MECHANICAL
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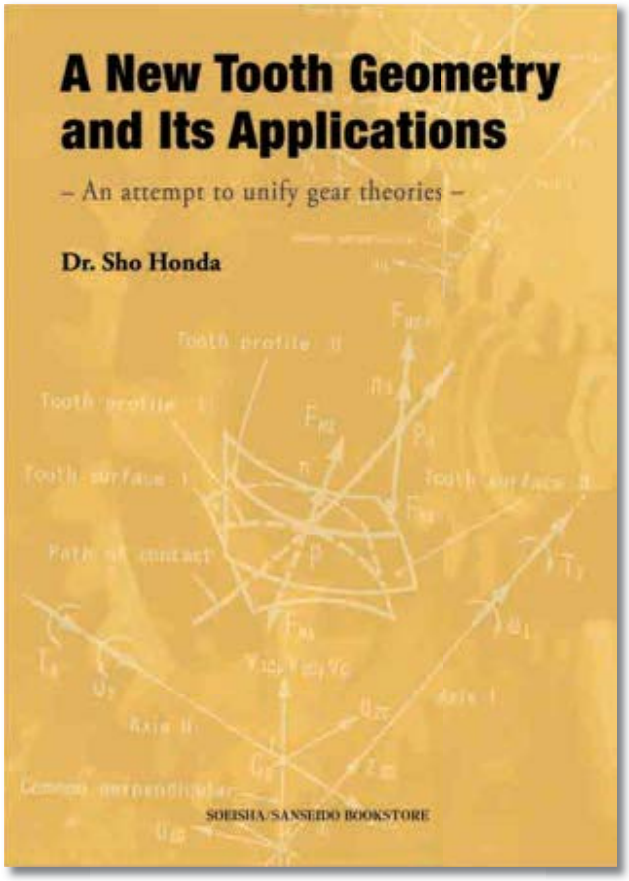
THE MAGAZINE OF ASME
No. 11
138

GO AHEAD, I'M LISTENING...

Artificial intelligence and voice recognition will change how we design everything.



[A4 size, deluxe edition
212 page]

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03/1965 : B.E.,Mechanical Engineering,The University of Tokyo,Japan.

A new tooth geometry is derived from the author's research and experience at both designing and manufacturing sites over 40 years.

Using this new theory, the hypoid gears with smaller sounds than the current version have been developed and equipped in automobiles.

The new tooth geometry is devised based on 8 coordinate systems, which are common to all types of gears, also it has the equation of motion. Therefore, this new theory could make it possible to design all types of gears and to estimate the dynamic increment of tooth load by common equations, which are defined in the common coordinate systems.

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A New Tooth Geometry and Its Applications

- An attempt to unify gear theories -

Dr. Sho Honda

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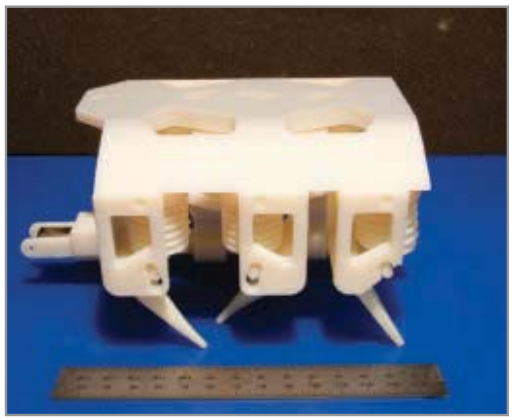
FROM TRACTOR-TRAILERS TO SELF-DRIVING MACHINES

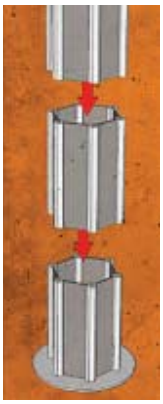
A CALIFORNIA-BASED STARTUP, founded by self-driving experts, is developing a $30,000 kit to convert recently built long-haul trailer trucks into self-driving vehicles. Ottomotto LLC, which goes by the name Otto, has already bought and outfitted four trucks and is testing the technology on public highways. The trucks are equipped with hardware—such as cameras and sensors—and sophisticated, customized software. Otto is getting ready to put out a call for truckers to provide feedback on which routes they would like to see served and to volunteer to test the system on their own trucks.



3-D PRINTING ROBOTS ON DEMAND

Researchers at MIT have come up with a new way to automatically 3-D print a dynamic robot in a single step. It can almost walk itself right out of the printer—no assembly required.

For these articles and other content, visit asme.org.



TOMORROW'S TALLER TURBINE TOWERS

Today's on-shore wind turbines are no taller than 262 feet due to transportation limitations. But taller towers can harvest more wind. Now Iowa State University researchers have developed a modular concrete construction method to help them reach for the sky.

INNOVATIONS AND EFFICIENCIES IN NUCLEAR TECHNOLOGIES

Westinghouse executives Mark Fecteau and Matt Dryden talk about changing demographics in the nuclear power market, where Asia continues to lead in growth.

NEXT MONTH ON ASME.ORG

GRID-SCALE ENERGY STORAGE PROJECT USES TRAINS, NOT WATER

A 50 MW energy storage project in Nevada draws on the principles of a pumped-storage hydroelectric project. But it moves trains—not water—up and down hill. The electricity generated from the trains will be fed into the grid in California.

ENGINEERING RENEWABLE ENERGY FOR HAITI

With sunlight and cellphones, engineering students at Georgia Tech are bringing desperately needed, inexpensive solar power to a remote village in Haiti, connecting them to the outside world.

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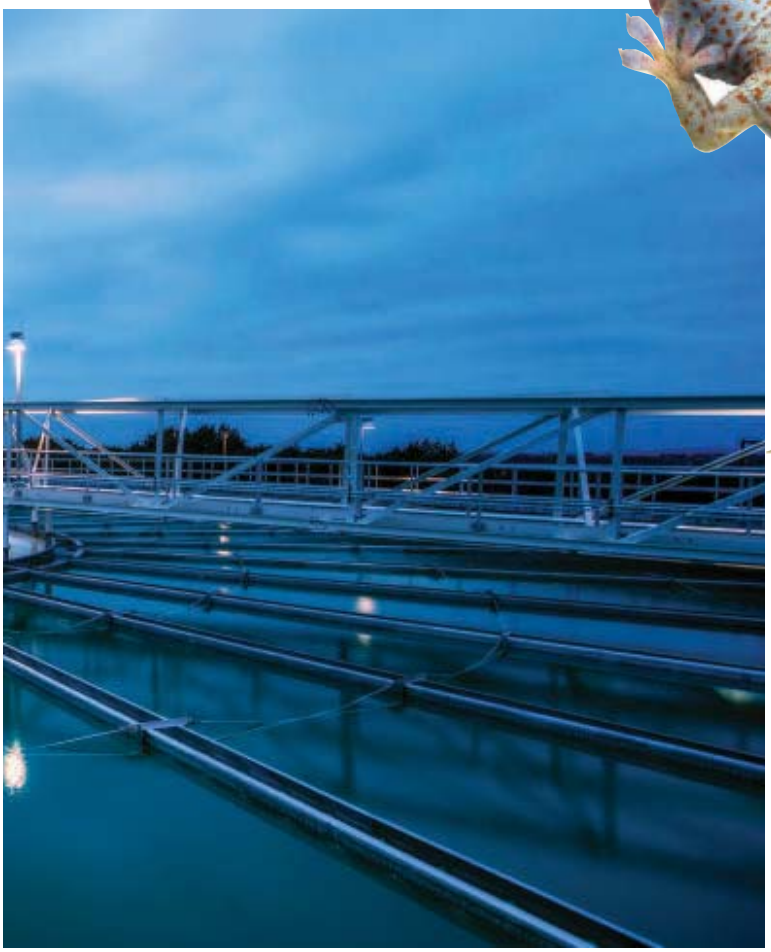

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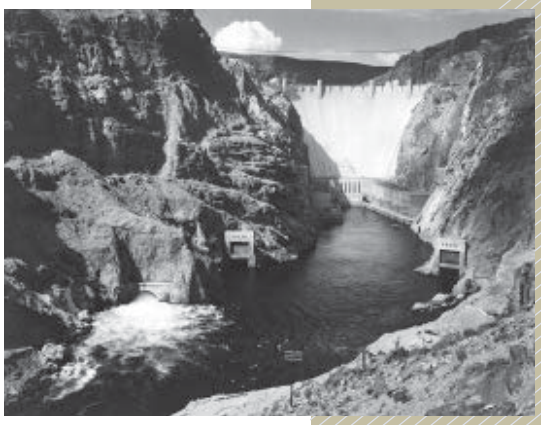

HIGH-IMPACT INVENTION 80

A young engineer turns an injury into opportunity.

BY JEFF O'HEIR

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Published since 1880 by the **American Society of Mechanical Engineers (ASME)**. *Mechanical Engineering* identifies emerging technologies and trends and provides a perspective on the role of engineering and technology advances in the world and on our lives. Opinions expressed in *Mechanical Engineering* do not necessarily reflect the views of ASME.

Give me the place to stand, and I shall move the earth
—Archimedes

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Mechanical Engineering (ISSN 0025-6501) is published monthly by The American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990. Periodicals postage paid at New York, N.Y., and additional mailing offices. POSTMASTER: Send address changes to Mechanical Engineering, c/o The American Society of Mechanical Engineers, 150 Clove Road, 6th Floor, Little Falls, NJ 07424-2139. Return Canadian undeliverable addresses to P.O. BOX 1051, Fort Erie, On, L2A 6C7. PRICES: To members, annually $37 for initial membership subscription, single copy $7; subscription price to nonmembers available upon request.

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John G. Falcioni
Editor-in-Chief

A MACHINE THAT THINKS FOR YOU

I was visiting a friend a few weeks ago when he started bragging about how he set up an Amazon Echo in his home office. "Alexa, what is the weather outside," he volunteered unfettered—even as I could see the sun shining brightly out his window. In a few seconds, a rather pleasant computerized woman's voice filled the room confirming my observation.

"Listen to this," he continued. "Alexa, play Elton John's 'Candle in the Wind'." A few moments later, the song came on.

It was getting irritating, so I decided to have a little fun. Before my friend could stop me, I commanded Alexa to place an order for a brown, four-shelf bookshelf. "Your order has been placed," Alexa responded.

The next five minutes were frantic. My friend desperately fluttered on his keyboard trying to find customer support, but the answer was obvious. "Alexa," I said sternly, "cancel the bookshelf order." She confirmed.

Google's co-founder, Larry Page, once described the perfect search engine as a machine that "understands exactly what you mean and gives you back exactly what you want."

If he's right, then the intersection of artificial intelligence and voice recognition is the pivot point. Google, the largest purveyor of search results on the Internet, has invested heavily—both dollars and engineering prowess—in data mining and artificial intelligence. The result is a technology likened to the talking computer on *Star Trek,* or a souped-up Siri, Apple's voice-controlled virtual assistant. But Google claims its Google Assistant will be ever-more powerful than Apple's Siri, Microsoft's Cortana, or Amazon's Alexa.

Sundar Pichai, Google's chief executive, says that machine learning is at a point where a virtual assistant is all we need to solve all our information-related needs. Google Assistant will learn our habits, our likes and dislikes, and have access to just about all our confidential information. It will have the processing strength to understand and contextualize what we want and how we want it. It will book a trip, buy a coat, order a pizza, and make an appointment with a favorite hairdresser.

Building something better than Alexa, Siri, and Cortana is ambitious, but as Henry Lieberman, a pioneer of human-computer interaction at MIT's Media Lab, told Associate Editor Alan Brown in this month's cover story, "Language will become a means—not to help users understand a product more easily, but to have the product understand its users."

The impact of harnessing the power of voice—and cognitive—recognition on product and systems design is still unclear. But we've seen significant strides in deep neural networks, referred to as deep learning. These are software constructs that enable machines to teach themselves how to recognize complex patterns. They have also greatly improved speech recognition.

Responding to public concern over the impact of machine learning on robots and intelligent systems, including factory automation and self-driving cars, a consortium of technology companies, including Amazon, Facebook, Google, IBM, and Microsoft, recently formed the Partnership on Artificial Intelligence to Benefit People and Society. Its focus is on ways to protect humans in the face of rapid advances in AI, and the potential for government regulation of the technology.

