

UNIVERSITY of DELAWARE

NOVEMBER
2013

Biomedical Engineering

www.bme.udel.edu



College of Engineering
BIOMEDICAL ENGINEERING

Mission Statement

To deliver a high quality of education in applying quantitative engineering analysis and design to biology and medicine.

To conduct high impact research at the engineering-biology interface that reveals basic knowledge of disease mechanisms to improve human health, and that develops new technologies and therapies to improve the quality of life.



DAWN ELLIOTT

Dear Friends and Colleagues,

What a wonderful year for the University of Delaware's Biomedical Engineering (BME) program, including new faculty hires, faculty/student honors and several program "firsts."

We are excited to welcome three new faculty to our program: **EMILY DAY**, **CHRIS PRICE** and **JOHN SLATER**. Emily Day studies the use of nanoparticles for detecting and treating disease. Chris Price researches the mechanobiology and mechanotransduction of bone and cartilage as each relates to osteoarthritis. John Slater works on biomimetic materials that enable control over cell fate. We anticipate great things from these three, as well as from our current faculty, several of whom are highlighted in this newsletter.

Our undergraduate program, now in its fourth year, is flourishing under the direction of **JILL HIGGINSON**. In building the program, Jill ensures that our students get the best education and are ready for BME careers. We are proud of our students' success, both academic and extracurricular. As our enrollment increases this fall from 150 to 200 students, we look forward to graduating our first undergraduate class in May 2014.

Our graduate program's inaugural year was also fruitful. Many graduate students won awards and all passed their qualifying exams taken this summer. We expect similar achievement from the eight new graduate students who joined us this fall. We plan to expand our program to include a master's degree and a 4+1 program, and we thank our graduate director **XINQIAO JIA** for ensuring that the program is nationally competitive.

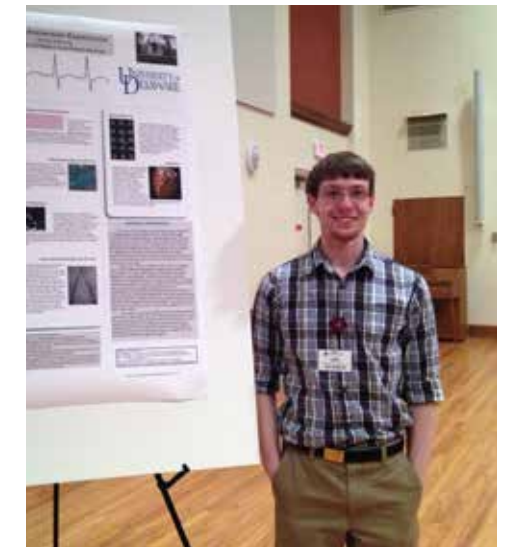
During Winter Session last January, we successfully launched our clinical immersion course in which junior undergraduate students shadowed health care professionals to observe clinical practices and identify unmet clinical needs. Additionally, our BME External Advisory Council held its first meeting in February to evaluate the program's status and provided advice on ways to help it grow.

We look forward to an equally productive and exciting year as we continue to build the BME program.

Warm regards,

Dawn Elliott

Professor and Director
Biomedical Engineering



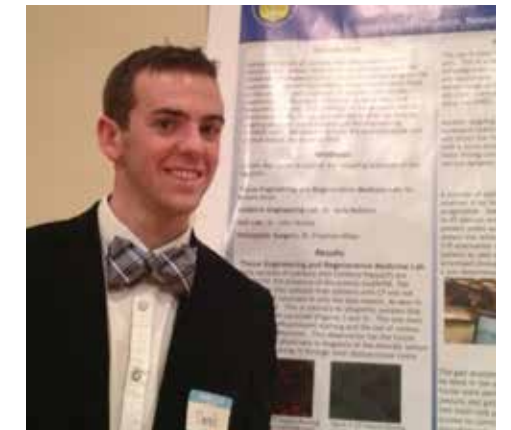
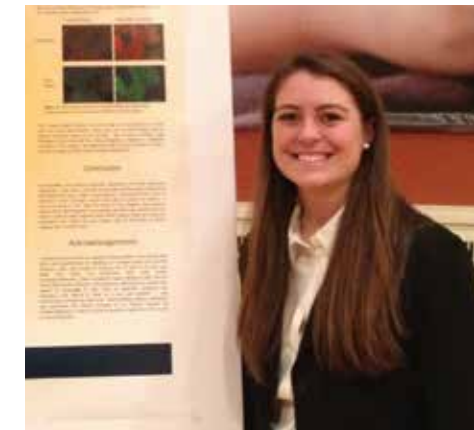
BME launches clinical immersion class

Eleven juniors and seniors were the first to experience BMEG 367, a clinical immersion course introduced in the 2013 Winter Session thanks in part to a Delaware Health Sciences Alliance (DHSA) grant awarded to BME faculty member **JILL HIGGINSON**.

Offered in partnership with clinicians and professionals at Christiana Care Health System and Nemours/Alfred I. duPont Hospital for Children, both in Wilmington, Del., and the Infant Behavior Laboratory at the University of Delaware's Early Learning Center, this innovative course enabled aspiring biomedical engineers to shadow health care professionals, observe clinical practices and identify unmet clinical needs.

"Students got a first-hand glimpse of the biomedical engineering challenges that are available in medicine for them to solve," explained Dawn Elliott, BME director.

As part of the experience, students developed a design idea to assist professionals in the field and presented their research ideas to participating



faculty and industry sponsors during a poster session at Nemours/Alfred I. duPont Hospital for Children.

