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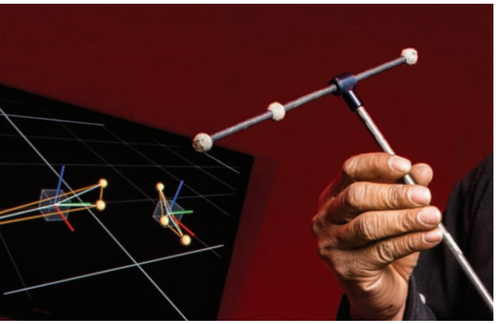
E@M

THE MAGAZINE OF THE A. JAMES CLARK SCHOOL *of* ENGINEERING

Smart Wears

WILL CLARK SCHOOL TECHNOLOGY BE INSIDE YOUR NEXT WEARABLE?

JAMES E. HUBBARD, JR.
2016 INDUCTEE, NATIONAL ACADEMY OF ENGINEERING



What's on the cover?
James E. Hubbard, Jr., holds a wand used to calibrate the VICON motion capture system, in the Clark School's Autonomous Vehicle Laboratory. VICON motion capture systems can be used to develop wearables.

Cover photo by Mike Morgan

FEATURE

DEPARTMENTS

PHOTO: MIKE MORGAN

"...we are ready to accelerate a wearable revolution."

Dear Friends of the Clark School,

There is a strong likelihood that you or someone near you is wearing a fitness tracking device. Wearable technology is not just the piece of plastic found around the wrists of millions of Americans; this technology includes clothing, glasses, smart watches, and jewelry, to name a few.

These devices have impacted our lives in big and small ways—think about the stir the first "calculator watch" created in 1975, and the way that the emergence of the Blackberry in 1999 changed our relationship with work. The past decade has seen an acceleration of wearables as the internet of things has proliferated, creating new conveniences, points of connection, and opportunities to collect data about almost every aspect of our lives.

A functional wearable is built on a lifetime of exceptional research in materials, sensors, and electronics. Dr. James E. Hubbard, Jr., who appears on our cover, developed piezoelectric film more than 20 years ago. In our feature story, we explore the potential applications of this film, along with fabric that could ultimately store energy, space gloves with robotic actuators, firefighter gear that protects from extreme heat, a sock that can measure the angles of your foot and length of your gait, and other technologies.

These innovations are not only beneficial to our lives; this research could offer an infusion of growth for the country's industrial economy. Based on the Clark School's technical expertise in advanced textiles and sensors, and our strong partners across the country, we are ready to accelerate a wearable revolution.

Sincerely,

Darryll J. Pines
DEAN AND FARVARDIN PROFESSOR OF ENGINEERING

Engineering @ Maryland is published twice a year for alumni and friends of the A. James Clark School of Engineering and the Glenn L. Martin Institute of Technology at the University of Maryland.

Letters to the editor and alumni notes are welcome. Please send them to ***Engineering @ Maryland*** Editor, 3228 Kim Engineering Building, 8228 Paint Branch Drive, College Park, MD 20742-2831. Information can be sent by fax to 301.314.6868 or by e-mail to mandreyc@umd.edu.

Please note that ***Engineering @ Maryland*** refers to the A. James Clark School of Engineering by that name in all cases, including stories that describe alumni who graduated before the name was established, in 1994, to honor Mr. Clark's outstanding philanthropy.

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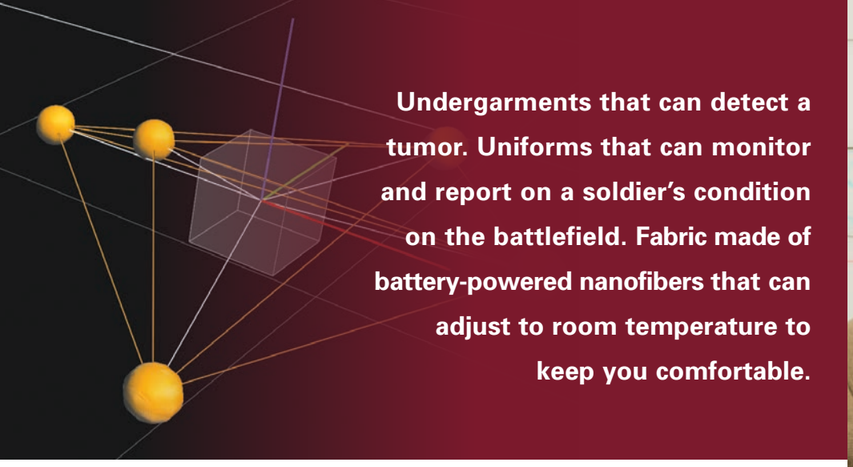


Undergarments that can detect a tumor. Uniforms that can monitor and report on a soldier's condition on the battlefield. Fabric made of battery-powered nanofibers that can adjust to room temperature to keep you comfortable.

Smart Wears

WILL CLARK SCHOOL TECHNOLOGY BE INSIDE YOUR NEXT WEARABLE?

PHOTO: EARL DWIGHT WILKOFF

PROFESSOR ROBERT BRIBER

"Wearables is a relatively new area of research that's grown in the last four to five years," said Robert Briber, Clark School associate dean for research and professor of materials science and engineering. "Our faculty are creating sensors and power supplies that capture energy from movement and could be integrated into clothing or shoes. Their work builds on several thrusts, such as energy storage and energy conversion technology, that have long been explored at the Clark School."

Briber sees wearable technology as a growth area beyond fundamental research. "There is interest from companies and customers in clothing that can monitor environmental conditions and adapt the temperature to make you cooler or warmer. There are health applications to monitor and report body functions. The potential is huge," he explained.

Wearable electronics also encompass other areas of research, such as smart building technology. "For example, a building would automatically adjust heating and cooling depending on how many people are in it," said Briber. "If clothing could communicate with that building, one could potentially realize very large energy savings."

According to Briber, the wearables research conducted at the Clark School could help reinvigorate this country's high-level textile manufacturing industry. "As the military moves to wearable technology, they would need to source it from U.S. suppliers," he said. "It is not unrealistic to imagine that within five years the technology would be available for everyone."

Smart Solutions Take Shape

"THE MATERIALS TODAY ARE VERY GOOD FOR SENSING THE HUMAN BODY..."

Department of Aerospace Engineering Samuel P. Langley Distinguished Professor James E. Hubbard, Jr., has devised innovative ways to use piezoelectric and piezo-resistive polymer thin films to sense movement. His work with these films is a 20-plus-year effort.

"This piezoelectric film looks like Saran Wrap, and an electric charge is generated when you press it," said Hubbard. The trick in making the film "smart" is converting that charge to a voltage signal.

"To convert it to a voltage signal, you must put an electrode on it," explained Hubbard. "I discovered that the voltage depends on the shape of the electrode, so we found a way to do on-board processing on the piezo film itself, just by shaping the electrode. That's what makes it smart."

Hubbard, a 2016 inductee to the National Academy of Engineering, directs the Alexander Brown Center for Adaptive Aerospace Vehicle Technology and the Morpheus Laboratory at the National Institute of Aerospace in Langley, Va. (See related story, page 27.)

Hubbard's ideas for using piezoelectric film with a charge, which he described as an excellent sensor for the body, have found their way into some smart wearable technology patents for practical use. "I saw problems on the horizon for the elderly when I heard about nursing shortages, and I saw kids getting killed by airbags," said Hubbard. "My solutions were motivated by real problems."

His solutions include a smart sheet, which can continuously monitor a patient from a bed and send vital signs and other information to a central location, and a smart car seat that senses a passenger's size and position and transmits the data to the car's computer to adjust airbag deployment. He also developed a smart shoe insert that a podiatrist can use to study a patient's gait. As a patient walks, the piezoelectric film in the insert senses gait movement and sends the data from an ankle transmitter to a centralized data collection center.

Hubbard predicts a bright future for wearable technology, but advises there is a right way to move forward. "These smart materials can do miraculous things, but they tend to have very low energy efficiency," Hubbard said. "The materials today are very good for sensing the human body, but there's work to do in developing new, more efficient materials."

AEROSPACE ENGINEERING STUDENT MICHAEL CUNNINGHAM, LEFT, AND JAMES HUBBARD, JR., EXAMINE A CENTER OF PRESSURE SENSOR WITH AN INTERDIGITATED ELECTRODE. THE SENSOR PATCH (INSET) WAS ORIGINALLY DEVELOPED BY HUBBARD TO DETECT AND MONITOR IMPACT LOCATION AND MAGNITUDE. A 2-D INTERDIGITATED SENSOR DESIGN, CREATED BY AEROSPACE ENGINEERING RESEARCH ASSOCIATE BYUNGSEOK YOO, COULD ONE DAY BE APPLIED TO ADVANCED WEARABLE TECHNOLOGY.

