinder, is comprised of layers of advanced, ultra-high temperature insulation and ceramic materials. It measures roughly 2 feet by 3 feet and weighs a hefty 1,750 pounds.

The conical geometry of the reactor' design uses gravity to feed zinc oxide powder (the reactant) into the system through 15 hoppers perched on top of the device using special gears and a custom built control assembly Koepf developed at UD. Cooling blocks embedded in the structure keep the motors, a quartz window and the aperture ring, where the sunlight enters, cool.

"The idea is to create a small, well-insulated cavity and subject it to highly concentrated sunlight from above," explained Koepf.

Koepf has been testing the main control systems for his reactor in Spencer Laboratory for months. The missing ingredient, however, has been sunlight. Beginning April 5, he will spend six weeks testing the prototype's effectiveness for the first time at the Swiss Federal Institute of Technology in Zurich.

"We will measure the temperature and the production of oxygen inside the reactor in real time, which will tell us how much solar fuel or zinc we are actually producing," Koepf explained.

During testing, light concentrated to simulate the energy of 10,000 suns will be focused down into the reactor, sending the temperature within soaring to over 3,000 degrees Fahrenheit, nearly one-third the temperature of the sun's surface. Once hot, the hoppers will feed zinc oxide powder (a benign substance resembling baking soda) onto the ceramic layer, causing a reaction that decomposes the powder into pure zinc vapor. In a subsequent step, the zinc will be reacted with water to produce solar hydrogen.

"Essentially, we take zinc oxide powder and thermochemically store the energy of the sun in it, then bottle it," explained Koepf, whose work is funded mainly through the Federal Transit Administration, a part of the U.S. Department of Transportation. "Zinc in and of itself is a very valuable fuel that can be used in batteries and fuel cells, among other things, even if you don't create hydrogen."

Koepf calls his research a "potentially sustainable energy path for the future" and he is working to patent his design through the University's Office of Economic Innovation and Partnerships (OEIP).

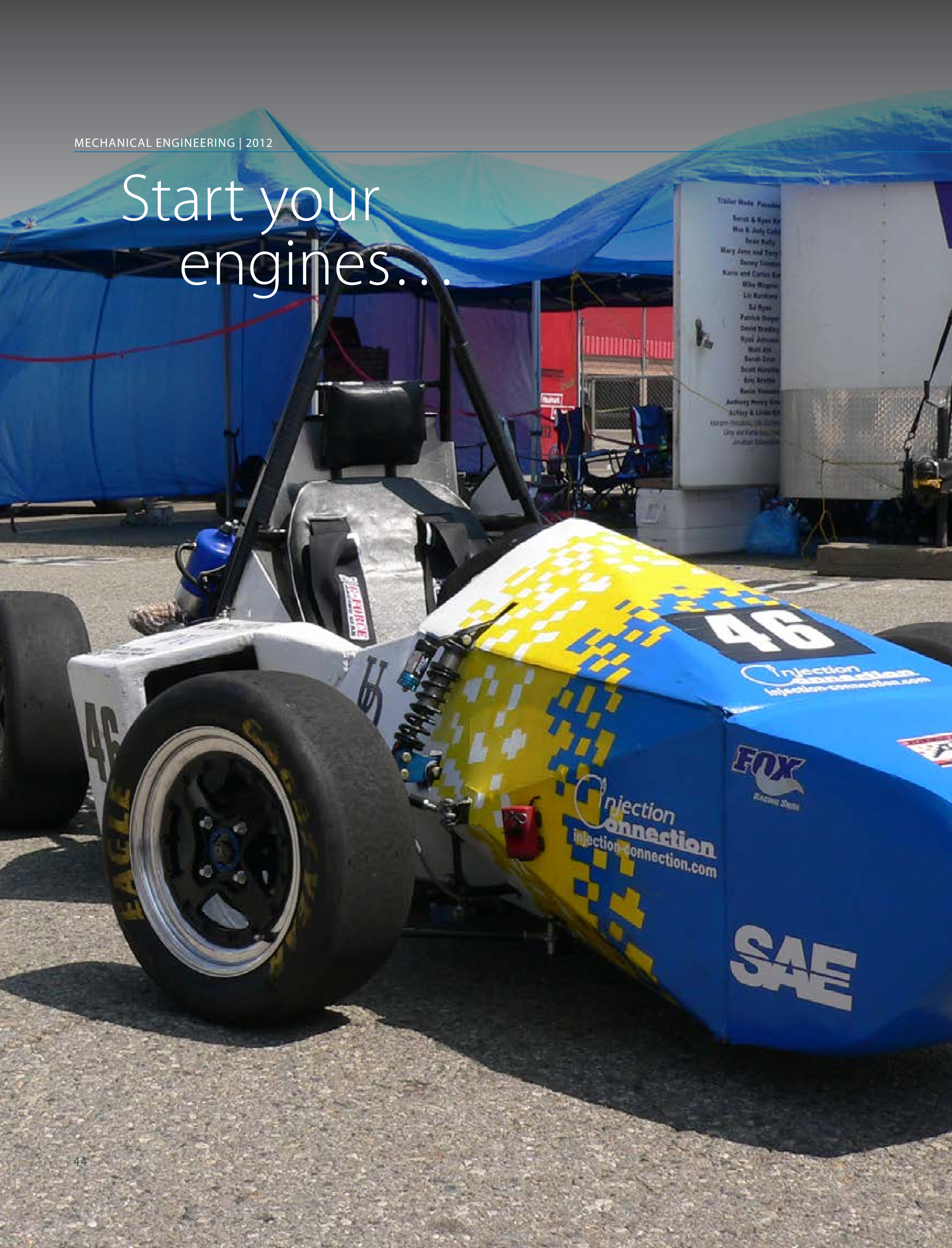
"Doctoral students typically specialize in one area, but Erik's reactor involves many different branches of mechanical engineering; notably fluid mechanics, heat transfer, reaction kinetics and experimental design," Prasad said.