"It was amazing to me how quickly the students grasped some of the problems, and also had potential solutions to those problems," said Nicholas J. Petrelli, M.D., Bank of America endowed medical director of Christiana Care's Helen F. Graham Cancer Center.

DHSA was established in 2009 with four founding partners: Christiana Care Health System, Nemours/Alfred I. duPont Hospital for Children, Thomas Jefferson University and the University of Delaware.

DHSA partners involved in BME's student immersion program include:

- Christiana Care Health System's Cardiovascular Clinical Trials Program
- Nemours/Alfred I. duPont Hospital for Children Center for Pediatric Clinical Research and Development
- Nemours/Alfred I. duPont Hospital for Children Cerebral Palsy Program
- Christiana Care Health System's Helen F. Graham Cancer Center
- University of Delaware's Infant Behavior Lab, Department of Physical Therapy
- Pediatric Engineering Research Lab at Nemours/Alfred I. duPont Hospital for Children.

BME welcomes three new faculty



EMILY DAY

EMILY DAY received her doctoral degree in bioengineering at Rice University with Jennifer West in 2011 and completed her postdoctoral research at Northwestern in Chad Mirkin's lab in the Department of Chemistry. Her research applies biomedical photonics and nanomedicine to create novel platforms for using nanoparticles as tools for the detection and treatment of disease.

Day develops nanoparticles to be molecularly specific contrast agents for the nonlinear microscopy of breast cancer so that they can be used for image-guided surgery. She also develops nanoparticles to be photothermal therapeutic agents that exhibit an unprecedented efficacy against glioma and to be potent agents for gene regulation in drug-resistant cancers.



CHRISTOPHER PRICE

CHRISTOPHER PRICE received his doctoral degree in biomedical sciences at the Mount Sinai School of Medicine. He came to UD as a postdoc in 2008 and joined the Department of Mechanical Engineering as an assistant research professor in 2010. He researches the role of mechanobiology and mechanotransduction in the development, maintenance, adaptation and degeneration of bone and cartilage, especially with respect to osteoporosis and osteoarthritis.

Price recently received a National Institute of Arthritis and Musculoskeletal and Skin Diseases grant to study the effects of articular cartilage damage in osteoarthritis using the novel bio-imaging technique of spatiotemporal image correlation spectroscopy. He also received, with co-principal investigator **X. LUCAS LU** (p. 10), a Department of Defense grant to study the highly targeted delivery of bisphosphonates, a class of traditional osteoporosis drugs, to prevent the initiation and development of osteoarthritis following acute traumatic knee injury.



JOHN SLATER

JOHN SLATER, formerly a research scientist in biomedical engineering at Duke University, received his doctoral degree in biomedical engineering at the University of Texas at Austin in 2008. He completed post-doctoral studies at Rice University with Jennifer West. His research focuses on developing and implementing biomimetic materials that enable simultaneous biochemical- and mechanotransduction-mediated control over cell fate. He investigates how biophysical and biochemical cues emanating from a cell's microenvironment are tuned to induce desired cellular responses such as increased migration, proliferation and differentiation.

Slater plans to develop and implement advanced biomaterials that imitate the highly organized cellular and biomolecular arrangement of tissue. He will use these materials to "prime" cells for use in cell-based therapeutics and to fabricate microtissues that mimic normal and diseased states so molecular mechanisms can be elucidated and drugs can be developed.

College & Department Awards



CAITLIN BANKS

Junior **CAITLIN BANKS** won a TEHEKA scholarship from the College, awarded to a student participating in the RISE program who is well-rounded and active in mentoring.

Junior **LINDSAY SCHEETZ** was awarded the BME Director's Award for overall excellence in academics, research and service to the University of Delaware community. She researches physiologically-based pharmacokinetic modeling of anticancer drugs in mammalian systems.

RYAN O'BOYLE received the Distinguished BME Senior Award and **KEVIN CHANG** received the Distinguished BME Junior Award for best cumulative GPA.

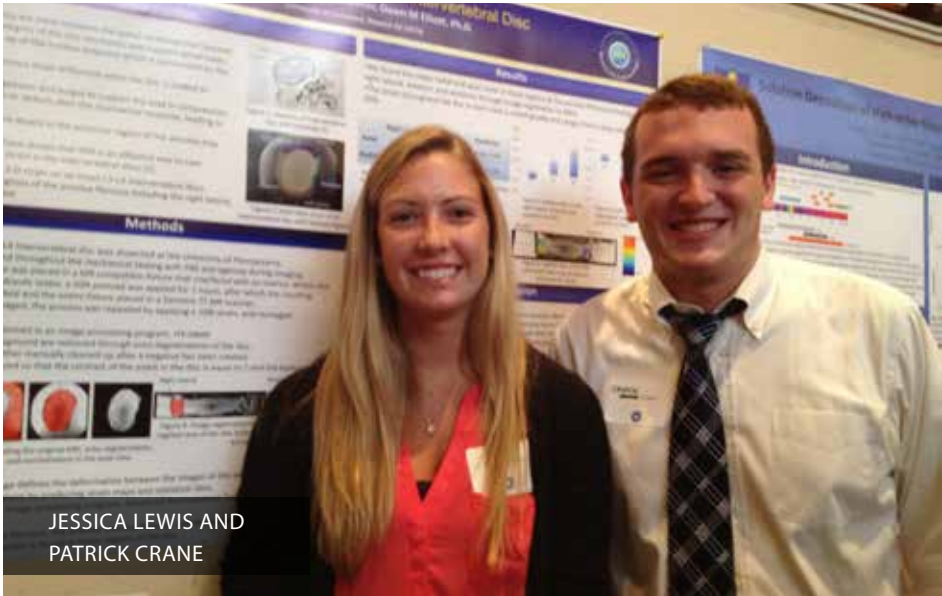


DOMINIC CAMPAGNOLA

Junior **DOMINIC CAMPAGNOLA** received the Matthew Maguire Celebration of Life Memorial Award for his service to the biomedical engineering program. This award is given by Michele Schwander, BME academic advisor, in memory of her brother Matthew Maguire.