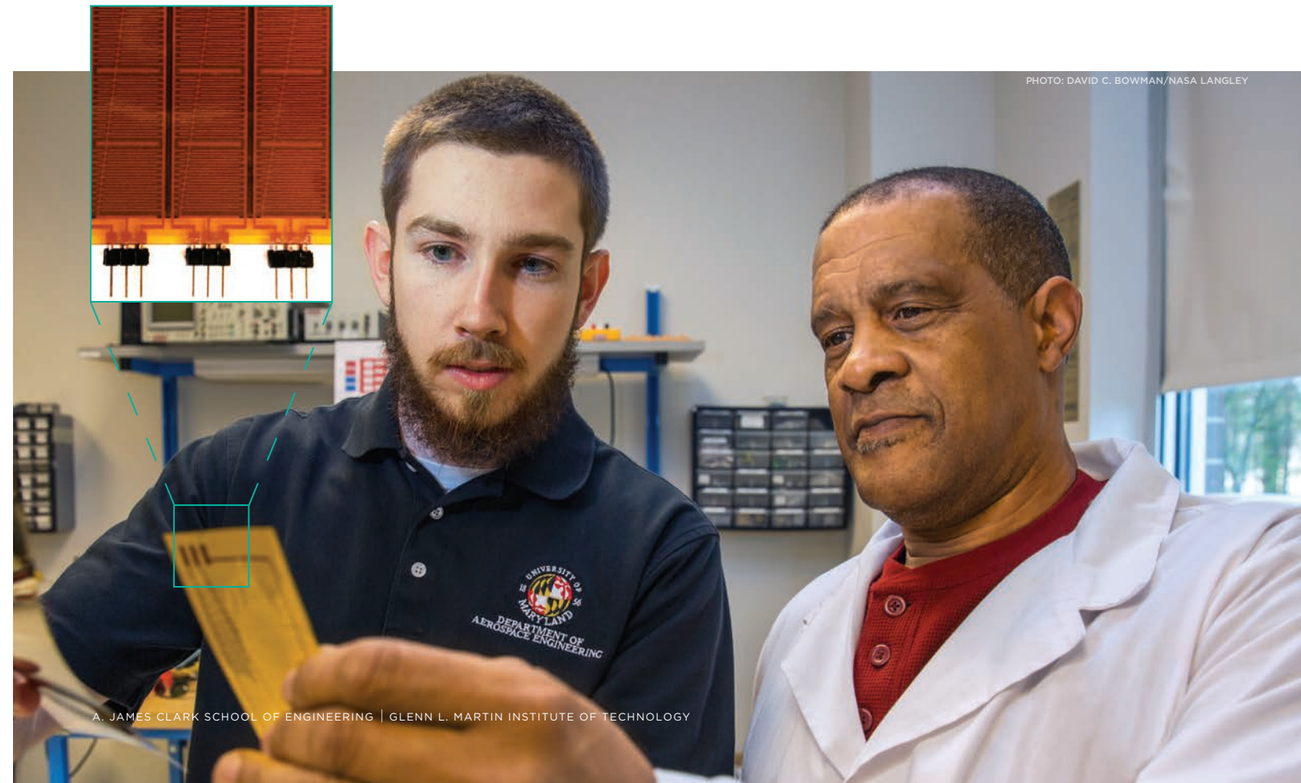


PHOTO: DAVID C. BOWMAN/NASA LANGLEY

Power Up

It's one thing to charge your Apple watch at your desk every few hours, but a soldier on a mission cannot stop to recharge a technology-enabled shirt. To make matters more complicated, wearable electronics need to hold a charge in a form that can bend and twist with body movement. Some of the most groundbreaking wearables research at the Clark School is exploring how to insert power into fabric that, like the Energizer Bunny, will keep going and going.

For Chunsheng Wang, associate professor of chemical and biomolecular engineering and member of the University of Maryland Energy Research Center (UMERC) and Maryland Nanocenter, part of the solution is as basic as a battery—but with a whole new set of requirements. "In traditional batteries, the power element is rigid. It can't bend without breaking or interrupting the energy flow," Wang said. "That won't work for wearables. The first step for wearable energy storage is to make the electrode, then the total cell, flexible."

Rechargeable lithium ion batteries have been the most important energy technology for flexible electronics, but current batteries have relatively poor flexibility compared to the anticipated needs for wearables. "We're working on how to insert energy into a flexible fabric so it can store as much energy as a rigid battery," Wang said.

Wang's team has designed flexible versions of two of the three elements needed for a battery. In 2014, they developed a new combined electrospinning and electrospray technique to create a flexible anode able to store and conduct power at levels needed to mass produce flexible batteries. They also fabricated polymer-ceramic fiber cloth composition electrolytes. "Along with a cathode, the three together will be a cell," said Wang. "Our fabrication strategy can be used on other flexible composite materials for wearable electronic clothing."

PHOTO: EARL ZUBKOFF

WANG'S TEAM DEVELOPED A NEW COMBINED ELECTROSPINNING AND ELECTROSPRAY TECHNIQUE THAT CAN BE USED TO MASS PRODUCE FLEXIBLE BATTERIES.

CHUNSHENG WANG, LEFT, AND ZHAOHUI MA, POSTDOCTORAL RESEARCH ASSOCIATE, HOLD A SAMPLE OF MATERIAL USED TO CONSTRUCT CARBON FIBERS. THE FIBERS (INSET) ARE MADE OF LITHIUM LANTHANUM TITANIUM OXIDES, WHICH CONDUCT POWER. THE CARBON FABRIC COULD ULTIMATELY STORE ENERGY.

PHOTO: EARL ZUBKOFF

LIANGBING HU, LEFT, AND TENG LI, WHO ARE BOTH MEMBERS OF UMERC AND THE MARYLAND NANOCENTER, WORK WITH WEARABLE BATTERY CABLES. BELOW, CELLULOSE NANO FIBER IMPROVES THE MECHANICAL STRENGTH OF BATTERY CABLES AND ALLOWS FOR 3-D PRINTING.

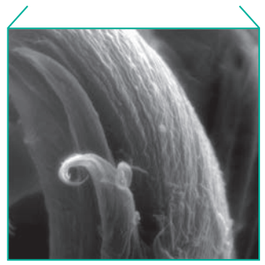
"IT TURNS OUT THE WOOD-BASED BATTERY CAN RESOLVE A BIG CHALLENGE."

LEVERAGING NATURE'S EXAMPLE

"One holy grail for materials science is how to make things stronger but also tougher," explained Teng Li, Keystone Professor and associate professor of mechanical engineering.

In the world of materials, strong and tough are not the same. "For example, diamond is super hard and strong, but also very fragile," described Li. "It is not tough enough to sustain large deformation, and thus breaks easily."

A major challenge for flexible electronics is determining how material deforms and why it fails. "When you wear clothes, you are constantly bending and moving, or deforming, them," noted Li. "So how can we use mechanics concepts to enable large repeated deformation of electronic materials that can bend without fracturing?"



The search for a strong yet flexible material that could be used to build a flexible battery for wearables led Li and his colleague Liangbing Hu, assistant professor of materials science and engineering, to one of the world's oldest sources of fiber: wood.

"Cellulose fibers as thin as human hair transport ions through a tree, much like a battery must transport ions," said Li. "The process has been there for millions of years. How can you beat nature?"

Hu's research group went to work exploring how to use wood's natural capabilities to build a flexible battery that could hold a sizable charge. One approach was a wearable battery cable, created by dissolving wood to extract the cellulose and reforming it into a micrometer-sized fiber. "Then we added highly conductive graphene in some fibers and silicon in others. Twist them together, and it's a battery," Hu said. "The cellulose in this case creates a lightweight, highly conductive fiber that is fully stretchable and very, very strong."

"It turns out the wood-based battery can resolve a big challenge," added Li. "When you charge a high-performance battery 10 times, it's dead." The wood battery, on the other hand, can maintain the capacity of a traditional battery, but can achieve a performance cycle 20 times higher than today's batteries.

CARBON NANOTUBE INK GIVES FABRICS CONDUCTIVITY.

Another wearable electronics technique the Hu lab has developed is similar to the centuries-old method of dipping fabric into dye to give it color, but they are dipping textiles into carbon nanotube ink to give it power. "The ink is the conductive material," Hu said. "When the ink dries on the surface of the textile, you have conductivity to apply voltage."

The carbon nanotube ink can be applied to existing fabrics, but the Hu lab also engineers its own fabric on a 3-D printer.

The key for both techniques is the fiber, according to Hu. "It is the building block for all kinds of shapes of flexible batteries."

Wearables in the Workplace

When your workplace is a space station orbiting more than 220 miles above the Earth or an ultra-high-temperature forest fire, what you are wearing can make a big difference.

Just moving hands in a space glove requires an incredible amount of exertion, according to Aerospace Engineering Associate Professor Dave Akin, who also directs the Clark School's Space Systems Laboratory. "Astronauts tell us that on a spacewalk, the hands and wrists tire the fastest," he said. "The gloves they wear don't have metacarpophalangeal (MCP) joints between the palm and the fingers. Astronauts carry tennis balls around for months to train their hands not to bend that joint."

Akin's group teamed with ILC Dover, the company that produces the NASA space suits, to design a glove to make the astronaut's job easier. ILC Dover built a glove with a fully articulated MCP joint, but it took about 16 pounds of force for the astronaut to move it.