Sure, Alexa understood my command to cancel my joke order for the bookcase—that was trivial. But it's critical that the engineering community recognizes the importance of building AI into the design of technologies in a way that doesn't violate ethical mores. That's no laughing matter. ME

FEEDBACK

Do you worry about the power of neural networks? Email me.

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AUGUST 2016

Reader Kayton advocates for a less connected industrial infrastructure.

« One reader suggests wind is dying down. And another explains that dictionary definitions are not always complete.

NO HOPE FOR WIND

To the Editor: Installed wind energy is growing rapidly because of generous subsidies. Subsidies work. But experience shows that wind energy dies when the subsidies stop. Wind and solar power is growing because of politics, not because of engineering superiority.

Business Insider Nordic reported in May that the Danish government has abandoned plans to build five offshore wind power farms and is scrapping its green energy tariffs. Other European countries are also having serious problems with the large subsidies to wind energy. It is time North America caught up with the rest of the world.

The reality is that renewable energy offers a false hope. Only nuclear fission energy has the capacity to replace most fossil fuels—it is also the safest way to generate large quantities of electricity.

H. Douglas Lightfoot, *Baie-D'Urfe, Quebec*

TEXTBOOK DEFINITION

To The Editor: A letter in the September 2016 issue claimed that entropy and evolution are contradictory, but that is based on a fundamental misunderstanding of the second law of thermodynamics.

First, nothing in the second law prohibits evolution; it simply says that if a process results in a system of lower entropy, then the entropy of the surroundings must increase by an equal or greater amount to compensate. This is reflected, for example, in the substantial expenditure of resources required to manufacture a complex product.

Secondly, entropy is a thermodynamic property of a substance, related to pressure, temperature, phase, and chemical composition. It is not necessarily a function of what we perceive as the "complexity" of a system or organism.

A dictionary is not a good source of information on thermodynamics, and the definition of entropy cited is far from a thermodynamic one.

William Hallett, *Ottawa*

MORE COMPETITION

To the Editor: Your news article, "Students Test Hyperloop's Viability" (TechBuzz, May 2016), described MIT's Hyperloop competition team. The article suggests that MIT's team won the competition, however the actual competition is in January of 2017. The only other Hyperloop competition coverage from ASME was a podcast interview in March with a member of MIT's team.

Although ASME has exclusively covered MIT's progress, there are numerous American teams working tirelessly to engineer the future of transportation. Virginia Tech, UC Irvine, University of Florida, and Carnegie Mellon University are just a few.

I am part of UMDLoop, an undergraduate Hyperloop competition team from the University of Maryland. Similarly to MIT's team, we are a group of inspired and motivated engineering students in the process of building our pod design for the upcoming competition.

The Hyperloop pod design competition is a huge international competition in which American engineering teams are excelling. Competition consistently breeds innovation and progress, which is true for the Hyperloop competition.

The ASME community should be well informed about national engineering efforts towards this competition, not just one university's. ASME members can then be inspired by the wonderful community of engineering students around the country who are passionate about engineering and creating a better future.

Mitchell Skopic, *Marriottsville, Md.*

ONLY DISCONNECT

To the Editor: Your August 2016 Trending article ("The IIoT is On the Way ... and Here Today") implies that sensors and actuators throughout a plant should be directly connected to the Internet.

Direct connection by wire and radio would be a huge mistake for critical plants (electric power, refineries, waste management, hospitals, and so on) from a security point of view. It would give outsiders myriad ways to attack the plant at its working level.

Instead, each plant should have self-contained wired data buses whose only interface to the outside are servers with attached firewalls. Only then can the plant operator be assured that no one can easily disrupt his processes. Any attack would have to be made through the firewalls and could then probably be logged and stopped.

Myron Kayton, Life Member, *Santa Monica, Calif.*

FEEDBACK Send us your letters and comments via hard copy or e-mail memag@asme.org (subject line "Letters and Comments"). Please include full name, address and phone number. We reserve the right to edit for clarity, style, and length. We regret that unpublished letters cannot be acknowledged or returned.

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Airmen may soon descend more safely from helicopters thanks to the Tactical Rope Insertion Assist Device (below, right) designed by Auburn University students.

UNDER PRESSURE

SOME HARSH WORDS SPURRED A STUDENT TEAM TO DEVELOP AN INNOVATIVE SAFETY DEVICE FOR U.S. AIRMEN.

The mechanical engineering students from Auburn University had signed up for an Air Force design competition, but they had so little to show for their efforts that their faculty advisor read them the riot act.

"We got chewed out," recalled Richard Gilliland, who along with nine other students learned that designing a real-world product is often more difficult than anticipated. But the hard work, they also learned, was well worth it: They won the 2016 Air Force Research Laboratory University Challenge to design a new system that would allow Air Force personnel and deadweight to descend quickly and safely down a two-inch thick rope from helicopters at heights of 20 to 90 feet.

At present, airmen have two ways of descending by rope. One is to don a thick pair of gloves, grab the rope, wrap their feet around it, and slide down like a firefighter descending a pole. But friction can cause the rope to burn through gloves, boots, and skin. If they're carrying a heavy pack or a service dog, airmen use existing fast-rope descenders. But those devices can take up to 30 seconds to attach and often require two sets of hands, an inconvenience a soldier under fire can't afford, said Gilliland, who now works as a design engineer for Altec in Mt. Airy, Tenn.

For its two-semester senior design class, Gilliland and his classmates tackled the problem.

In the beginning, though, the potential impact of the project did little to motivate the Auburn team. "We didn't give it the full respect and determination needed to succeed," Gilliland said of the first semester.

Auburn's mechanical engineering students, under the direction of professor David Beale, won the competition in 2014 and placed second last year. When Beale chewed the students out, Gilliland said, "That sparked a fire in us."

The students buckled down, working at least nine hours on each of their three off-days. They started asking for help and worked closely with grad students on SolidWorks design software and in the school's machine shop. They travelled to Fort Benning, watched fast-roping demonstrations, interviewed airmen enrolled in the Army's Ranger School, and applied every lesson to each iteration.

After about five iterations, the team came up with a mechanism they called the Tactical Rope Insertion Assist Device,

or TRIAD. Made mostly from aluminum parts, it weighs about 4.5 pounds. An airman can use one hand to quickly place a rope between two vertically aligned wheel-like roller shafts attached to two frames connected by a spring-loaded hinge. He then connects his harness to a thin rod on the bottom half of the hinge. When he applies weight to the rod, the force closes the hinge, adjusts the angle of the rope onto the wheels, and engages the device. The airman can hold the rod for stability.

Rotary dampers attached to each roller shaft limit the speed of descent to about seven feet per second for 250 pounds and up to about 13 feet per second for the 450-pound limit. The dampers are interchangeable, depending on load weights and preferred descent speeds.

The competition judges liked what they saw, saying the final version was the only project out of 17 that included the total set of design requirements.

"We learned that success takes hard work, but that you have to couple that with innovation," Gilliland said, adding that the team has filed for a provisional patent application.

JEFF O'HEIR

DRIVERLESS TAXIS LAUNCH IN TWO CITIES

Singapore and Pittsburgh offer a glimpse of the ride of the future.

THE FIRST TWO COMPANIES TO LAUNCH TRIAL autonomous taxi services were not Google or Tesla, the enterprises most often associated with driverless cars. Instead, Uber and nuTonomy started driverless taxi operations this summer as a demonstration of the future of mobility.

First off the block was nuTonomy, which began offering rides in late August in One North, a relatively quiet office park district of Singapore. Its six driverless cars travel along a 6-kilometer route and stop only at designated locations. The company plans to expand to 12 taxis by year's end, and operate a city-wide fleet by 2018. It is also in discussions with other cities around the world.

The 50-person company was founded in 2013 by MIT's Karl Iagnemma and Emilio Frazzoli, who directs the school's Robotic Mobility Group. Both worked on developing autonomous vehicles for the U.S. military, and have teamed with Singapore on autonomous vehicles since 2007.

Six driverless taxis developed by nuTonomy have begun providing rides through a section of Singapore. *Credit: nuTonomy*

Uber launched its service in a 31-square-mile section of Pittsburgh three weeks later. It plans to ultimately ramp up to as many as 100 taxis and provide rides throughout the city.

With its bridges, tunnels, narrow streets, potholes, winter snow, and street signs hidden by spring foliage, Pittsburgh presents a more challenging driving environment than Singapore.

The two pilot programs have a lot in common. Both sets of taxis may be autonomous, but they carry human backup drivers plus technicians to monitor the taxi's computers and sensors. And both nuTonomy's Renault Zoe and Mitsubishi i-MiEV electric cars and Uber's Ford Fusions are decked out with multiple sensors, including up to 20 cameras, radar, and several sets of LIDAR, a laser ranging system that acts like radar. These sensors generate the massive amount of data needed for full autonomous operation.

Such instrumentation can cost tens of thousands of dollars. This would drive away most potential consumers, but taxis can generate enough income, especially when not paying a driver, to justify the investment.

Uber may be running the larger pilot, but the ability of nuTo-

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Army engineers show a 3-D printed unmanned aircraft vehicle to defense officials visiting the U.S. Army Research Laboratory in August.
Photo Credit: Jhi Scott, ARL Public Affairs

PRINTING UAVS ON DEMAND

Army researchers are developing support aircraft that can be made to order.

Imagine that a military reconnaissance patrol has an immediate need for support from a small unmanned aerial vehicle. Someday soon, a soldier will be able to transmit the patrol's specific requirements to a fabrication lab where a technician will configure a system made of both off-the-shelf and custom parts. Within a day, the UAV will be available to the unit to be deployed.

Researchers at the U.S. Army Research Laboratory, the Army's "corporate" laboratory that provides critical links between the scientific and military communities, believe they soon will be able to deliver such customized UAVs capable of being be deployed within 24 hours, thanks to additive manufacturing.

The concept will be explored during the Army Expeditionary Warrior Experiments to be conducted at Fort Benning, Ga., where technologies under development get early feedback from potential end users.

ARL had been doing mission modeling and vehicle modeling as part of its micro autonomous systems research program in collaboration with Georgia Tech's Aerospace Systems Design Lab. Researchers felt it was time to incorporate 3-D printing into the mix, said John Gerdes, a mechanical research engineer within ARL's Research Laboratory Vehicle Research Directorate.

"OPTIMAL DESIGN IS IMPORTANT WHEN YOU HAVE WEIRD, CRAZY REQUIREMENTS FOR PARTS."
JOHN GERDES, U.S. ARMY RESEARCH LABORATORY

"Additive manufacturing has become so ubiquitous now," Gerdes said, "and we expect the Army, like industry and academia, will be adopting it all over the place."

ARL's project is one of 50 technologies accepted to participate at the next AEWE, 14 from government researchers and 36 from industry.

"At a top level we would hypothesize that such an ability would provide an advantage," said Eric Spero, aerospace research engineer and team lead on the project.

But researchers hope to delve deeper into the specific tactical advantages of additive manufacturing for UAVs on demand before proceeding.

"It's a good opportunity for us at the research lab to anchor our research goals of scientific ideas into a practical reality that soldiers operate in," Gerdes said.

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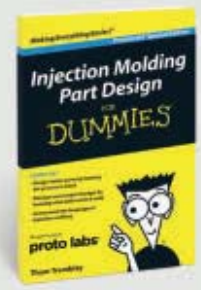

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LEAN MANUFACTURING FOR HEALTH

Diseases often go undetected in developing countries due to the high cost and scarcity of screening technology. Many treatable diseases, such as diabetes and urinary tract infections, can be detected via the analysis of urine. While urinalysis test strips are commonly used in developed countries, they are less practical for developing countries because they require high capital and import costs, complex manufacturing systems, and intricate supply chains.

Commonly used test strips can be broken down into three components: a substrate, an assay (where we see a color change), and an applicator (an instrument that applies the assay to the substrate). Test strips made via conventional manufacturing processes use a multilayer substrate containing plastic, absorbent pads, meshes, and a series of assays used to detect different disease markers. The manufacturing process itself requires a large and intricate assembly line involving rollers, cutters, chemical brewers, and applicators, among other pieces of machinery.

How can we simplify the manufacturing process to make it more appropriate for developing countries?

The Humanitarian Engineering and Social Entrepreneurship Program at Penn State University is exploring alternative approaches.

One manufacturing approach we examined was using repurposed inkjet printers and filling empty ink cartridges with assays. The printer "printed" the assays onto paper, which could then be cut into test strips. Further investigation, however, showed that printing was not suitable for resource-constrained contexts due to an unreliable electricity supply, mechanical issues, and relatively high expense.