Summer research showcase

Fifteen BME undergraduates participated in the fourth annual University of Delaware Undergraduate Research and Service Celebratory Symposium held Aug. 8. The students were among nearly 300 undergraduate research and service scholars and visiting scholars who participated in the capstone event, which included 215 poster presentations and 81 oral presentations.



JESSICA LEWIS AND PATRICK CRANE

DANIEL CHARYTONOWICZ

“Neural Mechanisms Surrounding Visual Attention”
Faculty adviser: James Hoffman, Psychology

MONIDEEPA CHATTERJEE

“Simulation of Microfracture Surgery Using A Bioreactor System”
Faculty adviser: X. Lucas Lu, Mechanical Engineering

PATRICK CRANE

“Incorporation of Biological Peptides in Hyaluronic Acid-Based Hydrogels”
Faculty adviser: Xinqiao Jia, Materials Science and Engineering

ZACHARY FOX

“Examining Stability Systems in HIV”
Faculty adviser: Abhyudai Singh, Electrical and Computer Engineering

BRETTA FYLSTRA

“Site Specific Distribution of Heparan Sulfate Proteoglycans in Bone”
Faculty adviser: Liyun Wang, Mechanical Engineering

SAISRI GAJJALA

“Examination of the On Track for Success Program”
Faculty adviser: Melva Ware, Delaware Center for Teacher Education

BRIANNA GIETTER

“Prescribing Optimal PD-AFO Stiffness for Post Stroke Patients”
Faculty adviser: Steven Stanhope, Kinesiology and Applied Physiology

CARISSE HAMLET

“Intervention with a Novel Device to Improve Upper Extremity Mobility in children with Movement Impairments: A Case Study”
Faculty adviser: Cole Galloway, Physical Therapy

CHRISTOPHER HUBLEY

“Electrochemical Deposition of EDOT Monomer onto Modified Indium Tin Oxide Slides”
Faculty adviser: David Martin, Materials Science and Engineering

JESSICA LEWIS

“2-D Analysis of Strain in Lumbar Intervertebral Discs”
Faculty adviser: Dawn Elliott, Biomedical Engineering

VAMSI MATTA

“Effect of Early Life Caregiver Maltreatment on Juvenile and Adult Anxiety- and Depressive-like Behavior”
Faculty adviser: Tania Roth, Psychology

ANNE SANGER

“The Characterization and Expression of Nucleotide Binding Oligomerization Domain-like Receptor Proteins”
Faculty adviser: Catherine Grimes, Chemistry and Biochemistry

GABRIEL SZCZEPANEK

“Polymer-Based Vascular Endothelial Growth Factor Biosensors for Treatment of Atrophic Macular Degeneration”
Faculty adviser: David Martin, Materials Science and Engineering

MOLLY WESSEL

“Validation of Quasi-static Gait Model for Biomechanical Testing of Femoral Fracture Fixation Implants”
Faculty adviser: Jenni Buckley, Mechanical Engineering

TIMOTHY WEST

“Relationships Between MRI-Based Estimates of Cartilage Contact and Other Predictors of Knee Osteoarthritis Progression”
Faculty adviser: Jill Higginson, Mechanical Engineering



KEVIN CHANG



ANNIE SANGER

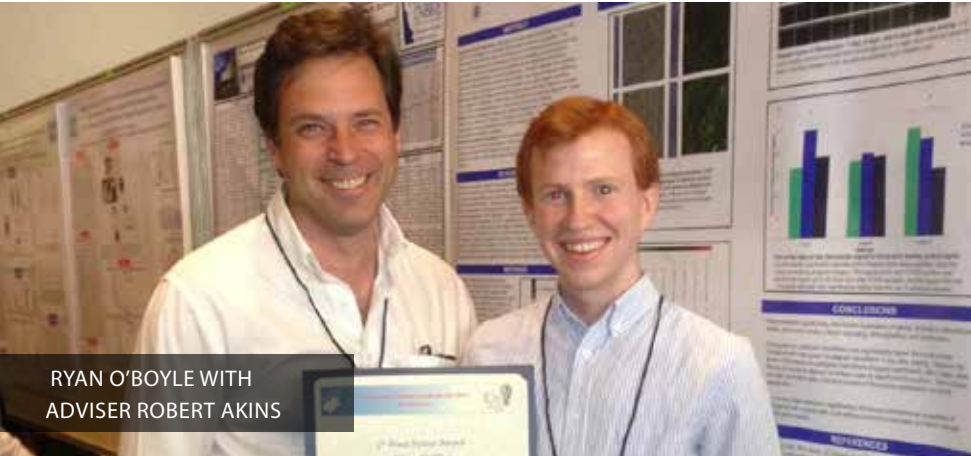
BME students take top honors

Junior **BRENDAN FARRELL** presented one of the top undergraduate posters at the Department of Material Science & Engineering’s annual open house. Farrell is investigating techniques to make implanted biomedical devices more biocompatible, stable and long lasting under the advisement of UD professors David Martin and Amy Griffin.

Junior **KEVIN CHANG** won first place in the biological sciences group at the 15th annual Undergraduate Research Symposium in the Chemical and Biological Sciences at the University of Maryland, Baltimore County. Under advisement from Kristi Kiick, Chang

worked on the 3D encapsulation of aortic fibroblasts with the hope of gaining information to make tissue engineering scaffolds for blood vessels. **ANNIE SANGER**, who conducts research under the guidance of professor Catherine Grimes, also presented at the symposium.