"At the Clark School, we built a robotic actuator and control system that basically moves the MCP joint for you," said Akin. The new system reduced the force needed to fully move the glove to only 12 ounces, giving astronauts a greater degree of flexibility in hand movements.

In addition to the glove, Akin's lab is now working with Arizona State University geologists to test new spacesuit and helmet designs that could be used for lunar and Mars exploration. "We do know how to make experimental versions of suits that augment or amplify human strength, but operational suits need further technology development," said Akin.

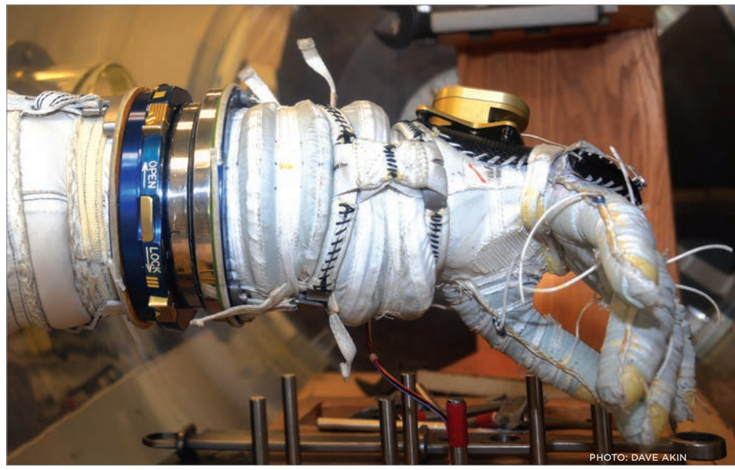


PHOTO: DAVE AKIN

GLOVE WITH ROBOTIC ACTUATOR AND CONTROL SYSTEM

BUILT-IN PROTECTION FOR FIREFIGHTERS

Back on the ground, Fire Protection Engineering Professor and Clark School Director of Facilities Marino di Marzo collaborated with Mechanical Engineering Keystone Professor and Minta Martin Professor Amr Baz to design firefighter gear that can better protect firefighters from extreme heat. Through research originally funded by the U.S. Department of Homeland Security, the team created advanced firefighter design gear that includes two key elements: heat-resistant thermal layers to capture moisture and shape memory material to create air pockets—both of which protect a firefighter from intense heat and reduce the likelihood of burns.

"This was as close to wearable technology as we could go," said di Marzo. "The novel arrangement of layers of insulation forms a barrier to keep moisture in the jacket and protect firefighters from increasingly rising temperatures, while allowing them to feel comfortable."

Baz, who also directs the Smart Materials and Structures Research Center, devised smart Nitinol wire rings made of nickel, titanium, and silicon. Placed inside pockets throughout the jacket lining, the rings expand into a scissor shape under high temperatures. "The rings are not noticeable until they expand during a fire event and create protective air pockets around a firefighter's body," explained Baz. The gear, tested by firefighters at the Maryland Fire and Rescue Institute, is patent pending.

A Step Toward Good Health

Lina Castano, a postdoctoral research associate in aerospace engineering, took a major step forward in the world of wearable technology when she created a sock that can detect foot pressure.

Using three sensors on the ankle, "the sock picks up information about the angles of your foot and your gait," Castano explained. "A module strapped to the leg transmits the information to a base station in the lab. That data can be used by diabetics to monitor neuropathy or by those recovering from an ankle or lower limb injury." Ultimately, she said, this type of biometric data could be transmitted to a smart phone or desktop computer.

"The technology also has the potential to monitor foot angles and range of motion remotely. For example, it could be used to study and prevent the effects of microgravity on astronauts in space," added Castano.

A concern in designing the sock was comfort. "You can't feel the sensors in the sock," Castano said. "We used an inherently conductive polymer for one type of sensor. The other type was a very soft and compliant carbon-based composite."

Beneath the Surface

Mechanical Engineering (ME) professors Hugh Bruck and Elisabeth Smela and Miao Yu, ME associate professor, are developing wearable technology to help detect hidden health threats. "Clothing will be more than just something that covers your body or gives you thermal protection," said Bruck. "It will be able to sense different body functions."

"We're working with biologically-inspired sensing," explained Bruck. "It operates like the nerves in your body, where you have receptors that transduce signals and ganglia that transmit them into the nerve fiber network."

The team has created a skin of "paintable sensors" that can be integrated easily into a variety of wearables, like an undergarment or a glove. They are currently applying the technology to sense the presence of tumors under the skin.

SKIN-SENSING GLOVE

PHOTOS: EARL ZUBKOFF

CASTANO DISPLAYS SENSORS. ABOVE, THE SENSOR SOCK PROTOTYPE CAN MONITOR MOVEMENT AND GAIT.

Castano's interest in wearable technology has grown since designing the sock for her master's thesis under the direction of Aerospace Engineering Professor Alison Flatau. In 2014, she co-authored an overview for *IOP Science* on the status and future of sensing technology. "One of the main issues with wearables is there are essentially no standards yet," Castano said. "We were somewhat successful in envisioning where the field could go. Major current developers are motivated by the fitness industry, so this may be the gate for wearables to enter and be positioned in our lives permanently."

"THE SOCK PICKS UP INFORMATION ABOUT THE ANGLES OF YOUR FOOT AND YOUR GAIT."

PHOTO: BRIAN SCHNEIDER

UNDER ARMOUR TESTED ITS SPEED SKATER SUIT AT THE GLENN L. MARTIN WIND TUNNEL.

Testing Ground for Wearables

When Under Armour approached Jewel Barlow, director of the Glenn L. Martin Wind Tunnel, in 2013 about testing that could improve the design of Olympic speed skating suits, Barlow was not sure the tests would deliver what the company was seeking. "Under Armour wanted to discover the aerodynamic effects of different fabrics on athletic performance," Barlow said.

The Wind Tunnel team routinely measures forces on aircraft, vehicles, and sailboats, but it was a first for clothing: measurements on people and on the effects of fabric choices are relatively new areas of investigation. "I was surprised when we found that the fabric does make enough of a difference for the effect to be easily measurable," Barlow said.

The initial testing used a dozen life-sized mannequins modeled on male and female skaters in various poses corresponding to selected stages of their races. The drag on the suits was measured, which provided a direct indication of the amount of energy required for different types of fabric on various parts of the suits. "It is not a simple exercise to translate these factors into overall performance," said Barlow. "A particular combination of fabrics may provide less drag in one pose but more drag in another pose."

Under Armour continues to leverage the resources of the Wind Tunnel. In 2015, testing was conducted with U.S. Olympic skaters, one woman and one man—a new wrinkle that required the Wind Tunnel team to determine how to measure and repeat actual movement. "It was our first application of real-time motion-tracking cameras," Barlow said. "The skaters would reposition themselves for different poses. We put targets on their elbows and wrists to ensure they could reproduce the positions."

The company is expected to return later this year for another round of testing. In addition to the force testing, Barlow said, "I think the entire heat transfer aspect of clothing is ripe for exploitation. The Wind Tunnel is going to add other kinds of measurements to its repertoire to be ready."

Wearables to Market

Electrical and Computer Engineering Professor Gil Blankenship knows what a fitful night's sleep is like. So when he was approached to help found a company that produces wearable electronics to help people improve their sleep, he was immediately intrigued.

The company, Awarables, was started by neuroscientist Madhvi Upender, who had an idea to create a wearable monitor to record data about heart rate, motion, snoring, and ambient sleeping conditions that people can easily use at home. Blankenship signed on to Awarables as a co-founder and chief science officer. "I knew how to make technology to measure data," Blankenship said. "Dr. Upender knew how to use it."

The wearable monitor is a small biometric signal recorder that attaches comfortably to the chest and can store and wirelessly upload data through a smart phone app to help users track their sleeping patterns. That data also can be easily accessed by trained professionals, including physicians, recruited by Awarables to counsel patients on better sleep hygiene.

Working with Jeffrey Wolf, M.D., a surgeon at the University of Maryland School of Medicine, they also developed a neck collar to detect and classify breathing problems that could signal obstructive sleep apnea.

This is far from Blankenship's first entrepreneurial venture. He previously founded TRX Systems, a leader in developing indoor location tracking for first responders and others, that graduated from the Maryland Technology Enterprise Institute, the university's incubator facility for startups. The requirements for success this time were a little different. "The wearable device had to be comfortable," Blankenship said. "People do not want to think about what they are wearing."

Awarables plans to create a way to monitor children with neurobehavioral disorders, who frequently have sleep problems. "For kids, you have to build something that can go in clothing, like a tee shirt, so they can't tear it off," added Blankenship.

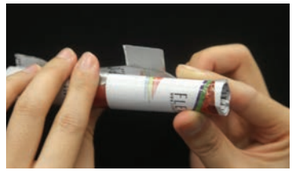
Awarables has won three Small Business Innovation Research awards, and company leaders are preparing to meet soon with Food and Drug Administration officials to organize product trials.