As a result, we turned to stamping: a method in which we dipped a common store-bought stamp into an assay and pressed it onto a substrate. The approach simplifies a traditionally complex system, replacing the multilayer substrate with filter paper and the manufacturing assembly with an operator and a foam stamp.

Since each assay on a urine test strip can screen for one marker (such as nitrite, glucose, bilirubin, and so on), stamped test strips can be customized to screen for particular diseases based on the selection of assays. For example, a test strip that screens for diabetes will contain a glucose assay and a ketones assay.

Test strips can be used to quickly detect common diseases.

Manufacturing the strips through stamping creates a system that is affordable, accessible, and tailored to be sustainable in resource-constrained areas.

In a study exploring the use of stamping for test strip manufacturing, we tested many low-cost and widely available substrates—everything from card stock to paper towels. We chose filter paper as an appropriate substrate because it was durable, assay-friendly, and reduced substrate costs to approximately $0.03 per strip.

We also tested many different applicators, such as rubber stamps, self-inking stamps, and droppers, but chose a foam stamp because it was low-cost, durable, and produced consistent results.

Using the stamping method described, our team was able to successfully create urinalysis test strips that screen for diabetes markers. The stamping method can be integrated into any setting with a startup cost of less than $10, giving individuals in remote communities access to valuable and potentially life-saving disease screening technology.

Commonly used test strips cost $0.05 to $0.15 to manufacture, depending on the number of assays. In comparison, stamped test strips cost $0.02 to $0.10 to manufacture, thus creating a more affordable disease-screening device.

The stamping method also enables quick turnover because it takes a matter of seconds to stamp each test strip. As a result, test strips can be manufactured in a made-to-order fashion depending on the flow and demand of customers.

To be sure, many challenges remain in marketing and establishing a new manufacturing process. One factor that influences manufacturing success is the assay component, which has precise protocols and environmental and storage requirements. Other challenges involve the shelf life of stamped strips, quality control, environmental controls, and training individuals on how to make and use the strips.

We hope to formally validate stamping as a reliable manufacturing method to create affordable, easily available, and easily accessible screening test strips that can be customized to screen for different conditions: from urinary tract infections and pregnancy to water purity and methanol levels in alcohol.

Ultimately, this stamping method has wide scope for humanitarian engineering applications in the fields of healthcare and environmental safety.

SHWETA SEN, SARAH RITTER, and **GABRIELLE GUNDERMANN** are in the Humanitarian Engineering and Social Entrepreneurship Program at Pennsylvania State University, and **KHANJAN MEHTA** is the program's founding director.

For more information on development engineering, go to Engineeringforchange.org.

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UAVS PRINTED ON DEMAND

In a white paper Spero wrote to apply for AEWE participation, he noted that small UAVs can be a useful unmanned teammate in several ways, such as investigating weapons of mass destruction at a safe stand-off distance, looking beyond gaps, collecting forensic data and breaching complex obstacles, for example, those that require hover-flight capability.

Meanwhile, ARL is continuing to research technical aspects. Spero notes that the size of vehicle they envision is similar to those now used mainly by hobbyists.

"There is a lot of research needed to see how size relates to performance and how that relates to quantified measures such as indirect range and payload carrying ability," Spero said.

According to aerospace research engineer Nathan Beals, another team member, one of the biggest engineering challenges is being able to accurately predict the performance of the vehicle so that it performs exactly the way soldiers expect.

Ideally, with the tool Beals is developing, a vehicle design will be created and sent to a 3-D printer and all the parts are manufactured in parallel so that one or more vehicles can be created in a single print job. So far, the tool can generate a vehicle design considering mission requirements and the inventory of parts available at the location, send it to a printer, and build the structure. With it, ARL has built a medium-size quadcopter as a demonstrator. The structure, including the hub and arms, took about 10 hours to print. The UAV was assembled by a technician with all the electronics in fewer than two hours and was ready to fly.

A fourth team member, Raymond Wildman, materials research engineer from the weapons and materials research directorate of ARL, is focusing on topology optimization to design the structure.

"Optimal design is important when you have weird, crazy requirements for parts," Gerdes said.

"And mass is a very important factor for a rotorcraft," Wildman added. "The way topology optimization works is it takes [all information into consideration] and comes up with the optimal way to place the mass to support the load."

Down the road, the team believes that nature may provide some clues as to how to optimize UAVs by merging multiple functions into one structure.

"Animals are so good at what they do because there is never a part on the animal that does just a single thing," Gerdes said. "We would like to 3-D print things that have merged functions." ME

NANCY S. GIGES is an independent writer. For more articles on additive manufacturion, go to ASME.org.

COIN OF THE REALM

Even if you don't see how it contributes to the bottom line, **you must deliver what your organization rewards.**

Many individuals think that working tirelessly in their positions will guarantee ongoing employment, reasonable salary increases, and periodic promotion. It seems to be a disease that engineers are born with and which manifests externally in college and persists through their careers.

Students and working engineers think that if they work hard the rest will fall into place. While there is some inherent truth to this thought, there is another, contradictory facet that frustrates many individuals in their careers.

Consider college professors. Most of the world thinks that college professors work only half time. This is only partly true.

I know a department with approximately 18 faculty members. Only three were on campus for more than 20 hours per week during the first month one summer. Only one of those faculty members was tenure track.

The others, putting in fewer hours, would all explain that they were working at home or elsewhere. Some were, I am sure.

Now you may be thinking how this relates to you. Of the three individuals who are obviously working hard, only one of them has been rewarded on an ongoing basis and will be rewarded long term in the organization. Of those who are less often present, many are well compensated and rank higher in the organization.

How? They publish, and they bring in research contracts. They work smarter, not harder.

An example of this phenomenon from industry involves a friend of mine who was irate at the annual reviews and compensation across the groups under our mutual manager. He had found out that another individual (also a friend of mine) had received a better review and a larger annual increase.

What put the irate friend over the top was his opinion that he had worked twice as hard as the other guy. From the sideline, I had to concur with this assessment. What happened? While the one friend had worked twice as hard on four projects, all of them had started before the beginning of the review year and none of them had finished during the review period.

The other friend had the corporate sophistication to understand that it was what you completed and delivered that counted, not necessarily how hard you worked. He worked half as hard on one project, but he completed it. Not only that, it was a higher-profile project of almost immediate product application, not the longer-term research projects of the other individual.

Many long-term research projects never culminate in the final product or service for a company. Even if they do, most people in an organization are dubious of these projects, often because of a lack of understanding or the statistically poor track record of previous projects.

Each organization has a coin of the realm. At a university it is both papers and funded projects. In companies, it often depends, not only on the industry, but certainly on the personality of the company and of your group in the company. It may be how many projects you complete. It may be how many patents you apply for in the year. It may be how many products you deliver to your customer.

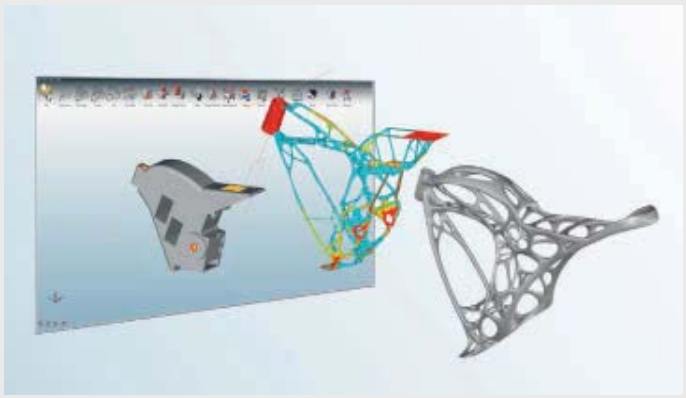
UNDERSTAND THAT IT IS WHAT YOU COMPLETE AND DELIVER THAT COUNTS, NOT NECESSARILY HOW HARD YOU WORK.

Regardless of the metric, it is imperative that you deliver what is rewarded in the organization—whether or not you see how it contributes to the bottom line or corporate longevity. This may help explain to you how someone else may be more valued and rewarded in your organization.

Of course, let us hope that, as a minimum, working harder than the slackers in your organization will mean that they will get laid off before you. ME

RONALD A.L. RORRER is an associate professor in the department of mechanical engineering at the University of Colorado, Denver.

DESIGN THE DIFFERENCE



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Q&A
DEAN BARTLES

ASME'S NEW TECHNOLOGY ADVISOR has manufacturing in his blood. Dean L. Bartles grew up in his father's welding and machine shop in Hagerstown, Md., before beginning a 38-year career in manufacturing operations, technology transfer, and research and development. Bartles was most recently the CMO for UI LABS and the founding executive director of the Digital Manufacturing and Design Innovation Institute in Chicago. He's now helping the Society execute its technology-based enterprise strategy and grow its impact in strategic markets.

ME: Digital manufacturing is no longer just a buzzword. How does it impact today's industry?

D.B: People get confused regarding the term digital manufacturing. Some people think digital manufacturing is 3-D printing, but it's not. Digital manufacturing is a virtual representation of the entire manufacturing process so that designers can make choices about materials and processes and immediately see the impact to production on a separate virtual computer screen. The idea of representing the manufacturing process in a real-time virtual environment so that designers can make those hard decisions during the design phase is really what digital manufacturing is about.

The Internet of Things and Big Data play a key role in digital manufacturing. If you can figure out ahead of time what the actual production should be and then compare that in real time to the data coming off the shop floor and readjust your models accordingly, the manufacturing processes can be designed more efficiently.

ME: What are the challenges of adopting digital manufacturing?

D.B: The biggest challenge is the concern that small and medium enterprises have regarding safety. Their biggest fear is what would happen if during predictive analysis, all of a sudden people hack into your machine tools and either cause that machine tool to damage itself or cause it to produce a defect in a part that's not observable until it is out there in the product. We will have to overcome this fear and figure out how to make it safe.

ME: With these new technologies being embraced by the industry, what would a typical factory floor look like in future?

D.B: A factory floor in the future will have every single machine tool with multiple sensors streaming real-time data for feeds, speeds, depths cut, oil viscosities, coolant viscosities, coolant temperatures, coolant volume flow, acoustic emissions, vibrations, and cabinet temperatures. Everything you can sense on a machine tool, that data is going to be streaming to the cloud. Predictive analytics will be able to alert you to problems that might happen *before* they happen. You will be able to predict those kinds of failures and have your maintenance crew on the weekend fix a problem before it interrupts the first shift of production.

ME: What role can organizations like ASME can play in speeding the adoption of digital manufacturing?

D.B: ASME has been a thought leader since its origin back in 1880. This is a new area that's emerging and I think it's imperative that ASME become a leader here, too. ASME has more than 120,000 members that are looking to it to make them aware of these new emerging technologies. Another role ASME can play is in workforce development, education, and training, by staying abreast of all the things that are coming down the pike and providing training courses to become better engineers.

ME: What's your advice to engineers who are just starting out and want to implement digital manufacturing in their production process?

D.B: In the field of advanced manufacturing today, it's really important for engineers to embrace their computer science partners. Everything in the future's going to be related to Big Data, predictive analytics, and IoT. So if you are going to be designing a product as a mechanical engineer, you are going to want to have a very close relationship with the predictive analytics department consisting of statisticians and computer scientists.

My advice to mechanical engineers today is to embrace those friendships you're making with those computer majors. Because it's all going to be so closely tied together. ME

CHITRA SETHI

TENDER FEELINGS FOR ROBOTS

Machines don't have feelings, but researchers have been working to provide robots with a sense of touch. One team in Korea now has developed a new stretchable tactile sensor material that could also be used as a touch panel on human skin and other soft surfaces that move and bend.

Developed by researchers at Seoul National University's Department of Materials Science and Engineering, this new deformable ionic touch panel is made from a hydrogel that can be stretched 10 times its original length. Despite the deformation, the touch points do not change during the stretch, wrote Chong-Chan Kim, the first author of a paper which recently appeared in *Science*.

Researchers stretched a flexible touch panel on an arm and used it to play chess.

Metal wires and other stiff materials are typically used in the development of stretchy touch panels, the team wrote. But many of today's soft robotics and similar applications require fully deformable components, something the team hopes to advance with its new touch panel.

"Our hydrogels are inherently soft and stretchable, so they can sustain a large deformation without fatigue," Kim said.