Senior **RYAN O’BOYLE** shared first place for best poster by an undergraduate at the Northeast Regional IDEa Conference in August. His poster, titled “Effect of cell culture substratum anisotropy on vascular smooth muscle cell phenotype,” described research he performed in Robert Akins’ lab at the Nemours/Alfred I. duPont Hospital for Children.



RYAN O’BOYLE WITH ADVISER ROBERT AKINS

EXTRACURRICULAR EXCELLENCE

In addition to academic success, BME undergraduates are making a name for themselves in extracurricular pursuits.

FIRST STEP PROGRAM: KEVIN CHANG, ANNE SANGER and RYAN LOCKE received monetary awards from the First Step Program launched by the College of Health Sciences to develop novel solutions to a health-related challenge. The students developed their solutions over a six month period, which they presented as posters in competition. Chang and Sanger, both juniors, were part of a team that won first place for creating "Noms Away," a mobile app that enables users to order and pay for restaurant food while also tracking nutritional content. Locke's project was "Biomedical Engineering Physical Therapy." The sophomore developed a specialized multitasking device to provide physical therapy for various joints of the body.

CAA CHAMPION: Sophomore AMIRA IDRIS received multiple awards at the 2013 Colonial Athletic Association Championships in May. She shared the Most Outstanding Field Performer award, won the triple jump and placed second in the long jump competition.



U.S. SKATING CHAMPION: Junior CAITLIN BANKS, a member of UD's Synchronized Skating Team for the last three years, helped her team take silver at the 2013 U.S. Synchronized Skating Team Championships. The team also won silver at the 2012 nationals and gold at the Eastern Sectional Synchronized Skating Championships in 2011 and 2012.



GLOBAL VIEW: Senior DEVON BOND was selected for the UD-Peking University Global Educational Exchange Initiative (GLOBEX) program. She spent six weeks taking classes at Peking University in Beijing, China alongside students from Chile, Japan and China.

COLLEGE ADVOCACY: In an independent study course, sophomore SAISRI GAJJALA and four other UD students developed a summer session to help rising high school seniors take critical steps in completing college and scholarship applications.

Building on a program implemented last year in partnership with Johnson and Johnson's Bridge to Employment initiative, the UD students worked on a model to improve college access and completion rates in the United States. Along with mentoring high school students, Gajjala and team met with Delaware state legislators, school officials, members of the corporate community and parents to determine how to best institutionalize the program.

MILITARY EXCELLENCE: ALLYSON ZEITSCHER received the Society of Military Engineers Award, which is presented to the top cadet enrolled in an engineering curriculum for military excellence. She was among 179 Alpha Company cadets who graduated from the Leader's Training Course at Fort Knox, Kentucky, as part of Reserve Officers' Training Corps preparation.



Four BME graduate students recognized in the program's first year



AIDAN ZERDOUM is one of five scholars participating in the new National Science Foundation-supported Integrative Graduate Education and Research Traineeship (IGERT) program. The grant brings together experts from across the university to provide

a multidisciplinary work/study curriculum to teach students critical skills related to science and engineering, as well as bioethics, research ethics, business innovation, communications and outreach. Zerdoum, who holds a bachelor's degree in biomedical engineering from Stevens Institute of Technology, studies the tissue engineering of functional vocal fold lamina propria with professor Xinqiao Jia.



As part of the newly launched Fraunhofer-UD exchange program, **PETER WORTHINGTON** spent his summer in Leipzig, Germany at the Fraunhofer Institute for Cell Therapy and Immunology working on diagnostic tests with Dirk Kuhlmeier in the

nanotechnology group. Worthington, who has a bachelor's degree in biomedical engineering from Rutgers University, conducts his thesis research with professor Darrin Pochan at UD and Sigrid Langhans at the Nemours/Al duPont Hospital for Children (Wilmington, Del.). His work focuses on using hydrogels as a cell scaffold and delivery mechanism for various tissue applications, including localized drug delivery, 3D cell culture and tissue regrowth.



AXEL MOORE received the 2013 Laird Fellowship, given annually to an engineering graduate student who exhibits character, creativity, imagination and perseverance. The award is meant to encourage recipients to engage in "broadening intellectual

pursuits" that may or may not directly apply to the student's chosen field. Advised by assistant professor David Burris, Moore's research centers on cartilage mechanics and the relationship to osteoarthritis. Also a 2013 Force and Motion Foundation Scholarship recipient, he presented his research at UD's third annual Graduate Student Forum and is a volunteer educator for UD's K-12 Engineering Outreach Program. He earned his bachelor's degree in marine engineering technology from California Maritime Academy, where he earned the distinction of cadet chief engineer.



ASHUTOSH KHANDHA received the Graduate Teaching Assistant Award for being the best biomedical engineering TA during the 2012-13 academic year. He holds bachelor's and master's degrees in biomedical engineering from University of Mumbai, India, and

University of Toledo respectively. Following eight years in the biomedical engineering industry, Khandha now researches gait analysis and neuromusculoskeletal modeling in professor Thomas Buchanan's lab.

Soft tissue biomechanics, cartilage tissue engineering and cell biomechanics

X. LUCAS LU, assistant professor of mechanical engineering, investigates soft tissue biomechanics, joint lubrication, osteoarthritis prevention and the involvement of bone marrow in cartilage repair.