Get the Big Picture

Interested in learning more about our work on wearables? Visit **http://go.umd.edu/wearables** to access journal articles and additional information about the faculty members cited in this article and their groundbreaking research.

Customized Battery Solutions

FlexEl LLC, a custom design battery company whose products can be included in wearables, is a prime example of how the university helps Clark School research move from the lab to market. FlexEl develops unique solutions for companies whose requirements cannot be met by off-the-shelf batteries. FlexEl has been



optimizing its original thin-film battery technology to create wearable technology, medical devices, military applications, disposable consumer electronics, remote sensing devices, and more.

Spun from the research of Electrical and Computer Engineering (ECE) Professor Emeritus and FlexEl Board Member Martin Peckerar and ECE professor Neil Goldsman, both FlexEl co-founders and part owners, the company is preparing to open a 10,000-square-foot research, development, and manufacturing facility in College Park. The company, which has 10 full-time employees, plans to add 50 new jobs over the next five years. Peckerar and Goldsman used many of the university's startup resources, including the Maryland Industrial Partnerships program and Maryland Technology Enterprise Institute incubator space, to launch the company.

Tomorrow's Engineering Leaders, pictured from left, include Lauren Trollinger, Sylvie DeLaHunt, and Elaine Petro.

Three Aerospace Students Recognized as Tomorrow's Engineering Leaders

Three aerospace engineering (AE) students have been recognized as "Tomorrow's Engineering Leaders: The 20 Twenties" by Penton's Aviation Week Network. The award, granted in partnership with the American Institute of Aeronautics and Astronautics, recognizes top engineering, math, science, and technology students worldwide and connects them with leaders in the fields.

Sylvie DeLaHunt, a second-year master's student, is working in flight dynamics and control with AE Department Chair Norman Wereley, her faculty advisor. As a 2014 National Science Foundation (NSF) Graduate Research Fellow, she is investigating the application of a variable recruitment control strategy to a bundle of miniature pneumatic artificial muscles (PAM) to try to mimic motor units in human muscles.

Elaine Petro is a third-year Ph.D. student exploring the field of electric propulsion under AE Associate Professor Raymond Sedwick. Her research focuses on the use of water vapor propellant for helicon thrusters. A 2014 NSF Graduate Research Fellow and a 2015 Amelia Earhart Fellow sponsored by Zonta International, Petro has been selected for the Clark School's Future Faculty Program.

Lauren Trollinger is a first-year master's student specializing in rotorcraft under Alfred Gessow Professor and Distinguished University Professor Inderjit Chopra, who also directs the Alfred Gessow Rotorcraft Center. Trollinger was a member of UMD's human-powered helicopter team, Gamera. She is now designing a vertical takeoff and landing aircraft to deliver emergency supplies to disaster victims as part of the American Helicopter Society Student Design Competition team.

>> LEARN MORE, VISIT http://go.umd.edu/20

UMD ADVANCES IN HYPERLOOP COMPETITION

A UMD-led student team will be taking its ideas for a new high-speed ground transport system to the next level after advancing at the recent SpaceX Hyperloop Pod Design Competition Weekend at Texas A&M in College Station, Texas. The team, including several Rutgers University students who are assisting with electronic efforts, will go on to test its Hyperloop pod, Prometheus, later this year at SpaceX's Hawthorne, Calif., headquarters.

SpaceX and Tessla Motors co-founder Elon Musk, who made an appearance at the competition, first proposed the Hyperloop in 2013. In the Hyperloop, passengers could travel nearly 400 miles—for example, from Los Angeles to San Francisco—in less than 30 minutes. The innovation could radically transform the speed and safety of passenger mass transit. SpaceX's Design Weekend was a preliminary competition for students to encourage innovation and challenge them to design and build the best Hyperloop transport pod.

The competition pod prototypes are scaled-down versions designed to operate on SpaceX's aluminum plate and rail test track. The model the UMD team proposes to build will be approximately three by nine feet and weigh about 1,200 pounds. If successful, the pod will be capable of safely topping 210 miles per hour.

Mentored by Fire Protection Engineering Visiting Research Associate Noah Ryder, the multidisciplinary team includes more than 25 students from the Clark School, the College of Computer, Mathematical, and Natural Sciences (CMNS), and Rutgers University. Some 124 student engineering teams from 27 U.S. states and 20 countries were selected from more than 1,200 initial proposals to participate in the Design Weekend. Only 30 teams, including UMD, will go on to test their pods in California. The team is supported by a number of industrial sponsors, the Clark School, CMNS, and a LaunchUMD crowd-sourcing campaign.

Rendering of UMD Hyperloop pod

>> LEARN MORE, VISIT http://www.rumdloop.com

UMD is one of only 30 teams selected to test its Hyperloop pod later this year at the SpaceX headquarters in California.

STUDENTS VIE FOR $2 MILLION IN PRIZES IN 2017 SOLAR DECATHLON

There is an old saying: "Many hands make light work." In the case of UMD students, many hands will put "light" to work in the form of solar power to construct the university's entry in the U.S. Department of Energy 2017 Solar Decathlon.

UMD students will compete against 15 collegiate teams from around the world to design and build a small sustainable home. Each house is assessed in 10 categories, including construction, energy efficiency, comfort, and market appeal. For the first time in the competition's history, teams will be competing for $2 million in prize money.

"The Solar Decathlon showcases the unbelievable talent that our students bring to hands-on challenges," said Farvardin Professor and Clark School Dean Darryll J. Pines. "Our solar-powered houses are built on a strong educational foundation and nurtured by creativity, team-building, and grit."

This is the university's fifth entry in the competition. UMD won the 2011 Solar Decathlon and placed second in 2007. The group's winning creation, WaterShed, was inspired by the Chesapeake Bay ecosystem and emphasized both solar and water efficiency. Following the competition, the WaterShed building was purchased by the regional electric service provider Pepco and converted into its Sustainability Center.

>> LEARN MORE, VISIT http://go.umd.edu/decathlon

PHOTO: STEFANO PALTERA/U.S. DEPARTMENT OF ENERGY

UMD looks to extend its winning record in the 2017 Solar Decathlon. Its 2011 entry, WaterShed, above, won first place in the competition.

UMD Team Captures Second Consecutive Gold Medal in iGEM Competition

UMD celebrated a second consecutive gold medal performance and was one of five nominations for "Best New Application" at the International Genetically Engineered Machine (iGEM) competition. The multidisciplinary team competed and collaborated with 250 teams from around the world in iGEM Jamboree, a high-intensity event that engages students to design and present novel synthetic biology products that address real-world challenges.

The UMD team earned a gold medal for creating an innovative approach to accelerate the construction of new biodesigns. The team's methods for plasmid maintenance without the use of antibiotics involved the construction of an inexpensive thermocycler using parts from a hair dryer.


PHOTO: JUSTIN KNIGHT/IGEM FOUNDATION

UMD students, in yellow, were among some 250 teams participating in the iGEM competition.

>> LEARN MORE, VISIT http://go.umd.edu/igem

ChBE Students Take Top Spot in Jeopardy Competition


PHOTO: AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

Jeopardy winners, from left, includeChBE students Ben Gastfriend, Amanda Merlock, Lidiya Gavrilenko, and Carla Repko.

A team of four students in the Department of Chemical and Biomolecular Engineering (ChBE), guided by faculty advisor and ChBE Associate Professor Chunsheng Wang, demonstrated exceptional knowledge of the field in the 2015 American Institute of Chemical Engineers Annual Student Conference Jeopardy Competition.

Students competed against eight teams from across the country at the institute's annual meeting in Salt Lake City. UMD team member Lidiya Gavrilenko attributed the come-from-behind win in the final round to the Clark School's rigorous chemical engineering curriculum.

>> LEARN MORE, VISIT http://go.umd.edu/chem

Fisher Named Chair of Fischell Department of Bioengineering

PHOTO: JOHN T. CONSOLI

John P. Fisher has been named the Robert E. Fischell Professor and Chair of the Fischell Department of Bioengineering.

"Dr. Fisher's rapid ascension in academic rank parallels his many outstanding achievements in both teaching and research," said Farvardin Professor and Clark School Dean Darryll J. Pines. "I am confident he will advance the Fischell Department of Bioengineering's reputation as a top-tier program by further propelling the department's commitment to groundbreaking research, high-quality education, and engineering entrepreneurship."

With the new A. James Clark Hall slated to open in 2017, Fisher will assume the role of chair as the department enters a new era of growth in terms of both size and breadth of research. As part of this expansion, the Fischell Department of Bioengineering plans to add up to seven new faculty members by 2019.

In 2013, Fisher was named the Fischell Family Distinguished Professor. From 2009 to 2012, he served as associate chair and director of graduate studies for the department. He began his UMD career as an assistant professor with the Department of Chemical and Biomolecular Engineering before helping to establish the Fischell Department of Bioengineering in 2006.

Fisher is a Fellow of the American Institute for Medical and Biological Engineering, and a member of the Biomedical Engineering Society, Society for Biomaterials, and Tissue Engineering and Regenerative Medicine International Society. He is currently editor-in-chief of the journal *Tissue Engineering Part B: Reviews*.