Along the edges of the hydrogel panel, the researchers placed electrodes that created a uniform electrostatic field across the panel. When an object touches the panel, it closes the circuit in the hydrogel and enables the current to flow from the electrodes to the touch point. Based on the strength of the current flow from each electrode to the touch point, the team could calculate the precise point of contact.

Lithium chloride salts added to the hydrogel act as a conductor and help to retain the water.

In a demonstration of the technology, the team applied a touch panel to a researcher's arm, attached it to a display, and used it to play a virtual piano, write words, and play games like chess. The technology can also help robots sense temperature, humidity, and other environmental elements, and to create a sense of feel for more accurate gripping and movement.

One of the biggest challenges the team faced was preventing the touch panel from leaking current, a problem referred to as parasitic capacitance, Kim said. The team pinpointed the origin of the problem by stretching the material and measuring the current in different area of the panel.

Before the touch panels hit the market, however, the team must improve their accuracy and durability, Kim said. ME

"**VEHICLE AUTONOMY COULD HAVE** as big an impact on society as the Ford mass assembly line had over 100 years ago."

Mark Fields, CEO of Ford Motor Co., quoted in the Financial Times, August 16, 2016.

continued from page 11 »

DRIVERLESS TAXIS

nomy to compete says a lot about the future of autonomous vehicles. Computer and sensor technology, while not cheap, is readily available, and even a startup can buy everything it needs to transform a production automobile into a driverless car.

On the other hand, software is the secret sauce that differentiates one company from another. For instance, nuTonomy uses formal mathematical logic to design and verify its software—something it says competitors cannot do.

Because it trusts its software's response, nuTonomy lets its taxis make a broad range of choices. There are some rules they must follow, such as "avoid obstacles, pedestrians, and other moving objects." But the company lets its taxis break less important rules, such as "don't leave the lane" in order to go around double-parked cars.

That makes trips faster and more efficient. In fact, Frazzoli developed an algorithm to control swarms of drones that also enables nuTonomy to maximize riders for its taxi fleet. In a 2014 paper in *Road Vehicle Automation*, Frazzoli estimated that 300,000 autonomous taxis could replace 780,000 private vehicles now operating in Singapore.

Also in September, the U.S. Department of Transportation announced a series of policies to promote autonomous vehicles. At their heart was a 15-point safety standard for the design and development of driverless cars. This includes standards for collecting crash and road incident data; responding to autopilot failure; validating technology; sharing vehicle data; protecting passengers in crashes; and automotive cybersecurity.

Much of the reporting is voluntary, but DOT could make it mandatory in the future. DOT also noted that it could apply existing regulations to autonomous vehicles. It also encouraged states to allow DOT to regulate autonomous vehicles uniformly rather than promulgate regulations that would create a patchwork of rules across the country. ME

ALAN S. BROWN

INDUSTRY EMBRACES SYSTEMS MODELS

NEW TECHNOLOGIES AND industry disruption are forcing manufacturers of off-highway and mining equipment to change their ways.

One response is to take a systems-level approach to reengineering their big machines, according to a study by Ora Research.

Systems modeling simulates product attributes and performance in the earliest stages of design. This helps engineers quantify how subsystems will interact and resolve issues before spending money on detailed design and prototype building.

Ora undertook the report for Maplesoft, which makes MapleSim, a software program to model complex systems.

Ora focused on mining and off-highway (primarily construction and agricultural) machinery. These large, expensive systems combine mechanical, hydraulic, electrical, electronic, and software subsystems that must interact with one another.

The report shows how new technologies are transforming these products. Off-highway construction and agricultural equipment, for example, must meet higher fuel economy and emissions standards. In the past, engineers did this by tweaking their internal combustion engines. Today, they are modifying powertrains by adding more electrical power. Some of that electricity also supports autonomous features that reduce operational costs while improving safety.

New powertrains and autonomous operations require tighter interconnection of conventional mechanical components with electrical systems, sensors, and software. That means manufacturers must design control systems in parallel with other systems, Ora reported.

Systems level modeling provides the tools to do this. Yet, while top engineering management understands the value of systems modeling tools, Ora found that most companies failed to use them fully. Many large firms prefer to make incremental improvements on existing products using such legacy tools as FEA and CFD. Other companies also lack engineers trained in systems thinking and design.

Still, many interviewees said that industry disruptions are forcing firms to embrace innovation. Ora argues that systems modeling could be part of an overall industry rethink. ME

TAKING THE PHYSICAL APPROACH

TODAY, MODELING AIR FLOW usually implies using computational fluid dynamics software. But physical models still provide many advantages.

Power burners produce and deliver some of the largest controlled flames in the world. They are used to generate steam for process industries or power production, and they generally range in size from 30 million to more than 300 million Btu per hour on a single burner heat release basis.

To ensure stable, reliable operation, power burners require a proper fuel and air mixture—typically 19 parts air for every one part fuel. The delivery and control of air is aided by a component called a "windbox" that contains baffles or perforated plates for directing the flow. Baffles work better than plates (which are called a distribution grid) but require modeling to ensure they are placed to produce the optimal effect.

Today, when engineers hear the word "modeling" they expect to it to be done in a software simulation. But Zeeco, the combustion and environmental engineering company where I work, has found that physical modeling is a more accurate, efficient, and flexible method of testing and adjusting air flow in a closed system.

Given the sizes of typical industrial boilers, building a full-scale replica of the boiler to conduct airflow testing is not practical: Windboxes can be as much as 26 ft. wide and 8 ft. deep. So, Zeeco builds manageable scale models for ease of testing—typically 1:4 to 1:8 scale. Zeeco constructs the models from Plexiglas because it is readily available, easy to work with, inexpensive, and most importantly, transparent. The ability to observe the flow and baffle locations aids in finding the optimal solution.

When setting up a test in a physical model, the first trial for baffle size, quantity, and location is an estimation based on experience. A trial-and-error method is then undertaken to determine the optimal solution. Baffle locations or angles can be adjusted, for instance. Baffles can be added to correct a spin in the air flow, but doing so may disrupt the uniform outlet distribution. The iterative process is used to correct and engineer the mass flow through the system as a whole. Changing the location or orientation of a baffle in the model takes a matter of seconds and adding a new baffle takes a matter of minutes.

The process of observing a problem, changing baffles, and recording another data point typically takes 15 minutes or less.

As an example of the flexibility of physical modeling, during the commissioning of a particular job in Canada, the service technician observed a potential airflow problem with the flame. It appeared the combustion air was swirling upon exiting the burner. So, a paddle spinner was installed to test this theory. A video shot of the spinner turning during a cold flow test showed a clear clockwise spin. When the windbox was inspected to ensure the baffles were installed properly, it was noted the old windbox wall had warped over time, creating a gap between one of the walls and two of the baffles.

These findings were relayed back to a physical modeling team that had access to a model of the boiler system constructed during the design and engineering phase of the project. It took only a few minutes to move the baffles to the observed position in the damaged windbox and retest the flow. A video was taken of the model and, when placed side by side with the onsite video, the swirl of the spinners was observed to be identical.

Clearly, the problem had been correctly identified.

Next, the air flow model engineer adjusted the baffles. After a few iterations that took less than an hour, a solution involving placement of the baffles—and no significant system changes—was relayed back to installation site. The correction was implemented the same day it was discovered.

Solving this issue solely with a computerized model via compu-

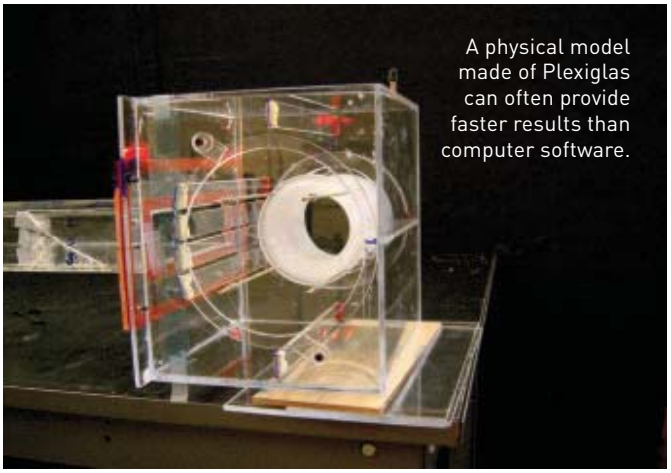
tational fluid dynamics would have taken days or even weeks.

More important than the flexibility and efficiency of physical testing is the accuracy of the results. Zeeco has yet to experience an instance where the physical model did not accurately reflect the conditions in the field. On the other hand, CFD modeling may not accurately reflect actual conditions. Each simulation begins with a number of assumptions: inlet conditions, outlet conditions, boundary layers, and boundary conditions. These assumptions are required to utilize the mathematical equations.

Other assumptions are made to decrease the CFD model's size and run time. For example, a distribution grid is typically modeled as a plane of pressure drop as opposed to a porous metallic object that would affect flows in ways a simulated pressure drop would not. While these assumptions can often produce similar results to actual conditions, physical modeling makes significantly fewer assumptions, leading to inherently more reliable results.

In physical modeling, inlet and outlet conditions and boundaries are replicated and each piece is fabricated instead of assumed.

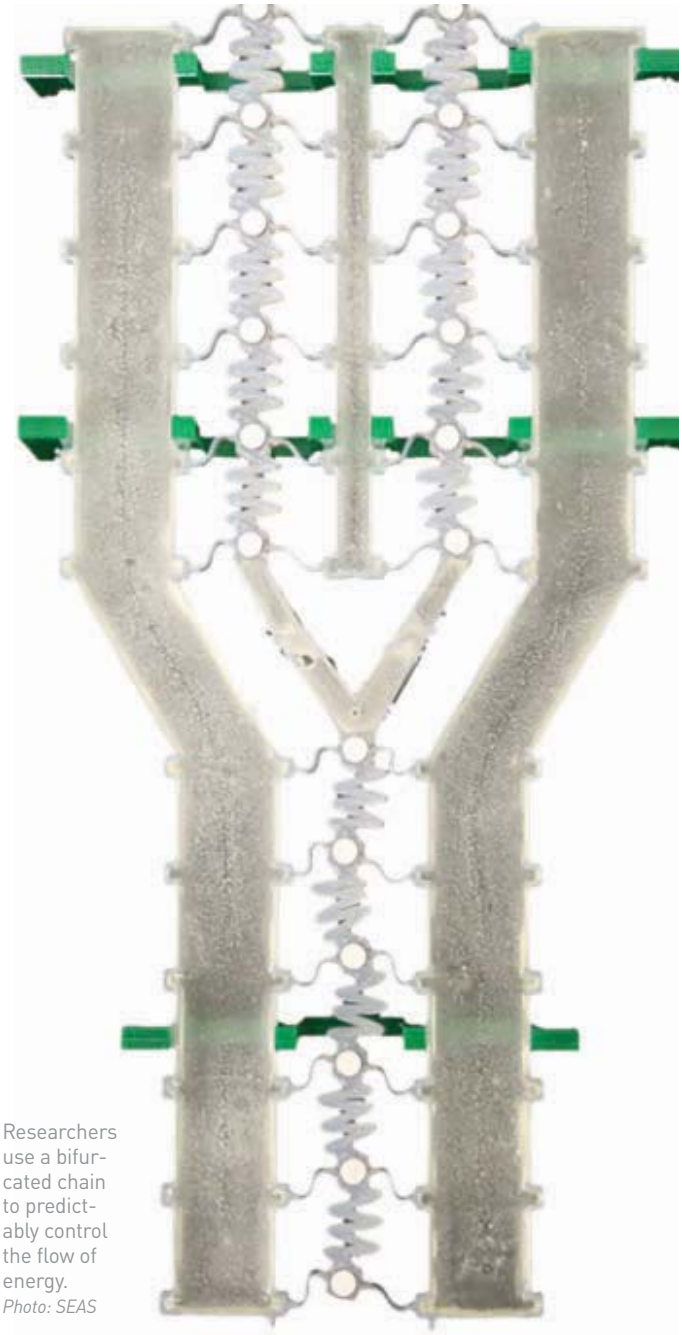
Finally, the main benefit of physical modeling is the finished result: the solution indicated by the model maps directly to the actual solution in the field. The final solution of a CFD model cannot be validated without the proof of physical data. Physical modeling skips the step of predicting what may potentially happen and directly models what is actually happening, providing a real-time analysis of the physical world. ME



A physical model made of Plexiglas can often provide faster results than computer software.