One interesting feature of the reactor is that, in theory, the zinc oxide byproduct created during the reaction will be re-usable, making the project self-sustaining.

"This is probably the most complex device built by a graduate student in the history of our department," added Prasad. "If he is successful, one day, we can imagine a huge array of mirrors out in the desert concentrating sunlight up into a large central tower containing a larger version of Erik's reactor and making hydrogen on an industrial scale."

Article by Karen B. Roberts

Start your engines. . .



FSAE race car fueled by ingenuity

The semester begins with the proverbial clean sheet of paper. Before midterms, the computerized prototype of how the suspension, chassis, drivetrain and engine will come together is fully developed. By semester's end, when most students are traditionally taking exams and turning in papers, students in Prof. Steven Timmins' FSAE senior design class are sliding behind the wheel of a fully assembled car geared up for intense international competition.

Many Blue Hen Mechanical Engineering alumni since 1996 will fondly recall Formula Society of Automotive Engineers days, from the FSAE club, in which students take to the roads (or parking lots) to practice and compete, to the more recent FSAE senior level elective course where about 15 percent of ME students actually design and build the car for that year's competition.

For the course, Timmins (BSAC '84, BSBA-Finance '84, BME '88, PhD ME '97) assigns students to one of four groups responsible for the engine, powertrain and axel; suspension; ergonomics; or the chassis. Instead of all 16 students working on the same assignment, groups must learn to successfully interact with one another in order to turn their respective parts of the project into a fully functional car.

Chasing a moving ball

"It's like chasing a moving ball all semester," Timmins acknowledged. "One group makes a change and that inevitably affects the other three groups." He estimates that each student devotes up to 40 hours per week working on the car. Alternate weekends find students and club members honing their driving skills.

Each group is mentored throughout the semester by a volunteer motorsport industry expert. Three of the mentors are Timmins' former students, including James H. Gil, BME '98, and Frank Sneeringer BME '09, both of ILC Dover; and Michael Bauman, BME '08 of H & H HandyTube.

Bauman, who mentors the chassis group, sees FSAE as a great outlet for alumni to support UD students and pass on years of experience and knowledge. "Students work closely with their alum sponsors to develop and improve the process of creating a complete FSAE car," he explained. "Team building skills and project planning techniques are passed down and become an invaluable asset to students entering the career force."