>> LEARN MORE, VISIT http://go.umd.edu/fisher

NSF ANNOUNCES FIVE CLARK SCHOOL CAREER AWARD WINNERS

President Obama Recognizes Jones as PECASE Winner

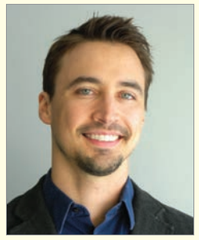
Four members of the Clark School faculty have received National Science Foundation (NSF) Faculty Early CAREER Development Awards, and a fifth faculty member has received both a CAREER award and a Presidential Early Career Award for Scientists and Engineers (PECASE).

CAREER awards foster the career development of outstanding junior faculty, combining research and education support of the highest quality and in the broadest sense. The PECASE award is the highest honor bestowed by the U.S. government on science and engineering professionals in the early stages of their independent research careers.

Aerospace Engineering Assistant Professor **ANYA JONES** received a five-year, $500,000 CAREER award for her research to improve the safety, reliability, and efficiency of air vehicles by gaining a deeper understanding of the physics of the large flow field disturbances encountered in high winds and gusty flight environments. In addition, President Barack Obama named Jones a PECASE winner. Her PECASE nomination was sponsored by the U.S. Department of Defense.

Electrical and Computer Engineering (ECE) Assistant Professor **BEHTASH BABADI**, an affiliate of the Institute for Systems Research (ISR), received a five-year CAREER award for approximately $490,000. His research will create a new mathematical framework to interpret recordings from the brain in order to understand brain functions that result in perceiving, learning, or memorizing sounds, speech, and music.

Fire Protection Engineering Assistant Professor **MICHAEL GOLLNER** received a five-year CAREER award for $500,000. Gollner will seek to further understand the previously unexplored role of intermittent heating that is driven by reacting-flow instabilities on wildland fire spread. His research could lead to a testable physical theory of wildland fire spread.



Assistant Professor **JEREMY MUNDAY** (ECE/Institute for Research in Electronics and Applied Physics, and Joint Quantum Institute) was awarded a five-year CAREER award for $500,000. Munday will investigate the effect of generating and extracting hot carriers within metals under optical illumination, while simultaneously developing tools to expand alternative energy education. His work could broaden understanding of how to mitigate power losses due to device heating.

Associate Professor **PIYA PAL** (ECE/ISR) received a five-year $500,000 CAREER award for her research to develop a systematic theory of smart sampling and information retrieval algorithms for modern sensing systems. The educational component of the project aims to integrate the research outcomes into innovative research/teaching platforms to help train the next generation of electrical engineers and encourage them to pursue careers in the fields of science, technology, engineering, and mathematics.

>> LEARN MORE, VISIT http://go.umd.edu/CAREER

Mote Named Member of Chinese Academy of Engineering

Glenn L. Martin Institute Professor of Engineering and former UMD President C. D. Mote, Jr. has been appointed a member of the Chinese Academy of Engineering. He is one of eight foreign members, including five Americans, named this year.

Mote currently serves as the president of the National Academy of Engineering (NAE), while still holding a professorship with the Clark School's Department of Mechanical Engineering. He was elected to the NAE in 1988 for his analysis of the mechanics of complex dynamic systems, which provided results of great practical importance in vibrations and biomechanics. He served as the president of the University of Maryland from 1998–2010. During this time, he launched the first Confucius Institute in the United States, which is located on the UMD campus.

FELLOWSHIPS, SOCIETIES, HONORS AND AWARDS

Civil and Environmental Engineering (CEE) Professor **GREGORY BAECHER** was awarded the 2015 GEOSNet Distinguished Award for lifetime achievement. Baecher was recognized for substantial contributions to the geotechnical risk and reliability community in research, education, and leadership.

Aerospace Engineering (AE) Associate Professor and Keystone Professor **CHRISTOPHER CADOU** has been named an American Society of Mechanical Engineers Fellow. His research focuses on combustion, including the physics of power system miniaturization, engine-solid oxide fuel cell hybridization, film cooling in rocket nozzle extensions, and pulse jet engine noise reduction.

Mechanical Engineering (ME) Keystone Professor **JAMES DUNCAN** just completed serving his four-year chairmanship track of the American Physical Society's Division of Fluid Dynamics (DFD) Executive Committee and his one-year term as division chair. He now serves as the division's past chair.

Glenn L. Martin Institute Professor of Engineering **GERRY GALLOWAY** (CEE) was inducted into the 2015 class of the National Academy of Construction. Galloway, an affiliate professor in the UMD School of Public Health, also received the Renewable Natural Resources Foundation's 2015 Sustained Achievement Award.

Keystone Professor **BONGTAE HAN** (ME), director of the Center for Advanced Life Cycle Engineering's Laboratory for Optomechanics and Micro/nano Semiconductor/Photonic Systems, is the 2016 recipient of the American Society of Mechanical Engineering Mechanics Award in the society's Electronic and Photonic Packaging Division. The award recognizes excellence in the area of engineering and science of structural mechanics of electronic systems.

Assistant Professor **CHRISTINE HARTZELL** (AE) and Associate Professor **RAYMOND SEDWICK** (AE) have received NASA Early Stage Innovations (ESI) Awards. The ESI program, funded as part of NASA's Space Technology Research Grants Program, focuses on innovative, early-stage space technology research of high priority to NASA's Mission Directorates.

Assistant Professor **LIANGBING HU**, materials science and engineering and University of Maryland Energy Research Center, and Assistant Professor **JEREMY MUNDAY**, electrical and computer engineering (ECE), Institute for Research in Electronics and Applied Physics, and Joint Quantum Institute, have received Office of Naval Research Young Investigator Awards. Hu will be studying "Printable Anisotropic Nanostructures with Boron Nitride Nanosheets for High Temperature Applications," and Munday will be studying "Novel Optoelectronic Materials for Hot Carrier Effects."

ME Associate Professor and Keystone Professor **TENG LI** has won the 2016 Society of Engineering Science Young Investigator Medal. Li is the first UMD faculty member to receive this recognition.

Distinguished Scholar–Teacher and Christine Kim Eminent Professor of Information Technology **K.J. RAY LIU** (ECE) has been elected to the Board of Directors of the Institute of Electrical and Electronics Engineers.

Professor **STEVEN GABRIEL** (ME), Applied Mathematics, Statistics, and Scientific Computation program and an affiliate with the Institute for Systems Research (ISR), has been named an Associated Member of the Group for Research in Decision Analysis (GERAD). He will concentrate on developing models and algorithms to solve optimization and equilibrium problems in energy and other networked industries with GERAD.

Professor **SENNUR ULUKUS** (ECE/ISR) has been named a Fellow of the Institute of Electrical and Electronics Engineers for contributions to characterizing performance limits of wireless networks. Ulukus's research interests include cognitive radio networks, wireless network security, and energy-harvesting and rechargeable networks.

Associate Professor **EDO WAKS** (ECE) has been elected as a Fellow of the Optical Society. Waks was honored for outstanding contributions to optical quantum information processing using quantum dots coupled to nanophotonic devices.

Professor **MIN WU** (ECE/ISR), affiliated with the University of Maryland Institute for Advanced Computer Studies and the Maryland Cybersecurity Center, received the 2015 Institute of Electrical and Electronics Engineers Signal Processing Society Meritorious Service Award for exemplary service to and leadership in the Signal Processing Society.

FOUR FACULTY RECEIVE DURIP AWARDS

Four faculty members have received funding through the Department of Defense University Research Instrumentation Program (DURIP). The awardees and their respective projects are:

Aerospace Engineering (AE) Associate Professor **ANUBHAV DATTA** for a mach-scale, high-speed tilt-roto test rig.

Mechanical Engineering (ME) Keystone Professor **JAMES DUNCAN** for a measurement system for the impact of a flexible plate on a water surface.

Distinguished University Professor **ASHWANI GUPTA** (ME) for advanced diagnostics for high-temperature distributed combustion.

Associate Professor **PINO MARTIN**, (AE) and University of Maryland Institute for Advanced Computer Studies, for centralization, management, and analysis of hypersonic flow base.

PHOTO: MIKE MORGAN

Bergbreiter is New Director of Maryland Robotics Center

Sarah Bergbreiter, associate professor of mechanical engineering and affiliate of the Institute for Systems Research (ME/ISR), is the new director of the Maryland Robotics Center. She succeeds Professor S.K. Gupta (ME/ISR), the founding director, who accepted an appointment at the University of Southern California.

Bergbreiter's research interests are in microrobotics, micro-electro-mechanical systems, microactuators, soft robotics, robot locomotion, networked centimeter-scale robots, and millimeter-scale power systems. She joined UMD in 2008 and earned tenure in 2014. She received a Presidential Early Career Award for Scientists and Engineers (PECASE) in 2013; an National Science Foundation (NSF) Faculty Early CAREER Development Award for "Microrobot Legs for Fast Locomotion over Rough Terrain," in 2011; and a DARPA Young Faculty Award in 2008.

Bergbreiter was the principal investigator for an NSF Research Experiences for Undergraduates in microrobotics and directs the new Robotics Realization Lab.