With co-investigator **LYNN SNYDER-MACKLER**, Alumni Distinguished Professor of Physical Therapy, Lu received a Junior Investigator Grant from the Musculoskeletal Transplant Foundation to investigate whether weight bearing during microfracture rehabilitation enhances the deposition and quality of newly repaired tissue at the injury site. Using a novel bioreactor system, they will subject 3D organic cartilage-bone tissue to weights resembling those applied shortly after surgery. Then Lu will measure and compare the longitudinal changes in the biomechanical and biochemical properties of the repaired tissue generated by the stem cells in bone marrow. This research will provide new details on bone marrow-cartilage interaction and on cartilage recovery with different rehabilitative treatments after microfracture surgery.

Lu also received a Department of Defense grant with co-investigator **CHRIS PRICE** to study a treatment for post-traumatic osteoarthritis (PTOA), a common disease among young adults, athletes and military employees. Their preliminary work with animal studies revealed that the FDA-approved bisphosphonate zoledronic acid (ZA) rescues PTOA, but has adverse effects on bone health. They will study whether localized ZA injection can effectively prevent PTOA without compromising the natural bone remodeling process—research that could significantly affect osteoarthritis treatment.

Musculoskeletal modeling and simulation

JILL HIGGINSON, associate professor of mechanical engineering, director of UD's Center for Biomechanical Engineering Research (CBER), and associate director of Biomedical Engineering, researches muscle coordination in normal and pathological movement through coupled experimental and simulation studies.

Her research team performs three-dimensional kinematic and kinetic analyses and EMG recordings during treadmill and overground gait, using experimental data with state-of-the-art modeling and optimization techniques to develop simulations. These models provide a cause-and-effect framework to relate muscle impairments to gait deviations and to help form a scientific rationale for therapeutic interventions. Additionally, her research group investigates post-stroke hemiparetic gait, progressive knee osteoarthritis and risk factors related to falls in older adults.

Higginson has been instrumental in launching and providing direction for UD's BME undergraduate program. She recently received a Delaware Health Sciences Alliance grant to develop BME's new clinical immersion course that fosters partnerships with local clinicians and enables BME students



to gain exposure to current clinical practices, identify unmet clinical needs and explore future career options (see p. 3). As director of CBER, she works to expand the center's mission of promoting interdisciplinary research to include more research exposure for undergraduate students. With Lucas Lu, assistant professor of mechanical engineering, Higginson initiated a summer undergraduate research fellowship to provide funding for two BME students to conduct research through CBER's 2013 summer program.



KRISTI KIICK, professor of materials science and engineering and deputy dean in the College of Engineering, specializes in the synthesis and assembly of biologically-derived macromolecules. She received the Delaware BioScience Association's 2013 Academic Research Award, which recognizes significant contributions to the advancement of life science research, for her work in developing novel hydrogels to regulate the rate of drug delivery and protect the therapeutic molecules from degrading before reaching their destination. These hydrogels will improve the treatment of cardiovascular conditions and the delivery of antibodies that protect against toxins.

In other research, Kiick collaborates with UD colleagues to explore the potential for an engineered resilin-like protein—similar to that found in the joints of insects—to treat vocal fold disorders in humans. She also works with members of the Fraunhofer Center for Molecular Biotechnology to develop and demonstrate the ability of engineered polymer gels to increase the stability, immunogenicity and/or therapeutic efficacy of proteins.

In collaboration with **DARRIN PCHAN**, professor of materials science and engineering, and a colleague at the University of Pennsylvania, she has received a four-year grant from the National Science Foundation's Division of Materials Research to develop useful protein-like molecules that can easily be scaled up into nanomaterials for industrial applications.

An advocate for improving the representation of female faculty in science and engineering, she is one of 19 women engineers selected nationwide for the Executive Leadership in Academic Technology and Engineering program at Drexel University College of Medicine. Kiick will participate with other engineering leaders on organizational development activities for women faculty in the science, technology, engineering and mathematics fields.

ABHYUDAI SINGH, assistant professor of electrical and computer engineering, studies biochemical processes inside living cells. In particular, he is interested in characterizing gene networks underlying disease systems, specifically pathogenic viruses such as HIV.

Singh is one of 30 winners selected nationwide to receive the Ralph E. Powe Junior Faculty Enhancement Award by the Oak Ridge Associated Universities, a consortium of 109 Ph.D.-granting institutions. With this award, he will model how cells process information and make decisions at the single cell-level. Specifically, he will investigate how the fidelity of these decisions is affected by cellular noise—the random diffusion and interaction of bio-molecules inside cells. Running simulations of biochemical reaction networks in noisy environments, he will predict how variations in protein level arise in otherwise identical cells. The research may help scientists understand how specific disease processes, particularly HIV and other stem cell disorders, occur.

Last year Singh also received two single investigator awards—from the University of Delaware Research Foundation and the National Science Foundation—to perform stochastic modeling and inference of gene networks.

Along with his research successes, Singh consistently receives exemplary teaching evaluations.



Faculty Accomplishments

RICHARD BRAUN, professor of mathematics, received the Outstanding Scholar Award from UD's College of Arts & Sciences. His research involves using mathematical models to address issues regarding the dynamics of tear film, a film required for overall eye health.

JENNI BUCKLEY, assistant professor of mechanical engineering, received UD's Excellence in Advising and Mentoring Award based on student nominations. It is accompanied by a monetary award and an inscribed brick in Mentors' Circle. Her research focuses on the development and mechanical evaluation of medical devices, particularly orthopaedic, neurosurgical and pediatric devices.

DAWN ELLIOTT, professor of biomedical engineering, was elected to the American Institute for Medical and Biological Engineering College of Fellows, as a member of the Class of 2013, and was named a fellow of the American Society of Mechanical Engineers. She researches orthopaedic tissues and their role in osteoarthritis and low back pain, studying the breakdown and restoration of intervertebral disc, meniscus, tendon and cartilage.