From classroom to competition

The entire car is rendered by computer before the first bolt is tightened. When complete, the finished project heads for international competition in June, this year in Lincoln, Nebraska, where Timmins and the students hope to build upon their successful completion of all events for the first time at last year's 2011 competition. The 2011 UD team placed 33rd in Fontana, California; their goal this year is to finish in the top 20.

Timmins believes they have a good shot. "This year's car is more thoroughly tested than any previous year," he noted, adding that this year's students have a slight advantage over previous groups. While putting together the 2012 car, the students can practice their driving skills with last year's model.

Fewer than half of the 85 – 100 teams who show up for competition actually finish, notes Timmins. Teams must not only maneuver their cars through rigorous dynamic events, such as braking and acceleration, skid pad, autocross and endurance, they must also excel at static competitions, such as the technical inspection for safety and race rule compliance, as well as deliver compelling presentations on budget, design and marketing.

Homegrown budget holds its own against industry-backed teams

The Blue Hen team's budget for the raw materials to build the entire car is about $10,000. Put that up against the $600,000 to $1.5 million budgets of industry-sponsored competing schools that consistently finish in the competition's top five, and UD's final product and finishing capacity is all the more impressive. Students and club members contribute toward travel expenses for competition by tuning about 800 lawnmowers at a marathon spring tune-up event each spring. Timmins also acknowledges support from both mechanical engineering and the Dean's Office, which makes FSAE an engineering-wide enterprise.

To help with budget, Timmins plans to create an evolutionary process as opposed to starting from scratch every year. The suspension and chassis must be new each year, but the engine, wheels and tires from previous years can be passed along to future models or used as spare parts.

Article by Martha Lodge

Graduate student wins first-place SAMPE award

James Sargianis, a master's student in mechanical engineering, took home a first-place award for his presentation at the SAMPE Baltimore-Washington Research Symposium on Feb. 8, 2012. In addition to a $500 cash award, Sargianis qualifies as a finalist for the student competition at the 2012 SAMPE National Conference in Baltimore, Md., in May. His expenses to the conference will also be covered by SAMPE.

Advised by Prof. Jonghwan Suhr, Sargianis is conducting research on natural material based sandwich composites with enhanced vibrational and acoustic performance.

"Composite sandwich structures offer superior mechanical properties at a low weight and are therefore quite popular in applications such as aircraft cabins and wind turbine blades," Sargianis said. "However, these same properties translate into efficient noise radiation and thus poor acoustic performance. One idea for improving acoustic properties was to use sandwich composites based on natural materials."

"The advantage to using natural materials, as opposed to synthetic materials such as carbon or glass fibers," he added, "is that we can essentially 'grow' our own materials. By growing our own materials, the carbon emissions resulting from synthetic material production would be reduced, along with other environmentally friendly benefits such as being recyclable and biodegradable."

The researchers have observed that with the use of these natural materials—which contain constituents such as cotton or bamboo fiber-based face sheets, or balsa and pine wood cores—acoustic performance can be substantially increased with only slight sacrifices in mechanical performance and weight.

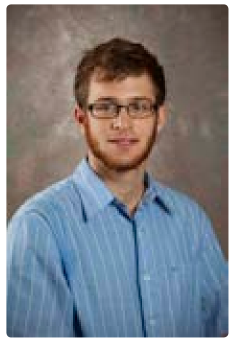
In addition, they have found that coupling a natural fiber based face sheet with a synthetic foam core provides a 233 percent improvement in acoustic performance, with minimal sacrifices in mechanical performance.

Article by Diane Kukich

James Sargianis (left), master's student working with Prof. Jonghwan Suhr.

Grad student spotlight

Outstanding undergrad returns for doctoral degree



Recent alumnus **Zach Melrose** completed his undergraduate degree at UD in 2011 having spent four years taking classes and conducting research in Spencer Laboratory and across campus. He distinguished himself among his peers winning awards such as the Society for the Advancement of Material and Process Engineering's (SAMPE) International Student Symposium and Exhibition.

After graduating in February 2011, he worked full-time at the Aberdeen Proving Ground Army Research Laboratory in Aberdeen, Maryland synthesizing vascular systems for self-healing and thermal management applications in composites. He quickly realized, however, that in order to take full advantage of the opportunities UD has to offer, he had to leave his position at Aberdeen and fully immerse himself in the university's graduate student experience.