PHOTO: MIKE MORGAN

TUNNEL VISION KEEPS BETHEL ABATE ON THE FAST TRACK

When it comes to keeping projects on track, civil engineer Bethel Abate (B.S. '06, M.E. '12) has tunnel vision. As a project manager on one of Washington, D.C.'s biggest construction projects—a $2.6 billion, 13-mile tunnel system—she is helping to keep Washington's water supply clean and safe for city residents.

"Our work involves building 23-foot-diameter tunnels 100 feet underground, as well as several near-surface structures, to pick up combined water flows that otherwise would go into the rivers untreated during heavy rain events," said Abate, who joined DC Water's Clean Rivers Project soon after graduating from the Clark School in 2006. "The project aims to reduce sewer overflows by up to 98 percent, making the rivers cleaner for people and aquatic life."

While the idea of continuing her education was always in the back of Abate's mind, the job provided the motivation to beef up her project management skills. The Clark School's Master of Engineering in Project Management program was the perfect fit for her busy schedule.

"As a Maryland grad, I already knew the quality of education," noted Abate. "Managing coursework and a demanding job is a bit challenging. But with so many online courses available, there is flexibility to work with your schedule."

Abate found the program's applied approach especially valuable. "The faculty are amazing," she said. "They are professionals with real-life experience, from lawyers practicing contract law, to engineers working in the field, to owners managing the construction side."

ADVANCE YOUR CAREER

Offered through the Clark School's Office of Advanced Engineering Education, the Professional Master of Engineering and the Graduate Certificate in Engineering programs assist engineers in the development of their professional careers and provide the technical expertise needed in business, government, and industry. The online programs were ranked 16th in the nation by *U.S. News & World Report* for 2016.

>> LEARN MORE, VISIT https://advancedengineering.umd.edu

>> EMAIL oaee@umd.edu

Jones Named Black Engineer of the Year


At awards ceremony, from left, Clark School Dean Darryll Pines; Chairman, CEO, and President of Northrop Grumman Corporation Wes Bush; Christopher Jones; and Aerospace Engineering Department Chair Norman Wereley.

Christopher T. Jones (Ph.D. '97, aerospace engineering) was named the 2016 Black Engineer of the Year at the recent 30th annual Black Engineer of the Year Award (BEYA) Science, Technology, Engineering and Mathematics (STEM) Global Competitiveness Conference. Jones, who is a member of the Clark School Board of Visitors, is corporate vice president and president of Northrop Grumman Technology Services, a recognized leader in integrated logistics, sustainment, modernization, defense, health, civil and government services, and training solutions. He is also a retired U.S. Air Force officer and retired member of the Connecticut Air National Guard.

Engineering Alumni Network Broadens Its Reach


Members of the Engineering Alumni Network Board enjoy the camaraderie and the weather at their August planning meeting.

Whether you are a recent Clark School graduate or are ready to re-engage with your alma mater, the Clark School Engineering Alumni Network is the perfect venue for connecting with former classmates and faculty members.

Members of the network's board of directors are exploring more meaningful events and activities for alumni and accelerating the Mentoring Program initiative to help young alumni advance in their career paths with the advice and counsel of other Clark School graduates. In addition, they have undertaken a number of new initiatives, including creating the Engineering Alumni Network Leadership Scholarship, which is awarded to students who are active members of the Clark School community. Be sure to join the University of Maryland Alumni Association to access all of the network's offerings.

>> VISIT THE UMD ENGINEERING ALUMNI NETWORK ON FACEBOOK AT http://go.umd.edu/fbalumni

>> FOR UPCOMING EVENTS, VISIT http://go.umd.edu/umdaaevents

ADLY PROMOTED TO VICE PRESIDENT AT CAIRO UNIVERSITY

Amr A. Adly (Ph.D. '92, electrical and computer engineering), the former student of Alford L. Ward Professor and Distinguished Scholar-Teacher Isaak Mayergoyz, has been appointed vice president for graduate studies and research at Cairo University. Established in 1908, Cairo University is a comprehensive higher education institution located in Giza, Egypt. Previously, Adly served as executive director of the Science and Technology Development Fund, which is affiliated with the Egyptian Ministry of Scientific Research.

WILSON SELECTED AS MODERN-DAY TECHNOLOGY LEADER

Ricky Wilson (B.S., '02) has been selected as a Modern-Day Technology Leader by the Council of Engineering Deans of the Historically Black Colleges and Universities, Lockheed Martin Corporation, and *US Black Engineer & Information Technology* magazine. Wilson has worked at Constellation, an Exelon company, since 2010 in a number of different capacities, initially as a business analyst both in Constellation's information technology group and in strategic systems and business operations. He currently works in Constellation's structuring group as a senior structuring analyst developing software solutions for the company.

Clark School Innovators Named to National Academy of Inventors


John S. Baras


Robert E. Fischell


Benjamin A. Shneiderman

The National Academy of Inventors (NAI) has named Lockheed Martin Chair in Systems Engineering John S. Baras and Robert E. Fischell (M.S. '53, Hon. Sc.D. '96), professor of the practice and namesake of the Fischell Department of Bioengineering, as 2015 NAI Fellows.

Baras was the founding director of the Institute for Systems Research (ISR). He holds 15 U.S. patents and a software copyright in the fields of Internet protocols, networks, wireless networks and security, and signal processing. An internationally recognized authority in satellite and wireless networks, Baras led the development of fast Internet over satellite, commercialized by Hughes Network Systems, and created a new industry sector for Internet services over satellite.

Fischell is the inventor behind major medical breakthroughs including highly flexible, drug-eluting coronary stents, the first implantable insulin pump, and a magnetic pulse device for treating human pain. (See related story, page 26.)

Distinguished University Professor in computer science Benjamin A. Shneiderman was also named to the 2015 induction class. Shneiderman has submitted more than 25 disclosures to UMD's Office of Technology Commercialization in the fields of human–computer interaction and information visualization, more than 20 of which have been licensed. Shneiderman, who has a joint appointment in the Institute for Advanced Computer Studies, is founding director of the Human–Computer Interaction Laboratory and an affiliate professor with ISR and the College of Information Studies.

"These individuals embody the University of Maryland's spirit of innovation. Our faculty, alumni, and students continue to put forth revolutionary inventions that have extraordinary impact on economic development, quality of life, and most importantly, the betterment of society," said Patrick O'Shea, UMD vice president and chief research officer.

Baras and Shneiderman are the first two UMD faculty members to join the ranks of some of the nation's most prestigious and creative inventors. In 2015, 168 NAI Fellows were announced, bringing the total number of NAI Fellows to 582. The 2015 Fellows account for more than 5,300 issued U.S. patents. The collective patents held by all NAI Fellows total more than 20,000. The NAI Fellows will be inducted in April as part of the Fifth Annual Conference of the National Academy of Inventors at the United States Patent and Trademark Office (USPTO) in Alexandria, Va.

>> LEARN MORE, VISIT http://go.umd.edu/nai

ENTREPRENEURS FROM CLARK SCHOOL MAKE THEIR MARK IN SILICON VALLEY

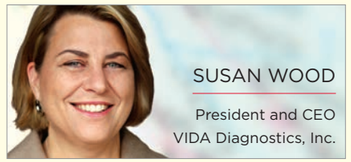
For decades, Silicon Valley has attracted some of the most creative and innovative thinkers looking to pursue new technology frontiers. Today, the world's leading hub for high-tech research accounts for approximately one-third of all the venture capital investment in the United States, according to Pricewaterhouse Coopers and the National Venture Capital Association. It should come as no surprise that droves of engineers have gravitated to this legendary startup environment.


HARSHA PRAHLAD
Co-founder and Chief Technology and Products Officer
Grabit, Inc.

"I was looking for a place where I could deepen the process of idea generation, marketing validation, and market acceptance," said Harsha Prahlad (M.S. '99, Ph.D. '02, aerospace engineering), co-founder and chief technology and products officer for Grabit, Inc. As principal inventor of Grabit's electroadhesion technology, Prahlad believes his company is positioned to revolutionize the multi-billion dollar material handling market with new solutions in both manufacturing and warehouse automation.

"I would definitely encourage Clark School graduates to explore the startup scene in Silicon Valley," he said. "You'll have a lot of work, you'll also have a lot of responsibility, and you'll see different ways of approaching problems."

"Silicon Valley has developed a framework to give innovators every chance for success." said Susan Wood (B.S. '84, engineering), president and CEO of VIDA Diagnostics, Inc., a leading company in


SUSAN WOOD
President and CEO
VIDA Diagnostics, Inc.

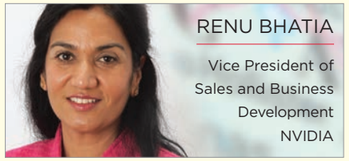
precision pulmonary imaging. Wood believes Silicon Valley's unique culture and fast-paced environment make it possible to start a company from nearly a blank sheet of paper. "Realistically, you can put a company together in two weeks in Silicon Valley because it has all the legals, the accountancies, and the 'rent-a-CFOs' to support a uniquely agile environment."