COLE GALLOWAY, professor and associate chair of physical therapy, was honored by his graduating UD class with the Class of 1963 Golden Anniversary Award for "outstanding humanitarian efforts" and for "enhancing the academic environment" at UD. His research focuses on providing



RICHARD BRAUN



JENNI BUCKLEY



DAWN ELLIOTT



COLE GALLOWAY

mobility for young children with disabilities.

Research by **XINQIAO JIA**, associate professor of materials science and engineering, on the repair of vocal folds was featured in an *ENT Today* review of stem cell-based organ transplants as an alternative to conventional organ donations. Her group is developing a hyaluronic acid-based complex gel network that withstands vibratory stresses and presents minimal risk of rejection because it is non-immunogenic. These hydrogels contain immobilized biomacromolecules that enable the slow release and prolonged presentation of various growth factors to induce tissue repair and regeneration.

An article by **CATHERINE KIRN-SAFRAN**, assistant professor of biology, on bioengineered injectable microgels was selected for *Biomedical Materials* 2012 highlights. She studies the use of these microgels to enhance the action of bone morphogenetic protein 2 (BMP2) in order to stimulate cartilage matrix repair in a reversible animal model of osteoarthritis.

KELVIN LEE, Gore Professor of Chemical and Biomolecular Engineering, received the 2013 Professional Progress Award from the American Institute of Chemical Engineers for his outstanding contributions to the field of chemical engineering. He researches the diagnosis and treatment of Alzheimer's disease.



XINQIAO JIA

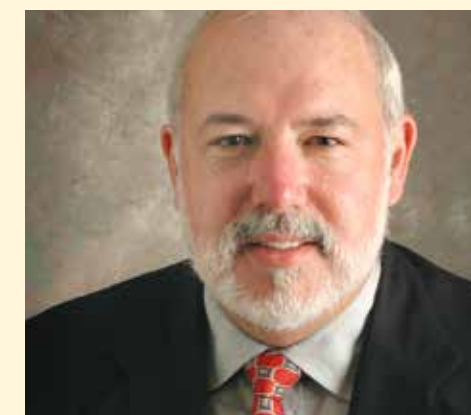


BABATUNDE OGUNNAIKE

BABATUNDE OGUNNAIKE, William L. Friend Chaired Professor of Chemical Engineering, was named dean of the College of Engineering effective July 1, 2013. His vision for the college includes a renewed commitment to excellence through strategic focus on three key engineering enterprises: research, education and entrepreneurship. He plans to increase the college's global reach, financial stability, diversity and engagement with alumni and the community. Ogunnaike served the college as interim dean from 2011-13 and, during that time, worked to develop partnerships with other academic institutions and to strengthen community partnerships with such organizations as Bloom Energy, U.S. Army Research Laboratory, DuPont and JPMorgan Chase.

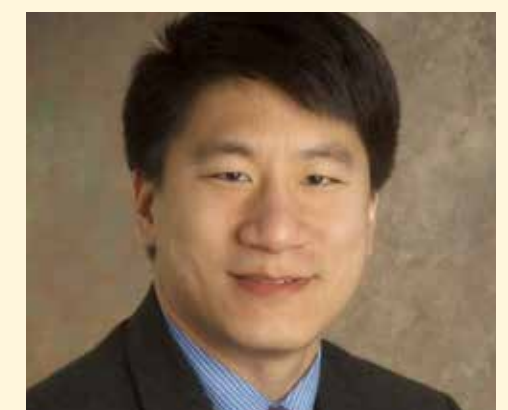


CATHERINE KIRN-SAFRAN



JOHN RABOLT

JOHN RABOLT, Karl W. and Renate Böer Professor of Materials Science and Engineering, received the Innovation in Materials Characterization Award which recognizes research that expands the knowledge of materials' composition, behavior or other characteristics. He was selected for co-developing Fourier Transform Raman spectroscopy, a technique that, for the first time, allowed the acquisition of Raman spectra of polymers in the presence of fluorescence so the chemical structure and properties of organic molecules and polymers in solids, thin films and solutions could be examined.



KELVIN LEE



MILLICENT SULLIVAN

MILLICENT SULLIVAN, associate professor of chemical and biomolecular engineering, was one of 23 young investigators selected nationwide to present at the 2013 Georgia Tech Frontiers in Bioengineering Workshop. The workshop brought together the world's leading bioengineers to discuss cutting-edge research and to identify critical long-term challenges in bioimaging, biomaterials and cellular and molecular bioengineering. Sullivan researches how medicines reach and enter malfunctioning cells and tissues.

Faculty Accomplishments

continued

**MICHELA TAUFER**

MICHELA TAUFER, associate professor of computer and information sciences, was named the David L. and Beverly J.C. Mills Chair of Computer and Information Sciences. Her research focuses on software applications in computing, cloud computing, performance analysis and modeling multi-scale applications.

**RYAN ZURAKOWSKI**

RYAN ZURAKOWSKI, assistant professor of electrical and computer engineering, has found new evidence that HIV replication may be occurring within the body's tissue, despite undetectable virus levels in the blood. His group used a mathematical model that represented how HIV-infected cells reproduce to analyze data from a clinical study in which researchers added a new drug, an integrase (enzyme) inhibitor, to the cocktail HIV patients were already taking.