Today, Melrose is pursuing his doctoral degree in mechanical engineering. Still in the early stages of development, Melrose's graduate-level research focuses on investigating practical, low-cost alternatives to traditional damage sensor monitors for composite materials. This involves using many sensors to monitor more problematic areas, as opposed to a single, large-scaled sensor for the entire composite.

"By adding damage sensing functionality to specific parts of the composite, only areas that are more prone to failure can be monitored," noted Melrose.

The work is challenging but also exciting, Melrose said, adding that he is grateful for the close relationships he has developed at UD, especially with his advisor, Erik T. Thostenson, assistant professor in mechanical engineering, and Amanda Wu, a postdoctoral researcher. Melrose credits his mentors with providing support and advice in undergraduate work as well as experimental techniques and lab procedures that directly benefit his research.

"Working with Dr. Thostenson and Dr. Wu showed me that the essence of a university isn't in the buildings or lecture halls, it is the people who work there. The ME department, in conjunction with the Center for Composite Materials, truly has a wealth of great professors who helped me realize that UD was the ideal place for me to continue my academic career and advance my research in the department's unique interdisciplinary program," he said.

Melrose is also the founding chair and current president of the Mechanical Engineering Graduate Association (MEGA). This graduate student organization enables mechanical engineering graduate students to meet and share life experiences both in and outside of research. MEGA is also a platform to address graduate student concerns and grievances at the department level, and at the university level via Graduate Student Senate representation.

"Helping the department and graduate student body through this organization is a way for me to give back and strengthen the program I've been a part of now for almost five years," Melrose remarked. "Whether a new student is just getting started, or a senior graduate student is stuck on a specific problem, we hope that MEGA will enable us to help one another."

Article by Zac Anderson

Mechanical engineering doctoral candidate receives Air Products Fellowship

John Gangloff, a third-year doctoral candidate at UD, holds the Air Products Graduate Fellowship for the 2011-2012 academic year. Gangloff is advised by Suresh Advani, George W. Laird Professor and associate director of UD's Center for Composite Materials (CCM).

Gangloff's research addresses processing of advanced composites. In particular, his work focuses on developing new control strategies to manipulate resin flow pressure, flow rate, and other variables to eliminate voids in liquid composite molding processes.

"If air is trapped within the composite and left to cure, the part will exhibit areas of porosity that can lead to stress concentrations under load and even premature failure," Gangloff said.

His work involves both the development of numerical tools to understand micro-length-scale physics as well as lab experiments to verify those tools.

"I have found John to be a very creative and highly motivated student who enjoys doing research and spreads his enthusiasm about it to other students," said Advani. "He is always bubbling with new ideas to explore and develop process models to explain the behavior of bubbles and volatiles in resins so that one day we can make composite materials void-free at an affordable cost.

"He is an ideal candidate for the Air Products Fellowship, as in my mind he is a perfect graduate student who not only loves what he does but is able to excite young minds to follow in his footsteps and motivate others around him to work on interesting and important problems."

Gangloff plans to work in the composites industry after he completes his Ph.D. "I can see myself in five years working for a large company in order to learn how the organization, operation, and management work within that context," he said. "I think it's important to understand not only a technology but everything else including management and marketing that makes it possible for technology to be successfully embraced and implemented in the real world."

Although still a student, Gangloff is no stranger to the ways of industry. Earlier this year, he and fellow doctoral candidate **Cedric Jacob** won a $10,000 cash prize in the Owens Corning Composite App Challenge, a global competition to find new applications for composite materials. They were recognized for their concept to develop an integrated structural composite fuel cell.

Gangloff credits CCM's environment with fostering his creativity and entrepreneurial spirit. "Through my work here, I've gained some valuable insights into the composites market and what it takes to be successful," he said. "I'm looking forward to my internship with Air Products so that I can ask more questions and learn more about what it takes to bring new ideas to market."

An active student leader in UD's chapter of the Society for Advanced Materials and Process Engineering (SAMPE), Gangloff has contributed to K-12 education through summer engineering camps and spearheaded the involvement of UD students in engineering competitions and industrial tours.