Matt Brezina, a former student in the Ph.D. program in electrical and computer engineering, was bitten by the entrepreneurial bug while at the Clark School. He left UMD to launch startup Xobni. "I struggled in my graduate classes," Brezina said. Still, he learned valuable lessons. "Maryland shaped me, in part, because it taught me how to do really painful hard work, and building a startup is painful and hard."


MATT BREZINA
Co-founder and CEO
Sincerely.com

All of that work has more than paid off. Xobni, a San Francisco-based company that specializes in software applications and services, including products for Microsoft Outlook and mobile devices, was acquired by Yahoo! in July 2013 for more than $60 million. Since then, Brezina, now co-founder and CEO of Sincerely.com, has focused on transforming his new company into a premier mobile gifting platform that allows users to create cards and other personalized gifts straight from their mobile devices. Sincerely was acquired by Provide Commerce in late 2013.

"When you are in graduate school, it's mostly you motivating yourself," he continued. "That's what it's like with startups. You have to be independently motivated and prepared to get knocked down over and over, then get up and do it again the next day."


RENU BHATIA
Vice President of Sales and Business Development
NVIDIA

The life of an entrepreneur is not for the faint of heart. "It's a given that you have the skill set, and it's a given that you have to knock things out of the park to be successful," said Renu Bhatia (B.S. '92, electrical and computer engineering), vice president of sales and business development for NVIDIA, a world leader in visual computing technologies. "When you are around risk-takers, it opens you up to possibilities" said Bhatia. "Ideas are easier to come by, but execution is hard. Since entrepreneurship and success depend on execution, I believe a brilliant, extraordinary team that works well together is key to any project."

New Imaging Technique Boosts Solar Cell Efficiencies

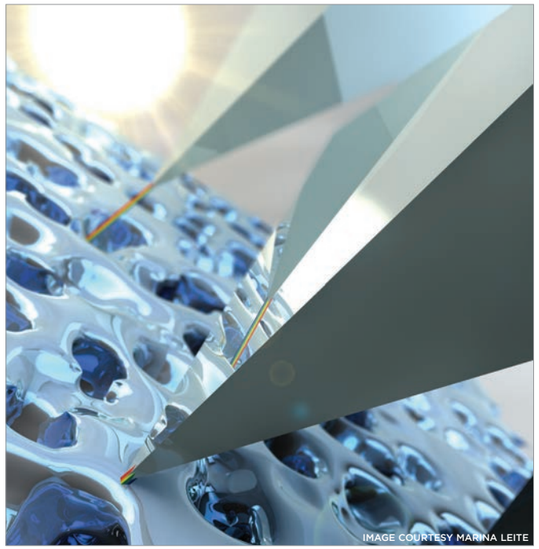


IMAGE COURTESY MARINA LEITE

A new diagnostic imaging technique developed by a UMD-led team of researchers promises to boost efficiencies of solar cells. Their work makes it possible to find and correct previously undetected ways that solar cells fall far short of theoretical efficiencies. Theory indicates that current solar cell technologies should be able to convert solar energy to electrical energy with at least 30 percent efficiency, but the actual efficiencies of current cells are only around 20 percent.

"With the new imaging technique our team has developed, academic and industry researchers will be able to diagnose where solar cells lose efficiency and close the gap between theory and the actual efficiencies experienced by consumers who install solar panels on their homes and businesses," said Marina Leite, assistant professor of materials science and engineering and the Institute for Research and Applied Physics. The new, ambient temperature imaging technique developed by Leite and her team is a variation of illuminated Kelvin Probe Force Microscopy, which is a non-contact, non-destructive imaging technique used to determine the composition and electronic state of a surface.

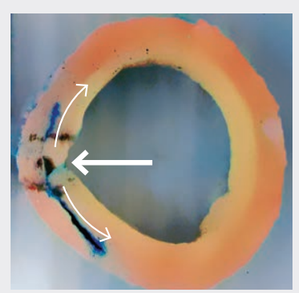
>> LEARN MORE, VISIT http://go.umd.edu/solarcell

DISCOVERING THE MECHANICS OF AORTIC DISSECTION

Aortic dissection is a serious, often fatal condition in which the inner layer of the aorta tears, leading to internal bleeding and possible rupture. A team of Clark School researchers has discovered that the aortic tissue does not dissect in a continuous path, but after the initial small crack, it begins tearing around the circumference of the aorta. Their findings may indicate that the different types of layers making up the aortic wall might each play a different role in aortic dissection.

Mechanical Engineering (ME) Associate Research Professor Henry Haslach and ME graduate student Lauren Leahy, along with a team of undergraduate researchers, have spent several years applying mechanical principles to investigate the effects of pressure on aortic tissue. The team ran a series of tests to apply pressure and shearing stresses to bovine aortas, applying mechanical engineering principles to soft tissue research. Their work has been published in the Biomedical Engineering Society's *Journal of Cardiovascular Engineering and Technology*.

>> LEARN MORE, VISIT http://go.umd.edu/o2m



The circumferential crack direction during shear (shown with blue dye in the cracks to make them visible) may indicate different types of layers making up the aortic walls.

THE UPSIDE OF WINTER'S WRATH

UMD RESEARCHER IMPROVES TECHNIQUES TO MEASURE SNOW, FRESHWATER AVAILABILITY

As the primary freshwater source for more than one billion people worldwide, snow provides water that is easy to capture for drinking, agriculture, and industry. But before researchers can determine best practices for preserving and managing snow as a viable resource for freshwater, they need a more accurate technique for measuring how much snow exists worldwide. That's where Barton Forman, assistant professor of civil and environmental engineering and Deborah J. Goodings Professor in Engineering for Global Sustainability, comes in. Forman is working to develop improved techniques to measure the Earth's total supply of snow and better understand how much frozen freshwater is available in the world at any given time.

Forman's technique to quantify snow uses two unique sources of information derived from satellites: the Earth's emission of microwave radiation and changes in the Earth's gravitational field. "Once we can figure out exactly how much snow exists in the world, we can start figuring out its movement and timing—when it melts and where—so that we can better plan for the future," said Forman, whose work helps measure drought and flood conditions based on gravitational fields.

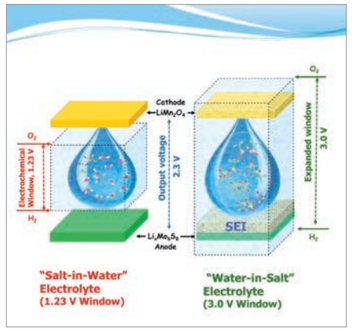
Forman has been named to the NASA Science Team for the Gravity Recovery and Climate Experiment follow-on (GRACE-FO) satellite launch in 2017. The goal of the mission is to accurately map variations in Earth's gravity field.

>> LEARN MORE, VISIT http://go.umd.edu/barton

UMD and Army Researchers Discover Salty Solutions to Better, Safer Batteries

A team of researchers from UMD and the U.S. Army Research Laboratory (ARL) have devised a groundbreaking "Water-in-Salt" aqueous lithium ion battery technology that could provide power, efficiency, and longevity comparable to today's lithium-ion batteries—but without the fire risk, poisonous chemicals, and environmental hazards of current lithium batteries.

The team of researchers, led by Chemical and Biomolecular Engineering Associate Professor Chunsheng Wang and Kang Xu, senior research chemist at the Sensor and Electron Devices Directorate of ARL, said their work demonstrates a major advance in the long history of water-based (aqueous) batteries by doubling the voltage, or power, of an aqueous battery.



The researchers said their technology holds great promise for a number of applications: those that involve large energies at kilowatt or megawatt levels such as electric vehicles or grid-storage devices for energy harvest systems; those in which battery safety and toxicity are primary concerns such as safe, non-flammable batteries for airplanes, naval vessels, or spaceships; and medical device applications such as pacemakers.

The research team found that the key to their breakthrough was the use of a type of water-based electrolyte containing ultra-high concentrations of a carefully selected lithium salt. This approach transformed the battery's chemistry, resulting in the formation of a thin protective film on the anode electrode for the very first time in a water-based battery.

>> LEARN MORE, VISIT http://go.umd.edu/batteries

Fischell Recognized by President Obama for Technological Achievement

Fischell Department of Bioengineering namesake and Professor of Practice Robert E. Fischell (M.S. '53, Hon. Sc.D. '96) was named a recipient of the National Medal of Technology and Innovation, the highest honor for technological achievement bestowed by the President of the United States.

"Bob Fischell's medical devices have improved the health of millions, and his new innovations promise to change the lives of many others," said UMD President Wallace D. Loh. "He is an apostle for education, an inspiration to our students, and a philanthropist who makes UMD's premier medical device engineering program possible."

Fischell holds more than 200 patents, including nearly 30 patents on orbiting spacecraft. In the medical device realm, Fischell has been a leading contributor to the invention of coronary stents, the implantable heart defibrillator, the implantable insulin pump, a device to prevent migraine headaches, and a device to prevent death from heart attacks.