EXTERNAL ADVISORY COUNCIL MEMBER, MICHAEL J. AXE, NAMED 'MR. SPORTS MEDICINE'

Michael J. Axe, M.D., of First State Orthopaedics (Delaware) received the 2012 Robert E. Leach "Mr. Sports Medicine Award," an honor presented annually to a sports orthopaedic surgeon who has made significant contributions to the world of sports medicine.

A prolific researcher, Axe has been an investigator on more than \$20 million in National Institutes of Health (NIH) grants at UD.

Axe has contributed significantly to the education of hundreds of physical therapists who are now practicing throughout the country. At UD, he has been course director for *Medical Science II: Orthopedics and Musculoskeletal Imaging* since 1990. He is a long-time supporter of the UD Physical Therapy Clinic, and has been a committee member for 12 doctoral students. Axe also teaches at the post-professional level as medical director of the UD Sports Physical Therapy Residency, and he contributes as a speaker at national and international meetings, focusing on return to play after shoulder and knee injury, weight lifting and baseball.

"Orthopaedics is the greatest area of strength in UD's medical research, and much of that is due to Dr. Axe," said **TOM BUCHANAN**, director of UD's Delaware Rehabilitation Institute. "Without his contributions, orthopaedics research at UD would be a far weaker enterprise. His contributions to the Delaware Rehabilitation Institute are enormous."

Grants



APRIL KLOXIN, assistant professor of chemical and biomolecular engineering, received an NSF Faculty Early Career Development Award and was one of 22 scholars nationwide to be named a 2013 Pew Scholar in the Biomedical Sciences. Her group investigates lung fibrosis by creating synthetic hydrogels that mimic the biology of natural lung tissue in order to study the extracellular signals that regulate tissue stability, disease and repair.



ARUN KUMAR, assistant professor of medical laboratory sciences, received a University of Delaware Research Foundation award to develop a new nanocomposite that mimics the structure and characteristics of natural bone and can be used in implants.



MILLICENT SULLIVAN, assistant professor of chemical and biomolecular engineering, received a Bioscience CAT grant to study the assembly of novel controlled release polyplexes for efficient mRNA delivery in partnership with Germany's Fraunhofer Center for Molecular Biotechnology.



DARRIN POCHAN, professor of materials science and engineering; **THOMAS H. EPPS, III**, Thomas and Kipp Gutshall Chair of Chemical and Biomolecular Engineering; and **CHRIS ROBERTS**, associate professor of chemical and biomolecular engineering, are among the co-principal investigators on a National Institute of Standards and Technology grant to continue neutron scattering research at UD's Center for Neutron Science. The Pochan research group will investigate biomaterials for controlled drug release; the Epps group will study block copolymer thin films for membranes, optoelectronics and self-cleaning coatings; and the Roberts group will explore the stability of proteins and protein aggregation related to biopharmaceuticals.

CHRIS PRICE, assistant professor, was awarded a National Institute of Arthritis and Musculoskeletal and Skin Diseases grant and a Department of Defense grant.





ADVISORY COUNCIL MEMBERS
NOT PICTURED ARE: LIZ GRIGGS AND HELEN STIMSON

Setting direction

The Biomedical Engineering External Advisory Council, which includes distinguished alumni and friends representing a cross-section of biomedical engineering talents, held its inaugural meeting in February 2013.

During their full-day gathering, the council met with the provost, the College of Engineering dean and more than 20 biomedical engineering joint and affiliated faculty to hear about program activities; toured UD’s new Interdisciplinary Science & Engineering Laboratory; and participated in a biomechanics lab with biomedical engineering undergraduate students.

The council’s main priorities are to advise on the program’s future direction, priorities and growth strategies and to help identify opportunities to promote the program among biomedical industries and engineering alumni. The council meets again in November.



YOU CAN MAKE A SIGNIFICANT IMPACT BY SUPPORTING BIOMEDICAL ENGINEERING.
For information on how you can help advance the biomedical engineering program, please contact **MICHELE QUINN**, associate director of development, at (302) 831-0840 or mlquinn@udel.edu.

Advisory Council Members

BRUCE C. ROBERTSON PhD ChE89 (chair)
UD Research Foundation board member;
Managing director, H.I.G. Bioventures

MICHAEL J. AXE, M.D.
Adjunct professor, Physical Therapy
Board-certified orthopaedic surgeon;
partner, First State Orthopaedics

JOHN V. FLYNN, JR. PhD ChE64
Retired global partner, Deloitte Consulting

ELIZABETH M. (LIZ) GRIGGS CEHD84
Founder, chairman, CEO, NextImage
Medical, Inc.

JOHN T. (JACK) KRAMER ChE82
UD Research Foundation board member;
Global technology leader, W.L. Gore
and Associates

MICHELE S. MARCOLONGO PhD ME86
Senior associate vice provost for
translational research, Drexel University

HELEN STIMSON
Alfred Lerner College of Business and
Economics Advisory Council, UD past
parent; VP & general manager, consumables
& supplies division, CAG, Agilent
Technologies, Inc.

Biomedical Engineering Faculty

BIODEVICES, BIOCOMPUTING AND BIOIMAGING include biomedical instrumentation and sensors, applications of nanotechnology to biomedicine, human-computer interaction systems, modeling and analysis of biomedical data, biomedical text mining, biomedical signal and image processing, and medical imaging modalities (including CT, MRI and ultrasound).

BIOMECHANICS applies experimental and computational approaches to explore biomechanical function across multiple scales, including the molecule, cell, tissue, organ and whole body.

BIOMOLECULAR ENGINEERING, CELLULAR ENGINEERING AND SYSTEMS BIOLOGY study, model and modify biomolecules, cells and the regulatory networks that control genetic, biochemical, cellular and physiological functions.