JAY RICHARDSON is a combustion engineer at Zeeco, a manufacturer of combustion systems in Broken Arrow, Okla.

FIRMING UP SOFT ROBOTICS



Researchers use a bifurcated chain to predictably control the flow of energy. *Photo: SEAS*

WE THINK OF ROBOTS AS made of steel and chrome, but advances in material research, 3-D printing, and control systems are making deformable robots a reality. Last month we reported on a team from Harvard's School of Engineering and Applied Sciences (SEAS) that created the first autonomous soft robot (the "octobot"). This month, we look at two other SEAS labs: One made a soft "muscle" from a unique combination of materials, while the other developed a deformable energy system using an old concept in a new way.

SOFT POWER

THE LAB Bertoldi Group and Lewis Lab at the John Paulson School of Engineering and Applied Sciences (SEAS), Cambridge, Mass.

OBJECTIVES Gaining deeper insight into the nonlinear behavior of materials and structures. Designing and fabricating functional, structural, and biological materials.

DEVELOPMENT Creating a way of storing and sending energy through soft material.

A device that is expected to bend, stretch, and revert back to its original shape—often multiple times while performing a singular task—needs an energy and control system that's just as deformable. A team at SEAS believes it has taken the first step in developing a system that's soft and powerful enough for the job.

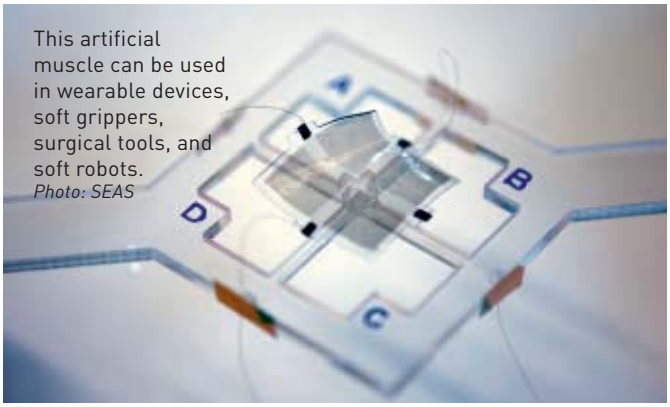
Soft materials like polymers are good at absorbing energy but bad at propagating it. In some engineering applications, such as soft robotics, propagating an undistorted mechanical wave could be very useful for control, something that's hard to do "through soft, squishy material," said Jordan Raney, a professor of mechanical engineering at the University of Pennsylvania who was a SEAS postdoc when he authored a paper, along with SEAS professors Katia Bertoldi and Jennifer Lewis, on the team's work in *PNAS*.

To store and release elastic energy along that wave, the team based its solution on the concept of bistable beams,

which are structures that are stable in two distinct states. The flick bracelets kids wear or a tape measure, where the strip of plastic or metal is equally stable in a straight or rolled shape, are good examples of bistable systems. In this case, the team built its system from a chain of nonlinear bistable elastomeric beams connected by linear springs.

When the beams deform or move, they snap and store energy. As the signal moves down the elastomer it snaps each beam back into its original configuration. This releases the stored energy and sends the signal downstream with a spring-like action. It's the same movement as a row of falling dominoes, Raney said. The researchers reset the beams by hand but are now seeking ways to automate the process.

The process required precise fabrication, which the team achieved through the 3-D printing techniques developed in Lewis' lab. "It sped up the entire process," Raney said. ME



This artificial muscle can be used in wearable devices, soft grippers, surgical tools, and soft robots.
Photo: SEAS

FLEXIBLE STRENGTH

THE LAB Robert Wood Microrobotics Lab and David Clarke Research Group at SEAS.

OBJECTIVE Advancing soft robotics and related applications.

DEVELOPMENT Created a faster muscle-like soft actuator that can be used in a number of soft robotic applications.

One challenge in building soft robots is getting them to move quickly. Pneumatic or hydraulic muscles are slow and difficult to untether from a fuel and power source. And artificial muscles made from dielectric elastomers, elastic materials with strong insulation properties that can transmit electric force without conduction, need rigid frames to maintain their shape and high voltage to jolt them into action.

A team made from members from Robert Wood Microrobotics Lab and David Clarke Research Group at Harvard's John Paulson School of Engineering and Applied Sciences recently developed a new soft muscle they believe can overcome those shortcomings.

To reduce voltage, increase energy density, and eliminate rigid components, the team—led by graduate student Mihai Duduta—created a new dielectric elastomer that used two well-known materials: an elastomer based on one designed by researchers at UCLA and electrodes made from carbon nanotubes and developed by the Clarke lab.

Duduta's elastomer starts as a liquid that's quickly cured under ultraviolet light. The paper-thin sheets are sticky on both sides and bond well with the nanotube electrode, which the team produces in sheets that can be as thin as 100 nm. The team alternately layered sheets of electrodes on top of sheets of elastomers, so the electrodes power the elastomers from above and below, effectively reducing the voltage needed to activate the entinre elastomer and increasing the energy density.

The new system responded 10 to 30 times faster than commonly used actuators, Duduta said. "You have all of these active components, so the energy density is as high as it can be," he added.

The team published its results in a recent issue of *Advanced Materials*.

During the next year, Duduta will work on making the actuator wireless and able to move with a wider range of motion. He envisions the actuators being used for wearable devices, soft grippers, laparoscopic surgical tools, artificial muscles, and entirely soft robots.

They could also be used in gloves and other devices that help victims of stroke or paralysis move their limbs during rehabilitation.

"The really interesting thing about soft robots is that they are not going to be used for just one solution," Duduta said. ME

JEFF O'HEIR

BIG CHALLENGE FOR MEASURING MEMS

Microelectromechanical systems, or MEMS, may be small, but they often include moving parts such as wheels, rotors, levers, and linkages that can stick together or wear out over time when they come in contact with other pieces. The motion of many MEMS—displacements of a billionth of a meter and rotations of just few microradians—has been too small to measure with existing methods. But a group of researchers at the National Institute of Standards and Technology recently developed a measurement system that could pave the way for new types of complex microsystems and applications.

The lack of precise measurements has prevented a complete understanding how the parts of MEMS actually move and interact. This understanding is necessary for improving performance and reliability challenges through better designs and materials.

"As mechanical systems decrease in size, fabrication tolerances become more important," said Samuel Stavis, a project leader at NIST and a co-author of a paper published in *Microsystems & Nanoengineering*. "And measurements of the motion and interaction of the parts becomes more challenging."

In the paper, the NIST researchers reported measuring the transfer of motion in links that connect and disconnect through a joint. The links, which ranged from a few micrometers to a few hundred micrometers (the diameter of a human hair is about 100 micrometers), convert straight motion into rotation. The researchers used standard microscopes and digital cameras to track surface features such as etch holes caused by the manufacturing process and florescent nanoparticles that were added to improve the precision of the measurements.

The researchers found the amount of play in the joints accurately determined how the links coupled and uncoupled, and how often the motion could be repeated before failure. MEMS tend to operate most reliably in a vacuum, which isn't always practical. In more realistic conditions, humidity and contaminants can affect surface properties and mechanical forces.

Ongoing measurements will help engineers and manufacturers design MEMS for such advanced applications as microbotics and microsurgery that perform better and last longer, Stavis said.

"These advances are necessary to realize the full potential of micro systems technology," Stavis added. ME

BIG NUMBER

MILES TRAVELED BY A FUEL-CELL ELECTRIC VEHICLE IN A 24-HOUR PERIOD.

1,438

RANGE ANXIETY IS A BARRIER to adoption of alternative-fuel or electric vehicles. No one wants to be running close to empty with nowhere to refuel or recharge. But a hydrogen fuel station network has expanded in California to enable fuel-cell electric vehicles to travel across the state. In September, a 300-mile range Toyota Mirai set out from Long Beach and traversed California—even reaching Reno, Nev.—to set what the hydrogen fueling company True Zero calls a record for travel by an electric vehicle.

CHINA TO EASE LOGISTICS, INCREASE TRADE NETWORK

The Chinese government is working to lower logistical costs and increase regional trade.

The National Development and Reform Commission is working to streamline reviews and approvals for logistics companies, as well as cutting taxes and fees.

Customs clearance will be sped up and delivery services will cover more rural areas, with financial support and adequate land supply guaranteed. Eligible logistics businesses may issue corporate bonds and go public or loan more from banks.

The initiative was reported by the Xinhua News Agency.

China wants to reduce the ratio of logistics costs to sales revenue. Logistic costs were 8.9 percent of sales in 2014. The target is to reduce that to about 8.5 percent for manufacturers and from 7.7 percent to around 7.3 percent for wholesale and retail sellers by 2018.

The logistics ratio in China is about twice that of the United States, the commission says, and 30 percent greater than the level of India.

According to Xinhua, a reduction of logistics costs of that magnitude could help industries save more than 900 billion yuan, or about $135 billion.

In another announcement, Fang Aiqin, deputy head of the Chinese Ministry of Commerce, reported that trade between China and the so-called Belt and Road countries exceeded $600 billion during the first eight months of 2016.

That accounts for more than a quarter of China's total trade.

Fang was speaking at a seminar on the Belt and Road Initiative in Xi'an, capital of northwest China's Shaanxi Province.

The Belt and Road Initiative is a shorthand for the Silk Road Economic Belt and the 21st-Century Maritime Silk Road Initiative proposed in 2013 by Xi Jinping, the president of China.

The initiative brings together countries in Asia, Europe, and Africa via overland and maritime networks.

According to Xinhua, He Lifeng, deputy head of the National Development and Reform Commission, said that in the three years since the launch of the initiative, over 30 countries have signed cooperation agreements with China.

Chinese companies have established more than 50 overseas economic and trade cooperation zones in Belt and Road countries, creating about 70,000 jobs, Fang was quoted as saying. ME

AIR INDUSTRIAL PLANNING IN THE POSTWAR PERIOD

MAJ. GENERAL B. W. CHIDLAW AND BRIG. GENERAL E. W. RAWLINGS
HEADQUARTERS, AIR MATERIAL COMMAND, WRIGHT FIELD, DAYTON, OHIO.

Two commanders in the United States Army Air Forces who would later become four-star Air Force generals described the merger of industrial capacity and military strength, and what that meant for engineers in peacetime.

LOOKING BACK

What to do with America's industrial capacity was a question being debated when this article was published in November 1946.

THE BEST YEARS OF OUR LIVES

In November 1946 as Benjamin Chidlaw and Edwin Rawlings discussed postwar industrial policy, Americans went to movie theaters to see a dramatization of the adjustments many of them were making. *The Best Years of Our Lives*, directed by William Wyler, followed three demobilized servicemen returning to strained relationships, slim job prospects, and a lack of meaning in their lives. The movie went on to sweep the Academy Awards, including a Best Supporting Actor award for Harold Russell, who lost both hands in an Army training accident.

Harold Russell (center) as sailor Homer Parrish. *Credit: MGM Home Entertainment*

More than 150 years ago this nation entered its first postwar period. Since that time this peaceful country has been compelled to undergo three major wars, three minor wars, and a number of military expeditions and special campaigns. During this span from the eighteenth to the twentieth century, great scientific, economic, and military advances have eliminated the barriers of time and space which once served to guarantee certain fortunate nations from the danger of hostile attack.

Today therefore following World War II, or what historians might someday refer to as "The Great Air War," it becomes increasingly necessary for this country to plan its security consistent with the principles of our Government and with the challenging problems of the foreseeable future.

World War I, and to a great extent World War II, showed that our war production, to be successful, required the complete coordination and harmony of the Armed Forces and industry. During the peacetime years of the 1920s and 1930s, there had been a certain but unfortunately limited amount of industrial planning. Now in 1946 all parts of our Armed Forces are concerned with industrial planning; the Navy, Army Ordinance, Signal, and the other services, as well as the Army Air Force.

The phrase "industrial planning" means just what it says, namely, planning the industrial aspects of our preparedness program. Planning must be soundly conceived and comprehensive in scope. We should have constant planning as to what we will want, when we will want it, who is going to produce it, where it will be produced, and how it will be produced. The "what" and the "when" comprise the military side of the problem, while the "who," "where," and "how" comprise the industrial side of the effort. There will be the necessity of integrating industrial plans with military plans; the industrial plans must be kept abreast of military-program changes.