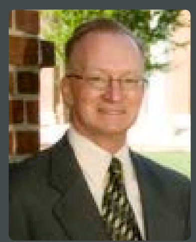
ABOUT THE AIR PRODUCTS FELLOWSHIP

The fellowship is supported through an annual gift to the University by the Air Products Foundation. The award includes an $18,000 stipend and an internship opportunity with the company.

Initiated in 2008, it is open to doctoral students in mechanical and chemical engineering. Gangloff is the first mechanical engineering to be selected. Previous winners include Elizabeth D'Addio (2008-09), Maeva Tureau (2009-10), and Thomas Kelly (2010-11), all in chemical engineering.

Article by Diane Kukich

Hello Mechanical Engineering Alumni and Friends!



It is my pleasure to announce a few major contributions to the College of Engineering.

- **Kipp and Thomas L. Gutshall ('60)** have funded the first endowed* **Assistant/Associate Professor Chair** at UD to be housed in the chemical engineering department. Their gift of one million dollars will be assigned this spring to an outstanding young professor in recognition of the faculty member's achievement and academic promise.

- **Robert W. Gore ('59)** made a gift of one million dollars to endow two new **Graduate Fellowships** within the college. The dean will use these to help attract new students to our doctoral programs. One fellowship is likely to be used for the new biomedical engineering program.

- **Beverly J. C. and David L. Mills** (emeritus faculty) created an **Endowed Chair** with preference for a female faculty member in the Electrical and Computer Engineering or Computer and Information Sciences departments. Their gift will support top teaching talent at the Assistant/Associate Professor level. The Mills Chair will be awarded in the near future.

As the largest enrolled engineering department this year, mechanical engineering could also benefit from new Endowed Professorial Chairs, Graduate Fellowships and Scholarships. Please note that these major gifts come about through lengthy conversations with donors in which preferences and individual circumstances are thoroughly discussed. For example, the Mills' gift was accomplished through a "Living Endowment" with a combination of outright and estate giving.

Meaningful gifts come in all shapes and sizes. Don't ever dismiss the value of your gift, or the University's appreciation of your support. Your financial support, at every level, impacts our success in securing foundation and corporate gifts, and adding your name to the donor list motivates classmates and friends to give.

Armand Battisti
Director of Development

*Endow means to provide a gift that will be invested and produce interest income to fund the activity in perpetuity.

Interdisciplinary Science & Engineering Lab

Projected completion: spring 2013

www.udel.edu/iselab

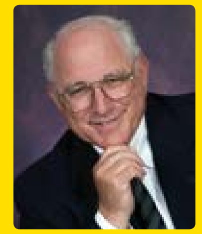
ISE-Lab construction on target for spring 2013 opening

A walk down Academy Street toward Lovett Avenue during Alumni Weekend will lead you to an important new site for engineering students. Exterior work on the new Interdisciplinary Science and Engineering Laboratory (ISE-Lab) is well underway, with completion of the 194,000-square-foot facility on target for spring 2013.

The first new laboratory building on UD's campus in nearly 20 years, the ISE-Lab includes classrooms and teaching laboratories, core research facilities for teams of researchers, and space for the University of Delaware Energy Institute, the Center for Energy and Environmental Policy, the Delaware Environmental Institute and the Catalysis Center for Energy Innovation.

GIFT

Q & A with alumnus, donor Charles H. Collier III



Retired engineering fellow **Charles H. Collier III**, BME '65, who traveled the world designing, building and starting up chemical plants for DuPont, is a proponent of interdisciplinary problem-based learning, and the ***power of a question***. He reveals the motivation behind his most recent gift to the College of Engineering and the inspiration he hopes students will receive while studying in ***"Wondie's World."***

What is the greatest challenge faced by engineers?

Achieving successful interface between disciplines is crucial to avoiding costly corrections in any project. Mechanical engineers need to understand the budgetary needs pushed by the economists; electrical engineers must be able to communicate with chemical engineers (and vice versa). Engineers should take the time to talk with the operators, laborers and mechanics who make the plant run, and so on. I found that we had much better start ups when we were conversant in each other's discipline and could understand, cooperate and help each other.

How can the University best prepare tomorrow's engineers?

First, we need to inspire engineers to ask questions. As we approach projects, we should question assumptions and ask ourselves, "Why are we doing it this way instead of finding a better way?" By asking a question, you will either find a better answer, or, at the very least, reinforce the value of what you know.