Fischell's support of the Clark School helped establish the Fischell Department of Bioengineering in 2006 and the Robert E. Fischell Institute for Biomedical Devices, which will be inaugurated later this year.

>> LEARN MORE, VISIT http://go.umd.edu/NMTI


PHOTO: LUISA DIPIETRO

TECH COUNCIL LIFETIME ACHIEVEMENT WINNER

Robert E. Fischell is a 2016 recipient of the Tech Council of Maryland's Lifetime Achievement award in the field of education. Each year, the Tech Council of Maryland, the region's largest life science and technology trade association, presents the award to individuals who have made outstanding contributions to the success of the technology community. Fischell was recognized for his contributions to the creation of lifesaving medical devices.

HUBBARD ELECTED TO NATIONAL ACADEMY OF ENGINEERING

Department of Aerospace Engineering Samuel P. Langley Distinguished Professor James E. Hubbard, Jr. has been elected to the National Academy of Engineering (NAE).

Hubbard was recognized as the key pioneer in developing piezo film sensors and piezoelectric actuation systems for smart structures and materials applications, as well as his extensive contribution to aerospace engineering in the field of smart structures. His contributions began as a faculty member at Boston University and continued as an industrialist for a number of successful high-technology startups and in his current role at UMD over the past 15 years.

"I am deeply humbled by this honor and excited to be included among the nation's best in engineering," said Hubbard in response to his induction. "I recognize that without the help and support of my colleagues, family, and students over many years this would not be possible."

Hubbard is director of the Alexander Brown Center for Adaptive Aerospace Vehicle Technology and Morpheus Laboratory, headquartered in Langley, Va. His research areas involve the design, analysis, simulation, and fabrication of spatially distributed systems, smart materials, smart structures, and smart transducers. (See related story, page 2.)

Over the years, Hubbard has received many awards for his work, including the Charles Stark Draper Engineering Vice President's Annual Award for Best Technical Patent, the 2002 Black Engineer of the Year President's Award, and the International Society for Optics and Photonics' (SPIE) 2016 Smart Structures and Materials Lifetime Achievement Award.

Hubbard joins 23 other Clark School-affiliated faculty members who have been inducted into the NAE. This group includes NAE President and former UMD President and Regents Professor C. D. Mote, Jr.

>> LEARN MORE, VISIT http://go.umd.edu/JH

PHOTO: EARL ZUBKOFF

CLARK PROGRAM EXPANDS SUPPORT FOR TRANSFER STUDENTS

After twice dropping out of a pre-med program in community college, then taking a low-paying job at a credit card processing company, Jimmy Vu (left) had his a-ha moment: He needed to get an education.

A car and motorcycle tinkerer, Vu decided to return to Hagerstown Community College to major instead in engineering. He graduated with a 3.5 GPA—his exact goal to be a competitive applicant for UMD and to win a spot on the Terps Racing team, which builds and races a Formula car every year.

Vu expected to pay his own way through loans and jobs—until he was awarded $10,000 a year through the new A. James Clark Opportunity Scholarship program.

"It took me by complete surprise," says Vu. "Finding out I got this scholarship has allowed me to put more time into my studies and into the racing team. Not having to worry about the finances really helped my stress factor."

He's one of 25 transfer engineering students who received the two-year award in the fall, funded by a $1 million gift from the Clark Charitable Foundation.

The rare scholarship to support transfer students in the Clark School—numbering 894 this academic year—specifically targets students who come from Maryland community colleges.

Bruk Berhane, assistant director of undergraduate and recruitment programs in the Clark School, says many of these students have significant financial need. Some can't count on support from their parents. Others are older with families of their own, might be the first in their families to attend college, or are first-generation residents in the U.S.

"You're dealing with a very heterogeneous population, one that we need to be paying more attention to as the tide shifts throughout the country," he says.

Vu is one of those first-generation students; his parents are Vietnamese immigrants. At Maryland, he discovered a passion for biology and chemistry. Now he plans to switch his major from mechanical to bioengineering—and to his parents' delight, he's starting the pre-med track after all.

Tyco and Koffel Increase Gifts to FPE Campaign

Two long-time corporate supporters of the Department of Fire Protection Engineering (FPE) have increased their gifts to the department's Legacy Campaign for a Professor of the Practice.

Tyco, a manufacturer of fire protection-related products, has increased its gift to the campaign by $100,000 for a total of $300,000. Koffel Associates, Inc., a fire protection engineering and life safety design and consulting firm, has doubled its original $100,000 gift to the campaign.

"We value our partnerships with such vital organizations as Tyco and Koffel Associates," said Department Chair James Milke. "Both of these gifts are vitally important in helping us reach our $2.5 million campaign goal by June 30, 2016."

Pepco Makes Gift to A. James Clark Hall

Pepco Holdings, Inc. has committed $100,000 to A. James Clark Hall. Opening in 2017, the building will be the central hub of the engineering complex on campus. Pepco will be recognized for its contribution in Clark Hall's outdoor space, which will feature sustainable design elements such as native plant communities and systems to manage stormwater and protect the environment.

"Pepco has enjoyed a long collaborative relationship with and is proud to support the Clark School of Engineering and the University of Maryland," said David Velazquez, executive vice president and leader of the power delivery business for Pepco Holdings, Inc. "Pepco employs a number of graduates from the University of Maryland, and our shared commitment to engineering education and environmental sustainability makes this a perfect opportunity to contribute to one of the communities we serve."

Trailblazer Honored by Workshop

Denice Denton, left, and her graduate student Reza Ghodssi, center, share engineering concepts with children at the University of Wisconsin in the early 1990s.

Reza Ghodssi, professor of electrical engineering and director of the Institute for Systems Research, will always be grateful for the guidance he received as a young doctoral student at the University of Wisconsin–Madison. He was lucky enough to be mentored by Denice D. Denton, a lauded expert and the first female engineer to receive tenure as a faculty member there.

"Probably the best lesson I learned from her was how to maintain excellence in research education and how to transfer what you learn to your community," recalled Ghodssi.

Denton was the first woman in the country to lead the engineering college of a major research university as dean of the College of Engineering at the University of Washington. At the time of her death in 2006, she was the ninth chancellor of the University of California (UC), Santa Cruz: the youngest person to be appointed chancellor in the UC system.

Shortly after her death, Ghodssi helped to create the Denice Denton Emerging Leader ABIE Award, sponsored by Microsoft and the Anita Borg Institute. Each year, the selection committee chooses a junior faculty member to receive the prestigious honor for her high-quality research and significant positive impact on diversity.

Past recipients of the award have recently come together to start a new tradition. Along with numerous sponsors and supporters, the women have organized the Denice Denton Emerging Leaders Workshop. At the workshop, invited junior faculty will share experiences, meet mentors, and—equally important—learn how to support and pave the way for future academics.

"What makes us successful in life is creating networks," said Ghodssi. "We can all benefit significantly by working together." It is a lesson he learned from Denton that he continues to put into practice in his own life.

>> TO LEARN MORE ABOUT THE WORKSHOP, VISIT www.ddd.umd.edu

FORUM HIGHLIGHTS INCLUSION IN ENGINEERING

Furthering its commitment to foster inclusion in engineering, the Clark School hosted "A Day of Inclusive Excellence" in late March. The forum, launched in support of UMD's Maryland Dialogues on Diversity and Community, brought together students, faculty, and staff for an open discussion about how the Clark School can enhance the education and research experiences of all members of its increasingly diverse community.

"The evolving demographic landscape of the U.S., the need for constant economic competitiveness, and the upholding of our core values to ensure equal opportunity and access to those who seek it all point to the importance of actively embracing inclusiveness in all our endeavors," said Farvardin Professor and Clark School Dean Darryll J. Pines.

Panel discussion on "The Importance of Diversity in STEM Education." From left to right: Kumea Shorter Gooden, Irving Pressley McPhail, KerryAnn O'Meara, and Tasha Inniss.

Ernesto Felix of The Intel Corporation delivered the keynote address on how diversity impacts innovation in high-technology companies, followed by a panel discussion on the importance of diversity in STEM education moderated by Kumea Shorter Gooden, UMD's chief diversity officer. Panelists included Tasha Inniss, National Science Foundation program director; Irving Pressley McPhail, executive director of the National Action Council for Minorities in Engineering; and KerryAnn O'Meara, UMD professor of higher education and director of the ADVANCE Program.

The final panel of the day, which focused on the student perspective, featured students from aerospace, bio, chemical, electrical, and mechanical engineering.

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HAPPY FIFTH ANNIVERSARY

ALUMNI CUP!

STUDENTS FROM **THE DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING** CAPTURED FIRST PLACE IN THE FIFTH ANNUAL ALUMNI CUP ENGINEERING DESIGN COMPETITION HELD DURING ENGINEERS WEEK IN LATE FEBRUARY.

The event was started in 2012 by the Clark School Engineering Alumni Network. This year's week-long challenge pitted teams of students from each department against one another to stay within a limited budget to design a machine that moved a pencil to write a sentence. The Department of Mechanical Engineering captured second place, with third place going to the Department of Areospace Engineering.

PHOTO: AL SANTOS