It should be pointed out that the atomic bomb, current developments in guided missiles, and other new weapons raise a number of questions about the part which conventional airplanes will play in the maintenance of air power. It is not believed that the present conception of an air force is radically altered. This conception includes all of the developments which are taking place in new methods of propulsion, in the use of electronic devices, and in the attainment of supersonic speeds. The necessity for constant revisions in planning to take these new factors into account as rapidly as possible, although self-evident, is strongly emphasized.

Air industrial planning is a plan of peacetime industrial preparedness that will insure our ability to expand rapidly air material production. In event of an emergency, industrial planning buys valuable time, precious time, perhaps even priceless time. ME

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Modeling Nonlinear Structural Materials and Fatigue in COMSOL Multiphysics

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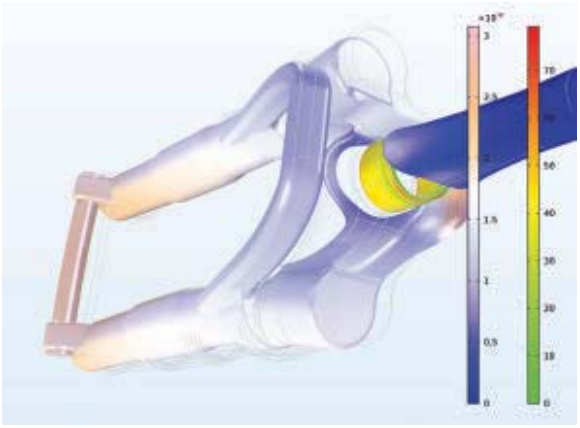

A contact analysis of a fitting on a mountain bike fork. The plot shows the deformation of the fork (left scale) and the contact pressure in the fitting (right scale) during operation of the bike.

If you want to learn how to model nonlinear structural materials and evaluate fatigue in COMSOL Multiphysics, tune into this webinar. By combining multiphysics simulation with advanced material models, you can achieve highly accurate analysis results for a wide range of design challenges.

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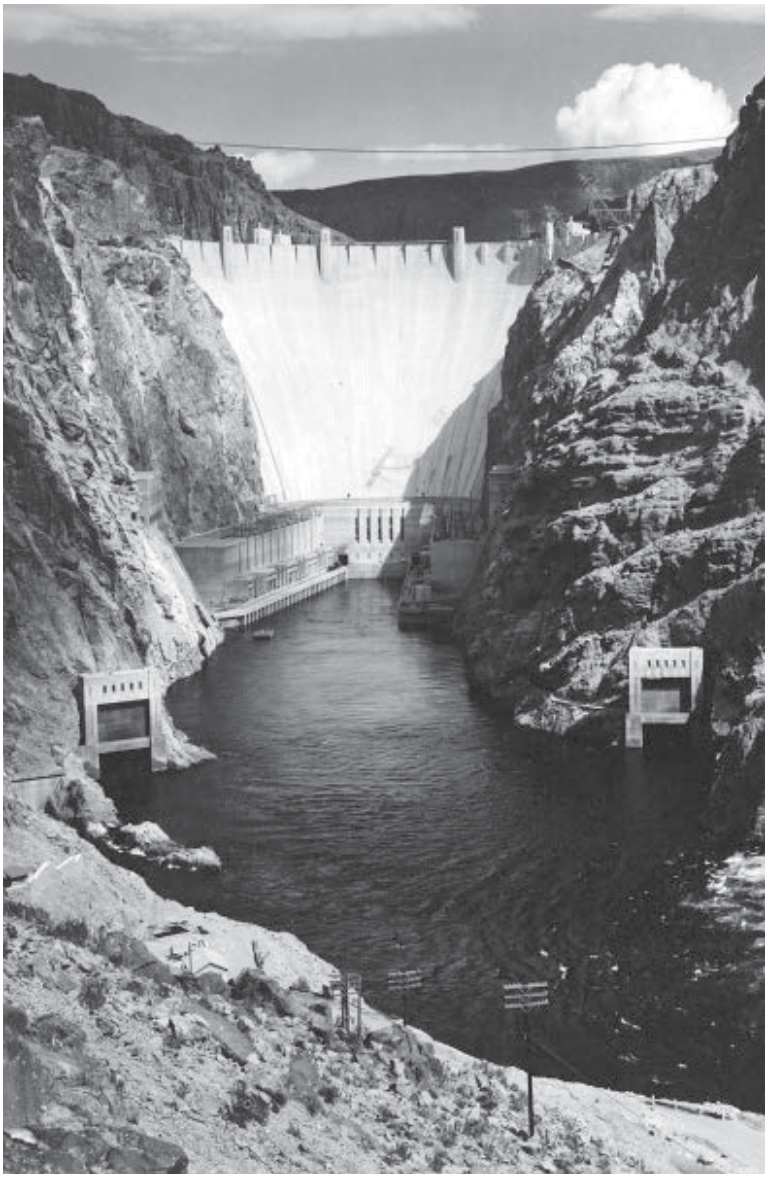
BY THE NUMBERS:

NEW HYDRO FROM OLD DAMS

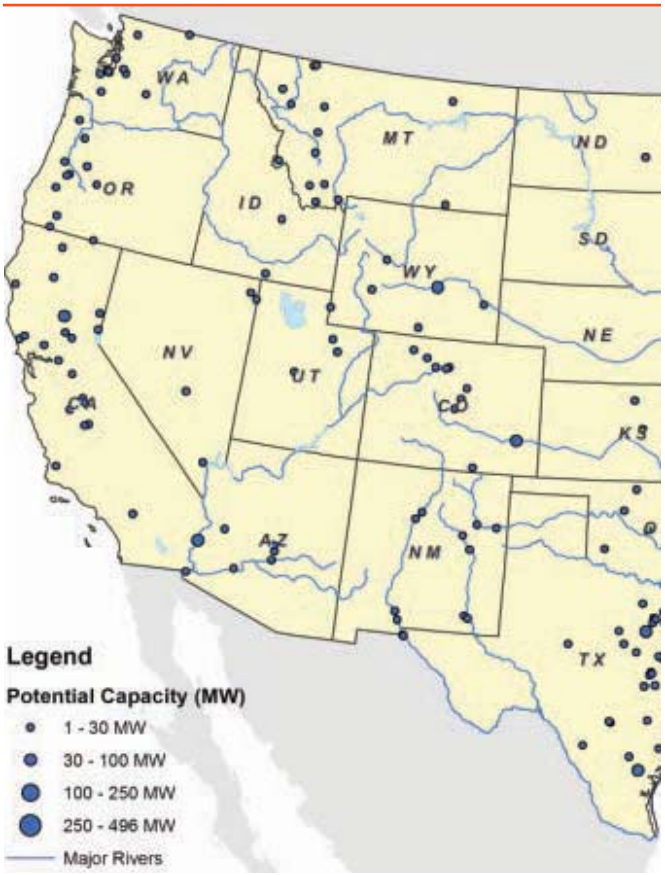


The Hoover Dam

In the power industry, it's often easier to add capacity to an existing plant than it is to build a new one. That's especially true for nuclear plants, where the timeline from planning to commercial operation can span decades. The Nuclear Regulatory Commission has approved power uprating equal to about seven nuclear plants since 1977.

The same dynamic is seen with new hydroelectric power generating capacity. While dedicated hydroelectric structures such as Hoover Dam (at left) are what people think of when they envision the taming of North America's rivers, in actuality, those 2,500 hydroelectric dams are a small fraction of the more than 80,000 dams in the United States. Those nonpowered dams were built for flood control, inland navigation, or irrigation, and since the disruptive impact of the dams on the environment has already

Nonpowered dams with potential



occurred, owners can add hydroelectric turbines without much protest from local stakeholders.

According to a July report from the Energy Information Administration, nearly 300 MW of electricity generating capacity will come online due to adding turbines to previously nonpowered dams. Most of that work has been done on the Ohio River; if the full potential of Ohio River Basin dams was tapped, it would add some 3.2 GW of hydropower to the grid.

All told, the United States could add 12 GW of generating capacity by building turbines into its nonpowered dams, according to a 2012 report prepared by the Oak Ridge National Laboratory for the Department of Energy. Much of that new capacity is found in areas of the country where the potential for wind or solar power is muted, making it a good complement for other renewables.

capacities greater than 1 MW

To be sure, that 12 GW would produce 45 TWh of electricity a year, a little more than 1 percent of the annual U.S. electric consumption. But in an era in which few people are clamoring for largescale power projects in their backyards, adding new turbines to old dams might be a stealth way of keeping the lights on. ME

JEFFREY WINTERS

POTENTIAL OF NONPOWERED DAMS

Capacity and generation, by hydrologic region

Hydrologic Region	Potential Capacity (MW)	Potential Generation (TWh/yr)
New England	243	1.110
Mid-Atlantic	479	1.997
South Atlantic-Gulf	1,618	3.778
Great Lakes	156	0.903
Ohio	3,236	13.603
Tennessee	53	0.197
Upper Mississippi	2,027	9.943
Lower Mississippi	743	2.802
Souris-Red-Rainy	58	0.239
Missouri	258	0.865
Arkansas-White-Red	1,898	5.960
Texas-Gulf	608	1.308
Rio Grand	98	0.241
Upper Colorado	53	0.145
Lower Colorado	124	0.370
Great Basin	29	0.080
Pacific Northwest	225	0.871
California	156	0.586

Map and chart data: U.S. Dept. of Energy

Talk to me

Artificial intelligence and voice recognition will change how we design everything.

by Alan S. Brown

Gregory Abowd owns one of the first Tesla cars, built before they were capable of autonomous driving. Abowd may not have buyer's remorse, but since he is a distinguished professor at the Georgia Institute of Technology's School of Interactive Computing and an expert in human-computer interfaces, he's been giving serious thought to how he wants his next Tesla—one that presumably will be able to drive on its own—to handle.

"One other thing I learned when I took an autonomous Tesla for a drive—I would like it to mimic my way of braking," Abowd said.

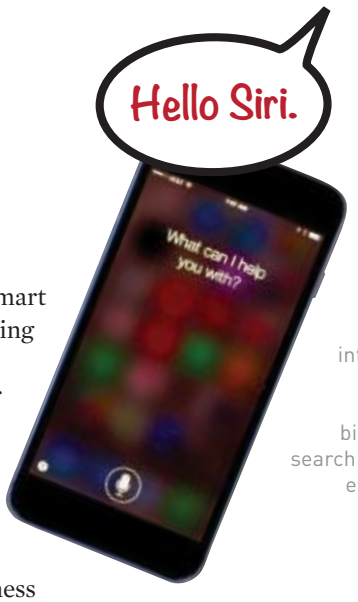
"Its braking style is much too abrupt for me."

Today, teaching a smart car such tricks might require some serious programming, or perhaps a lengthy tour through multiple app screens and drop-down menus. But Abowd has a different vision. Within a few short years, he believes, we will be able to talk with our cars and tell them what we want them to do. Their voice recognition systems will not only translate our words, but apply artificial intelligence to understand our intentions as well.

Most of us may never learn how to program a car's braking performance, but soon we may have a simple way to reach deep into the heart of its control system and customize its behavior. Indeed, we may have the power to program any smart device in our homes, offices, and factories in ways that were previously impractical or impossible for all but the most sophisticated technophile.

That sounds radical, but new technology has been simplifying interfaces for decades. In the 1980s, personal computers transitioned from command lines to graphical interfaces that we could access by clicking a button on a mouse. Less than 10 years ago, the iPhone's touchscreen and accelerometers revolutionized how we operated handheld devices.

Voice recognition, its proponents argue, has the same potential to change what we expect from the everyday products. As those products grow smarter and more capable, voice promises to simplify how we communicate with smart cars, smart homes, smart offices, and smart factories. Instead of mastering one new app after another, voice could make it simpler to command them all.



Voice interfaces already handle billions of search queries each day.

Incorporating voice interfaces will transform product design.

"The job of the mechanical engineer will be to harness those capabilities," said Henry Lieberman, a pioneer of human-computer interaction at MIT's Media Lab. "People want to have to understand the details of how things work.

"Language will become a means—not to help users understand a product more easily, but to have the product understand its users."

Machines that hear us

Anyone who hung up in frustration on voice-activated virtual assistants such as Apple's Siri or on voice-driven customer service centers and never went back has missed the advances in voice recognition. Today it is fast, accurate, and smart enough to understand everyday speech—and consumers are increasingly taking to it. Two years ago, spotty performance discouraged most people from using speech to run Google searches on their phones. This year, 20 percent of queries handled by Android phones were spoken, according to Google. That's 20 billion spoken queries daily.