NEUROENGINEERING AND REHABILITATION ENGINEERING explore the neural control of posture and movement, brain-machine and other neural interfaces, biomimetics, motor learning and robotic training for rehabilitation, decision-making and artificial intelligence, and neuromuscular system modeling.

TISSUE ENGINEERING, BIOMATERIALS AND DRUG DELIVERY examine the application of biologically inspired and biologically produced materials for the delivery of therapeutic molecules, the understanding of cell biology and mechanotransduction, the repair of damaged tissues and the creation of functional substitutes.

Adj=Adjunct; BIOL=Biology; BME=Biomedical Engineering; CBE=Chemical & Biomolecular Engineering; CIS=Computer & Information Sciences; ECE=Electrical & Computer Engineering; KAAP=Kinesiology & Applied Physiology; ME=Mechanical Engineering; MLS=Medical Laboratory Sciences; MSE=Materials Science & Engineering; PT=Physical Therapy

		Biodevices, Biocomputing and Bioimaging	Biomechanics	Biomolecular Engineering, Cellular Engineering & Systems Biology	Neuroengineering & Rehabilitation Engineering	Tissue Engineering, Biomaterials & Drug Delivery
PRIMARY/JOINT FACULTY						
Arce, Gonzalo	ECE	•				
Barner, Kenneth	ECE	•			•	
Buchanan, Thomas	ME	•	•		•	
Chen, Wilfred	CBE			•		
Day, Emily	BME			•		•
Duncan, Randall	BIOL			•		•
Elliott, Dawn	BME	•	•			
Higginson, Jill	ME	•	•		•	
Jia, Xinqiao	MSE		•			•
Kiick, Kristi	MSE			•		•
Lee, Kelvin	CBE			•		
Lenhoff, Abraham	CBE		•	•		
Martin, David	MSE	•			•	•
Mirotznik, Mark	ECE	•				
Price, Christopher	BME	•	•	•		•
Shatkay, Hagit	CIS	•				
Singh, Abhyudai	ECE	•		•		
Singh, Anita	BME		•			
Slater, John	BME		•	•		•
Taufer, Michela	CIS	•				
Wang, Liyun	ME	•	•	•		•
AFFILIATED/ADJUNCT FACULTY						
Akins, Robert	Adj					•
Beris, Antony	CBE	•				
Binder-MacLeod, Stuart	PT				•	
Braun, Richard	Math		•	•		
Buckley, Jennifer	ME		•			
Burris, David	ME		•			•
Colby, David	CBE			•		
Epps, Thomas	CBE					•
Fok, Pak-Wing	Math	•		•		
Galloway, Cole	PT	•	•		•	
Kambhamettu, Chandra	CIS	•				
Kirn-Safran, Catherine	BIOL			•		•
Kloxin, April	CBE					•
Kumar, Arun	MLS			•		•
Lee, Samuel	PT				•	
Liao, Li	CIS			•		
Lu, Xin (Lucas)	ME		•	•		•
Manal, Kurt	ME		•		•	
Nohe, Anja	BIOL	•		•		
Ogunnaike, Babatunde	CBE			•		
Ou, Yvonne	Math		•			•
Papoutsakis, Eleftherios	CBE			•		•
Pochan, Darrin	MSE					•
Poulakakis, Ioannis	ME		•		•	
Rabolt, John	MSE					•
Reisman, Darcy	PT				•	
Roberts, Christopher	CBE			•		•
Santare, Michael	ME		•			
Scholz, John	PT				•	
Snyder-Mackler, Lynn	PT		•			
Stanhope, Steven	KAAP		•		•	
Sullivan, Millicent	CBE			•		•
Tanner, Herbert	ME			•	•	
Wu, Cathy	CIS			•		
Yu, Jingyi	CIS	•				
Zurakowski, Ryan	ECE			•		



College of Engineering

Biomedical Engineering
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Newark, DE 19716

The University of Delaware does not discriminate on the basis of race, color, national origin, sex, disability, religion, age, veteran status, gender identity or expression, or sexual orientation in its programs and activities as required by Title IX of the Educational Amendments of 1972, the Americans with Disabilities Act of 1990, Section 504 of the Rehabilitation Act of 1973, Title VII of the Civil Rights Act of 1964, and other applicable statutes and University policies. The University of Delaware prohibits sexual harassment, including sexual violence. The following person has been designated to handle inquiries regarding the Americans with Disabilities Act, the Rehabilitation Act, and related statutes and regulations: Tom Webb, Director, Office of Disabilities Support Services, 240 Academy Street, Alison Hall Suite 119, University of Delaware, Newark, DE 19716, 302-831-4643. The following person has been designated to handle inquiries regarding the non-discrimination policies and to serve as the overall campus coordinator for purposes of Title IX compliance: Bindu Kolli, Chief Policy Advisor, Office of Equity and Inclusion, 305 Hullihen Hall, University of Delaware, Newark, DE 19716, 302-831-8063. The following individuals have been designated as deputy Title IX coordinators: for Athletics, Jennifer W. Davis, Vice President for Finance and Administration, 220 Hullihen Hall, University of Delaware, Newark, DE 19716, 302-831-2769; and for Student Life, Dawn Thompson, Dean of Students/AVP for Student Life, 101 Hullihen Hall, University of Delaware, Newark, DE 19716, 302-831-8939. Inquiries concerning the application of anti-discrimination laws may be referred to the Title IX coordinators or to the Office for Civil Rights, United States Department of Education. For further information on notice of nondiscrimination, visit <http://wdcrobcop01.ed.gov/CFAPPS/OCR/contactus.cfm> for the address and phone number of the U.S. Department of Education office that serves your area, or call 1-800-421-3481.