It's also important for engineers to take non-core classes (including subjects such as business, economics, marketing, etc…) that will prepare them to interface with other disciplines. We need to understand the language of other specialties, to recognize the value that those disciplines bring to the project and to find a connection point with those with whom we interface in our work.

I was a mechanic in a chemical plant for three years before graduation where I saw every phase of the operation, so I also think it's important for students to get their hands dirty with real-world experiences.

You've made a generous leadership gift to fund a group study breakout room in the University's new Interdisciplinary Science & Engineering Laboratory (ISE-Lab). What inspired your gift?

My wife and I had been considering a gift to the ISE-Lab prior to her death last summer because we liked the approach to interdisciplinary learning. Our children and grandchildren came up with the name "Wondie's World" for the room I eventually gifted in her honor (the grandchildren call her "Wondie," short for "Wonderful Grandmother"). I hope that as students spend time in "Wondie's World," they will be inspired to question the assumptions we routinely make about the world around us, which, in turn, will prepare them to be better engineers.

What are your words of encouragement for fellow alumni considering reconnecting with the University?

Do it! It is a wonderful vehicle by which you can compare your life's experiences with others, and it allows you to make an impact on the lives of future generations. It's also fun to return to campus and see what has changed. I find that very encouraging.

What career or life advice would you send out with each Engineering graduate as he or she leaves UD to enter the workforce?

Use your engineering degree as a stepping-stone to question your surroundings. Make the world a better place for the less fortunate; life without contribution seems very shallow. Don't take yourself too seriously. And, enjoy the life you have – it's shorter than you think.

Engineering majors dominated UD basketball in early 1960s

What stands well over 6 feet tall, can rebound and score with the best players in the nation and intimately understands the concepts of mechanical systems?

Surprisingly, the answer is almost any University of Delaware player on the 1961-62 basketball team, which posted an outstanding record of 18-5. In fact, nine of the 12 players that year were engineering majors; five majored in mechanical engineering.

"Many of the team members were 'walk-ons' without benefit of scholarships or financial aid packages," said Bill Wagamon, the team's co-captain and one of several members who celebrated the team's 50th anniversary during a halftime ceremony as part of Alumni Hoops Hysteria at the Bob Carpenter Center on Jan. 14.

Nate Cloud, Dave Sysko and Pete Cloud led the team in scoring and rebounding. Nate Cloud and Sysko were inducted into the Delaware Sports and Museum Hall of Fame, as well as the UD Sports Hall of Fame and the Colonial Athletic Association Legends.

Cloud, UD's first All-American basketball player, would be drafted by the NBA's New York Knicks following graduation.

John Barry, the team's storyteller and co-captain, recalled a game during which UD's "academic lineup" outshone their opponent, the University of Michigan. "[The Wolverines] had two poli sci majors and one economics major on their starting five and they were busting their buttons," Barry remembered.

"Basketball is a game that requires both intellect and skill. We used our academic and athletic talents to give us an edge," added Sysko.

Following college, several of the team members received Reserve officer commissions in the U.S. Army, serving at least two years on active duty. All of the players went on to successful careers in business, engineering, medicine and law.

One of the ways the team has stayed connected at UD is by creating a scholarship fund for engineering student-athletes.

Funded primarily by the 1961, 1962 and 1963 men's basketball teams, the Coach Irv Wisniewski Sports/Engineering Scholarship honors their former coach, Irv (Whiz) Wisniewski. The current recipient of the endowed scholarship is Mollie Smith, an energy and environmental policy major and member of the Blue Hens women's lacrosse team.

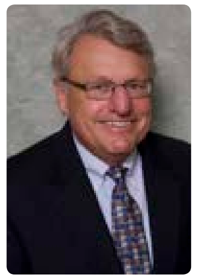
"It's very rewarding to help current student athletes in the name of our basketball coach, whom we have grown to respect even more as we reflect on what an inspiration and life role model he has been to us," said Cloud.