Voice recognition is also expanding its beachhead in physical products. Many new cars use voice to place calls, set the GPS, write and receive texts, change radio stations, and adjust the temperature. The Eurofighter Typhoon military jet has a speech recognition system capable of controlling communications and allowing pilots to assign targets.

This is only the start, Lieberman said. Speech is not only convenient, but also much richer than typing or flicking an app.

"Think about it," Lieberman said. "We only speak to other human beings. So when we speak

GE appliances are among hundreds of devices that have the ability to communicate with Amazon's Alexa.

to a computer, we treat it as another human being. It's like talking to a dog. You know it doesn't really understand you, but you express yourself as if it does. That's the synergy you get from voice recognition that you don't get from typing."

The real sea change won't come from products responding to clearly enunciated commands. Rather, it will happen when they wade through the torrent of half-finished sentences, parenthetical remarks, and place-holding "ums"—and figure out what we really mean.

Artificial intelligence connected to the Internet makes that possible. The machine learning software behind voice recognition analyzes data from actual interactions to improve its performance. By analyzing the words used in searches, for instance, voice systems know which words are likely to go together, and those inferred relationships help them make sense of complex sentences.

In the connected world, machine learning software can draw on a billion interactions a day. That learning shows. Voice recognition can now easily navigate accents or pick out a single voice in a crowded room. Most voice systems are more than 97 percent accurate in identifying individual words. And while virtual assistants may not "know" the meaning of our words, their ability to link words helps them figure out what we want.

Not only is voice recognition more capable, it is also easier for engineers to use. There are many large vendors—Amazon, Apple, Google, Microsoft, Nuance, and Baidu—and several offer free software to developers. And semiconductor firms such as ARM Holdings, Intel, and Sensory have introduced new chips optimized for voice. These chips provide fast, reliable voice recognition, even when devices are not linked to the Internet.

Nouns, verbs, and beyond

The graphical interfaces we've used for a generation make it straightforward for systems to interpret the commands they receive. A touchscreen may have clearly marked buttons for each input, or specialized apps access different operations. That clarity makes it easy for a device to understand what a user wants.

With voice recognition, the same input is used for initiating everything, from setting a thermostat to making a phone call. An always-on virtual assistant in a device that sits on a kitchen counter or desk, such as Amazon's Alexa, must field seemingly random requests and figure out whether to access a grocery list or a music library when someone asks for "some Red Hot Chili Peppers."

Vendors that want to use Alexa's voice interface to control their products must first bridge this gap. Wink is one company that has done this. It makes hubs that work with a broad range of home automation products from many different vendors,

each with its own capabilities and commands.

Wink brings order to this profusion of interfaces by creating a common model for each class of product, Matt Bornski, Wink's chief architect of enterprise services, said. Its lighting model, for example, supports every feature found in smart lightbulbs, from simple actions like "turn off" or "dim" to less common ones, such as "change colors." Each light uses a subset of these commands.

The common interface also makes it easier to link different devices with Alexa. Bornski does this by creating a framework, or domain, for each common model. The domain relates the words we might use to the actions a product can take. This enables Alexa to understand what we mean when we talk to our lights.

Wink has been so successful with its common model approach that it recently signed a deal to link the Alexa home automation system with Ford's voice-activated car consoles. The resulting system will let customers check the gas tank before the morning commute or turn on their porch light from the car.

Creating voice interfaces requires building in safeguards that might not be obvious to those used to tangible controls. For example, Alexa will activate but not disarm a security system. "You don't want a burglar to yell 'Turn off the alarm' through the back window," Bornski said.

The system also needs to anticipate that it won't work perfectly, given the limits of the equipment and requests from fallible humans.

"If I tell one light to turn red and it can't, I'll get an error message," Bornski explained. "But if I tell all my lights to turn red and only some of them can do it, I would feel frustrated if I got an error message. So our system does what a human would do, and changes all lights that accept the command."

Other companies are designing voice interfaces that take into account that speech conveys not just nouns and verbs—but also emotion.

IBM, for example, infers the emotional content of words by using its Watson deep learning technology, said Rama Akkiraju, a distinguished engineer at IBM Research in Almaden, Calif. And

> You don't want a burglar to yell "Turn off the alarm" through the back window.
>
> — Matt Bornski, Chief architect of enterprise services, Wink

IPsoft's Amelia "cognitive assistant" can tell when customers are losing patience with automated transactions and call for a live agent.

IPsoft got its start developing "virtual engineers" to automate routine IT tasks. Still, it takes experts to use the virtual engineers. Amelia uses voice recognition so anyone can ask these engineers for help.

"I can tell Amelia I want to install a new speakerphone in a conference room," said Jonathan Crane, IPsoft's chief commercial officer. "Amelia will check if the room can support the phone, whether the phone is available, and if I have the authority to order it. It fills out all the paperwork. Instead of me speaking IT, I can speak to Amelia in English and it just does it."

Such performance impressed two global consulting firms, Accenture and Deloitte. They recently signed deals to use Amelia to automate business processes and IT center engineering and

> Instead of me speaking IT, I can speak to Amelia in English and it just does it.
>
> — Jonathan Crane, Chief Commercial Officer, IPsoft.

Amelia's avatar as it appears to users.

administration.

Marc Carrel-Billiard, Accenture's global managing director for technology R&D, believes Amelia can help technicians maintain products. He points to air-conditioning repair as an example.

"We could feed a user guide into Amelia so she understands how it works. Instead of looking for information in a manual or on a tablet, a technician could explain what he or she tried and Amelia would give advice like, 'If you did this and it didn't work, try that.' Over time, Amelia would learn more about how the system worked, and one day might apply what it learned about one model of air conditioner to another."

Meanwhile, a few manufacturers have approached Crane about capturing the hard-won knowledge of an experienced but aging workforce. Amelia, Crane said, could act like an intelligent apprentice. It could look over a technician's shoulder, recording and transcribing explanations and abstracting it for later analysis.

"These conversations are giving us a strong sense of how we might solve these problems," Crane said.

Working together

Other groups are harnessing voice recognition and artificial intelligence to forge new models for human-machine collaboration.

Companies like Rethink Robotics and Universal Robotics already make collaborative robots. While they learn new tasks easily, they cannot really change collaboration strategies on the fly. But the collaborative robot built at Georgia Tech by doctoral student Crystal Chao, now with Google, and her advisor, Andrea Thomaz, now a professor at University of Texas, adjusts to its human partners by simply talking with—and listening to—them.

To show how this works, Chao and Thomaz created a task: building a Lego tower. They outfitted the robot not only with mechanical hands and vision sensors, but also with microphones and speakers. Then they gave the robot and its human partner different goals.

"We might tell the robot to use a red door and the human to make the tower six blocks high," Thomaz said.

Sometimes, the robot followed the human's lead, placing like-colored blocks the way one child might copy another. Other times, rather than wait for a command, the robot took the initiative. It might, for example, simply add the red door or ask if the color was okay.

The conversation flowed naturally. The robot reacted to human commands, and also to half-formed phrases, laughter, and verbal shortcuts like "uh-huh" or "uh-uh" that humans take for granted. Sometimes, the robot even interrupted with a suggestion or a question.

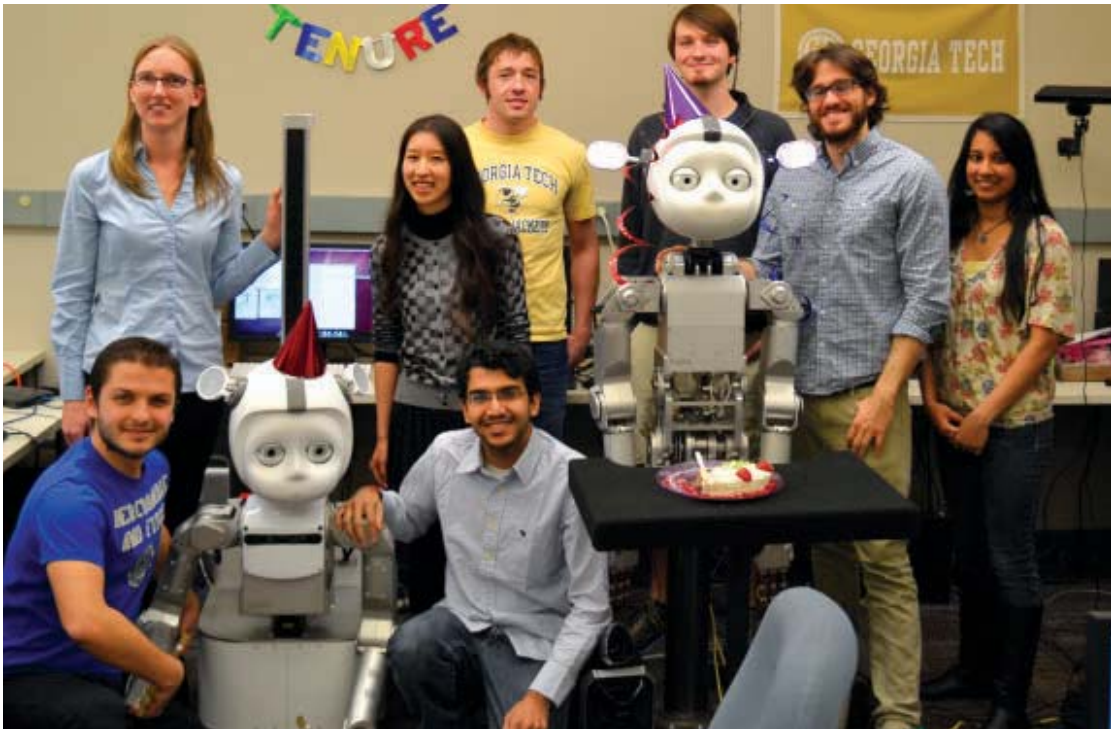
The interactions looked very much like the way humans collaborate with one another.

"In this type of collaborative dialogue, we're not leaning anything, we're just substantiating what we already know," Thomaz said.

The results were far from perfect. Humans are much better than robots at inferring what a partner is trying to do, and to reacting to dialogue that is outside the domain created by the robot's developers. Still, this robot's flexibility is anything but robotic.

It is a glimpse of how AI-driven voice recognition might soon change the way we work with machines.

Clearly, voice recognition has a way to go. It still gets simple searches wrong, and nobody is about to use it to control sophisticated machinery. But remember, this is a self-correcting technology that learns from every mistake. It will only get better and better.



Andrea Thomaz and Crystal Chao (top left) along with research students at Georgia Institute of Technology's School of Interactive Computing in 2013.

By coupling natural language requests to the deepest workings of the operating system, we may soon have new types of products that will give anyone access to features that only a professional could manipulate today. Instead of pouring through a manual to find the proper technique for an in-camera effect, one could simply tell the camera, "Focus on the faces, and make the background blurry," and the system would produce the image. A microwave would ask you what you were cooking and then apply a sequence of power cycles to crisp it to perfection.

Or the autonomous driving system of a Tesla could respond to the critiques of Georgia Tech's Abowd and adjust its brakes—or cornering performance or acceleration—to his liking.

It is certainly not hard to imagine technicians working with flexible robots capable of reacting to their motions and commands on the fly. More powerfully, systems may one day provide advice to engineers looking to boost factory performance, or help designers work through difficult problems when they are not sure how to explain what they are want.

Language is a rich enough medium to do all that. And so much more. ME

ALAN S. BROWN is associate editor at *Mechanical Engineering*.

The Grammar of Privacy

Google and other online companies know a great deal about those of us who use their search engine, email, maps, calendar, news, travel sites, and other services. They know where we live, what we buy, where we travel, which subjects interest us, and much, much more.

Voice recognition systems will know even more.

"Voice allows us to tap into far more detailed analytics than text," said Sam Vasisht, chief marketing officer for MindMeld, which builds natural language systems for consumer websites. "The way we speak can reveal if we are happy, sad, or angry, and whether we're just looking or interested in buying. It can show our gender and age, and our economic and educational status."

Voice systems will analyze this data to understand us better, so they can have more meaningful dialogues with us, said Werner Goertz, research director for personal technologies at global IT consultant Gartner. They will also use it to target advertisements at us.