Article by Janie Sikes

ATHLETIC ENGINEERS

Pictured are (from left to right) **John Barry, Bill Wagamon, Rod Steel, Nate Cloud, Pete Cloud, Dave Sysko.** Photo courtesy of Mark Campbell

1973 ME alumnus David R. Helwig named to Alumni Wall of Fame



Alumnus and long-time donor and advisor to the College of Engineering **David R. Helwig** will be inducted into the University of Delaware Alumni Association's (UDAA) Wall of Fame June 2, during 2012 Alumni Weekend festivities.

A senior executive with nearly four decades of leadership experience in energy-related companies, Helwig is an industry expert on resource development, power generation, energy delivery, alternative energy and energy efficiency. More recent efforts are devoted to the creation and development of corporate enterprises with private equity backing. Helwig keeps a full schedule as president of Helwig Consulting Services, LLC; as chairman of Infrastructure & Energy Alternatives, one of the largest wind farm engineering and construction firms in North America, and as executive chairman of GTL Energy, an Australian company developing and commercializing proprietary technology for the upgrading of low rank coals.

UD helps prepare Helwig for career as energy industry expert

Helwig earned his bachelor's degree in mechanical engineering from UD in 1973, his master's from University of Pennsylvania in 1977, and completed Duke University's Advanced Management Program in 1987. This registered professional engineer retired from Excelon in 2003 and led InfraSource Services, Inc. (IFS) through major growth and NYSE listing. Upon its sale to Quanta Services (PWR) in 2007, IFS was the second-largest utility infrastructure engineering and construction company in North America. Prior to joining IFS, Helwig was general manager of the General Electric Nuclear Energy Global Services Business and spent almost 30 years in executive leadership positions with ComEd and PECO Energy (subsequently merged to become Excelon), including serving as senior vice president of Energy Delivery, senior vice president of Nuclear Engineering and Services, vice president of the Limerick Nuclear Generating Station and vice president of Power Delivery.

While responsible for the Limerick Generating Station, he conceived of and led the development and adoption of numerous major innovative practices that subsequently became the standard throughout the commercial nuclear power industry.

In August 1999, in the wake of the blackout of downtown Chicago, Helwig was named executive vice president of ComEd, responsible for organizational improvements in all areas of electric transmission and distribution to 3.4 million customers throughout northern Illinois.

An inspiration for students

Anette M. Karlsson, department chair, who nominated Helwig for the Wall of Fame, noted, "From the time he graduated from our program, David Helwig has been very successful in all his endeavors. He has stayed connected and involved with the University of Delaware, College of Engineering, and the Department of Mechanical Engineering. His great success in business and his engagement in UD is an inspiration for our students."

Helwig has been a member of the Engineering College Advisory Council since 1993. His placement on the Wall of Fame is not his first recognition by the University for his accomplishment, leadership and support. In 1993, he was awarded the Presidential Citation for Outstanding Achievement, which honors UD graduates who have exhibited great promise in their professional and public service activities. In 1995, the Engineering Alumni Association added Helwig to its list of outstanding alumni. And in 2000, the College of Engineering bestowed its Outstanding Alumni Award on Helwig.

Helwig support is crucial to PhD student recruitment

David and his wife Connie (Constance LaRoe, UD Alfred Lerner College of Business & Economics class of '73) have a long history of philanthropic support to the College of Engineering, including leadership support of two endowed Professors. Currently, they provide full funding for two outstanding PhD student fellows in mechanical engineering. The couple make their home in the Florida Keys and in Avalon, New Jersey.

"The funding David and Connie provide for graduate students in the department has been crucial in helping us recruit excellent PhD students to our program," Karlsson acknowledged.

The UDAA established the Alumni Wall of Fame in 1984 to recognize notable outstanding professional and public service achievements by UD graduates. The entire list of University Wall of Fame members can be found at www.udconnection.com/Awards/Alumni-Awards/Wall-of-Fame.

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 designate your gift to ME, select *other* from the list provided, then specify Mechanical Engineering.

July 1, 2010–June 30, 2011

Names highlighted in blue represent gifts made specifically to Mechanical Engineering.

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In Memoriam

E. Douglas Huggard (BME '55, MME '61) died October 23, 2011 at 77, following a long battle with Parkinson's disease.

Doug spent 37 years with Atlantic Electric in southern New Jersey where he joined as a junior engineer, and retired as CEO and chairman of the board.

He was instrumental in creating the School of Engineering at Glassboro State College, now Rowan University. In 1999, the UD College of Engineering honored Doug with the Outstanding Alumnus Award, and again in 2010 with the Distinguished Career Award.

Courtesy of Fort Myers News-Press

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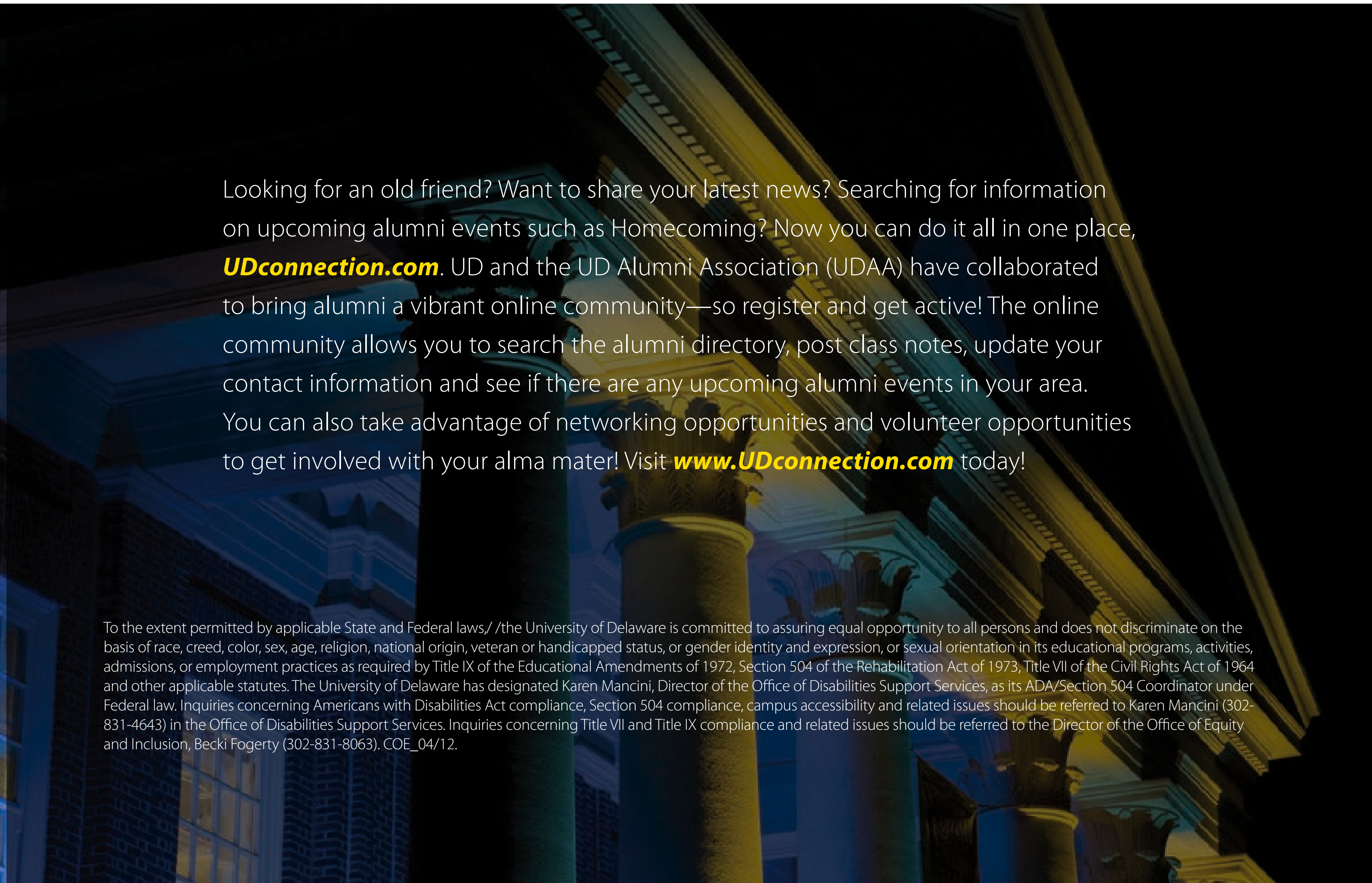

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