"The big driver for voice recognition is its commercial use," Goertz said. "The more they understand our preferences, behavior, and proclivity to make buying decisions, the better they can predict ways to maximize the value of the ads they show us."

A world of always-on virtual agents might feel even more intrusive, Dan Roberts, CEO of Scout Alarm, which makes Alexa-connected home automation systems, said. Alexa, he notes, is always on, but right now, it listens only for the keywords in commands and ignores everything else.

"When we talk about Alexa becoming more proactive, it will be listening for more than those keywords," Roberts said. "This will bring privacy issues to the fore. When we install any device that is always on and connected to the cloud, it raises privacy concerns for some consumers. Not everyone is going to want to stream a picture of their home." ME

THE WATER

By Michael E. Webber

The word "tantalize" has its roots in a water-based legend. The Greek gods punished Tantalus, a son of Zeus, by giving him a great thirst and forcing him to stand in a pool of water that always recedes as he leans down to take a drink.

Such a myth feels like a fitting parable for humankind's relationship with abundant water resources that seem to be forever beyond our reach. In fact, it is this inconvenience that drives much of our energy investments for water: we spend significant sums of energy moving, treating, or storing water so that it is available in the form, location, and time we want it. While those energy investments overcome the limits of water's tantalizingly distant location, billions of people still remain without clean, accessible water.

What's more, demand for energy and water has been growing faster than population, driven by economic growth on top of the population growth. Affluent people eat more meat and consume more electricity—two activities that use water. With many water withdrawals coming from nonrenewable resources, the trends for greater

Austin's Water Treatment Plant 4, completed in 2014, is capable of treating 50 million gallons a day with room to expand to 300 mgd.

TRADE

In a world of declining freshwater availability, we are exchanging energy for clean water to meet the needs of thirsty billions.

consumption will trigger water shortages unless something changes.

By 2005, at least half of Saudi Arabia's fossil (nonrenewable) water reserves had been consumed in the previous two decades. Significant declines have also been observed in the Ogallala Aquifer under the Great Plains of the United States, spanning eight states from South Dakota to Texas. Water tables in Texas have lowered by as much as 234 feet, while the average drop across the entire aquifer was 14 feet. Storage of water fell from 3.2 billion to 2.9 billion acre-feet.

Overall, water availability is declining globally. Available water dropped from 17,000 cubic meters per person in 1950 to 7,000 cubic meters per person in 2000. Water stress occurs between 1,000 and 1,700 cubic meters, and a water crisis occurs at less than 1,000 cubic meters. Notably, counties such as Qatar, Libya, and Israel are well below 400 cubic meters per person, and even the "green and pleasant" United Kingdom only has 1,222 cubic meters.

All of these datasets point toward a conclusion that water stress is increasing. High-profile research published in *Nature* has concluded that nearly 80 percent of the global population

This reverse osmosis desalination plant in Barcelona turns the Mediterranean into drinking water.

endures high levels of threat to water security.

To compensate for the decline in water availability, we are moving toward more energy-intensive water. This relationship is just one aspect of the energy-water nexus: the dependency of water availability on energy inputs, and the dependency of power generation on available water. The increased energy intensity of water has several different components, including stricter water/wastewater treatment standards, deeper aquifer production, long-haul pipelines, and desalination. Each of those elements is more energy intensive than conventional piped water today, and seems to be a more common option moving forward.

CLEANER

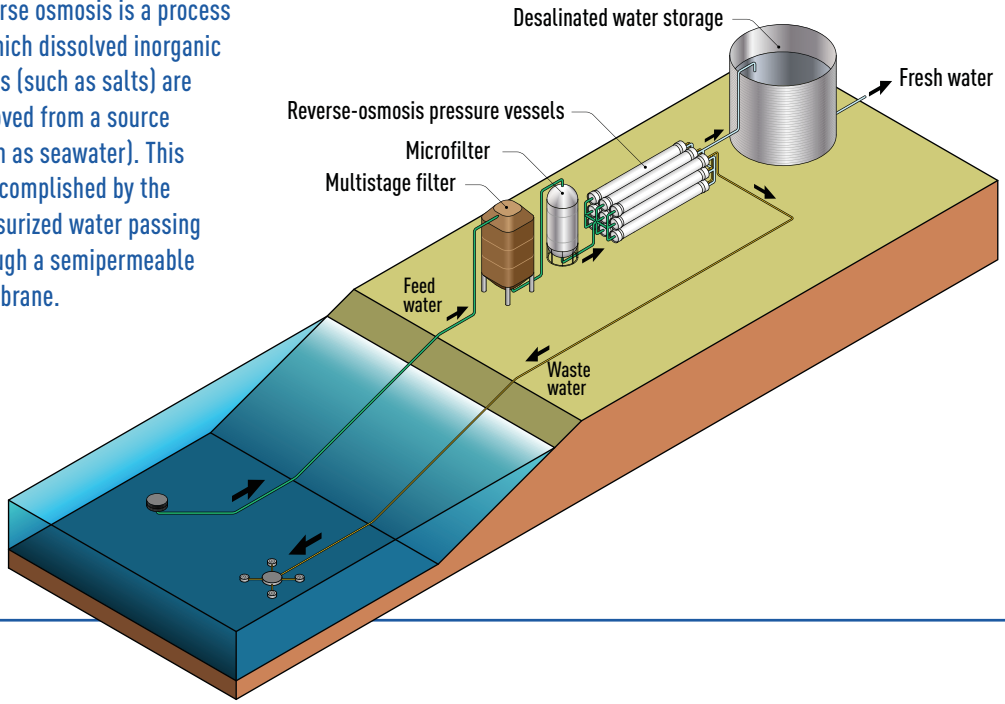
As societies become wealthier, their concerns shift from focusing on economic growth to protecting the environment. Protecting drinking water quality and preserving the ecosystem from the discharge of water treatment plants are two important pieces of that trend.

But water and wastewater treatment require nontrivial amounts of energy, and advanced treatment methods to meet stricter standards are more energy intensive than treatment for lower standards. For example, advanced treatment systems for wastewater with nitrification require about twice as much energy as trickling filter systems. As we tighten the standards for water and wastewater treatment, we are essentially edging toward increases in energy consumption. While new treatment technologies and methods become more efficient over time after their initial implementation, the standards tighten in parallel. How these balance out is unclear.

At the same time, the water coming into water and wastewater treatment plants is getting more polluted with time. As population grows, there are more discharges into the waterways. Those discharges contain constituents that weren't always there in such high concentrations. For example, there have been growing concerns about pharmaceuticals (including birth-control pills and pain pills) in sewage streams, which are difficult for wastewater treatment plants to remove. Doing so requires new equipment and ongoing investments of energy.

In an ironic example of the energy-water nexus, some of our energy choices create water quality impacts that require additional energy to treat. For example, increased biofuels production from Midwest corn is expected to cause additional runoff of

Reverse osmosis is a process in which dissolved inorganic solids (such as salts) are removed from a source (such as seawater). This is accomplished by the pressurized water passing through a semipermeable membrane.



nitrogen-based fertilizers and other pollution that will require more energy to remove.

Also, the wastewater streams from hydraulic fracturing of shales to produce oil and gas contain much higher levels of total dissolved solids than most wastewater treatment plants can handle. That means more energy has to be spent in one of several ways: on trucking that wastewater to disposal sites or specialized industrial wastewater treatment facilities that might be far away (something that happens rarely), for on-site treatment to recycle and reuse the water in subsequent wells, or on new equipment at the wastewater treatment plant to treat those streams. Even that new equipment is sure to require energy.

FARTHER

We are also contemplating moving water farther from its source to the end user. Long-haul pipelines and inter-basin transfer, which is moving water from one river basin to another, are common proposals to solve the crisis of declining local water supplies. While the idea of aqueducts has been around for thousands of years, the scale, length, and volumes of water that are moved are growing.

Some of the classic water transfer systems include the State Water Project in California, which is the state's largest electricity user because it must pump the water over mountains. (It also captures a lot of energy when the water flows back downhill through inline hydroelectric turbines coupled with chutes.) The Hawaiian island of Maui has an incredible series of hand-cut water channels that circle its two volcanoes, moving water miles from the wet portion of the island—one of the wettest places in the United States—to the dry inland plains where farming occurs. This system operates by gravity, and also generates electricity along the way.

Moving forward, as water tables fall and surface sources dry up, municipalities are more likely to consider the cost of expensive and far-flung water-gathering systems that pull water to a city from deeper in the ground or farther away. These long-haul systems will generally not be gravity-fed and will require a lot of energy. Plus, they will impact the ecosystem as water from one basin is moved to another, both in terms of loss of water in one watershed and the potential for invasive species in the other.

Perhaps the most ambitious water project in the world is the South-North Transfer Project in China (also known as the South-North Water Diversion Project, or SNWD). The scale, scope, and ambition of the project is reminiscent of U.S. water planners who have dreamed for decades of diverting the Yukon River in Alaska or the Missouri River in the Great Plains to the American Southwest, so that the deserts would bloom with flowers and fruit

trees. This project essentially aims to move major southern rivers—the Yangtze and Han—across the country to the Yellow and Hai Rivers. The industrialized north is relatively water poor, whereas the southern part of China is relatively water rich. The total estimated flow for the Chinese endeavor is projected to divert 44.8 billion cubic meters per year from the south more than a thousand miles to the north, at a total cost estimated to be $62 billion.

Not to be left out, India is also building its own long-haul water pipeline. And joining the pack, Texas is, too. For example, in Texas, a 240-mile pipeline is being built to bring 370,000 cubic meters per day of water from Lake Palestine to the Dallas-Fort Worth Metroplex. The total capital cost for the construction is estimated to be $888 million, or $3.7 million per mile of pipeline. The annual electricity consumption is expected to be $11.3 million, or $0.71 per cubic meter.

In addition, there is a water pipeline that oil and gas tycoon T. Boone Pickens proposed in early 2008 with the expectation that water would be the new oil. The pipeline would move water from Roberts County in the panhandle of Texas toward the Dallas-Fort Worth Metroplex. This project was controversial for a variety of reasons, one of which is that the water rights Pickens holds are for fossil water in the Ogallala aquifer, which can take millions of years to recharge. In Dallas, one of the likely applications for that fossil water would be for sustaining lawns.

While some energy would be used for pumping the water out of the aquifer, once it is at the surface, the water would mostly use gravity for its downhill trip to Dallas. Ultimately the deal was scuttled because of the $3 billion price tag for the pipeline. Instead, Pickens sold the water rights to thirsty local cities.

FRESHER

Another of the key trends to watch is how many municipalities are turning to desalination as a solution for water supply issues. In 2013, over 17,000 desalination plants were already installed worldwide, providing approximately 21 billion gallons per day (67 million cubic meters per day) of freshwater. With a blistering pace of growth, that capacity is projected to keep expanding quickly. More than three-fourths of new capacity will be for desalinating seawater, with the rest from brackish groundwater or salty rivers.

The California Aqueduct is a critical part of the State Water Project. The Water Project is the single largest user of electricity in the state.
Photo: California Department of Water Resources

While thermal desalination (using heat) represents about 25 percent of the installed capacity by 2010, it represents a shrinking share of new installations as builders seek the less energy intensive reverse osmosis membrane-based system. Even with the lower-energy approach, desalination is still an order of magnitude more energy-intensive than traditional freshwater treatment and distribution. Desalination is capital intensive, too: The annual global desalination market exceeds $10 billion.

Growth in desalination is particularly rapid in energy-rich, water-poor parts of the world, such

as the Middle East, northern Africa, and Australia. After a severe drought that lasted several years, water-strapped Israel famously turned to the sea for its water, rapidly building a handful of desalination plants to produce about 200 billion gallons of freshwater annually by desalting water from the Mediterranean.

Rapid desalination growth is also occurring in China, where booming industrial activity is straining water supplies that serve the world's largest population. It is also popping up in locations such as London, where a new desalination plant was very controversial and became a big part of several mayoral campaigns.

Despite its relative water wealth, the United States is the world's second-largest market for desalination, trailing only Saudi Arabia. This phenomenon is partly the result of the unequal distribution of water resources across the United States. And, as a wealthy country, the water consumption per capita is quite high and the money to finance large-scale infrastructure projects is available. Projects are under consideration for seawater reverse osmosis in coastal states such as California, Texas, and Florida. And projects are under development to serve inland communities that sit atop large brackish aquifers, as in Texas, Arizona, and New Mexico.

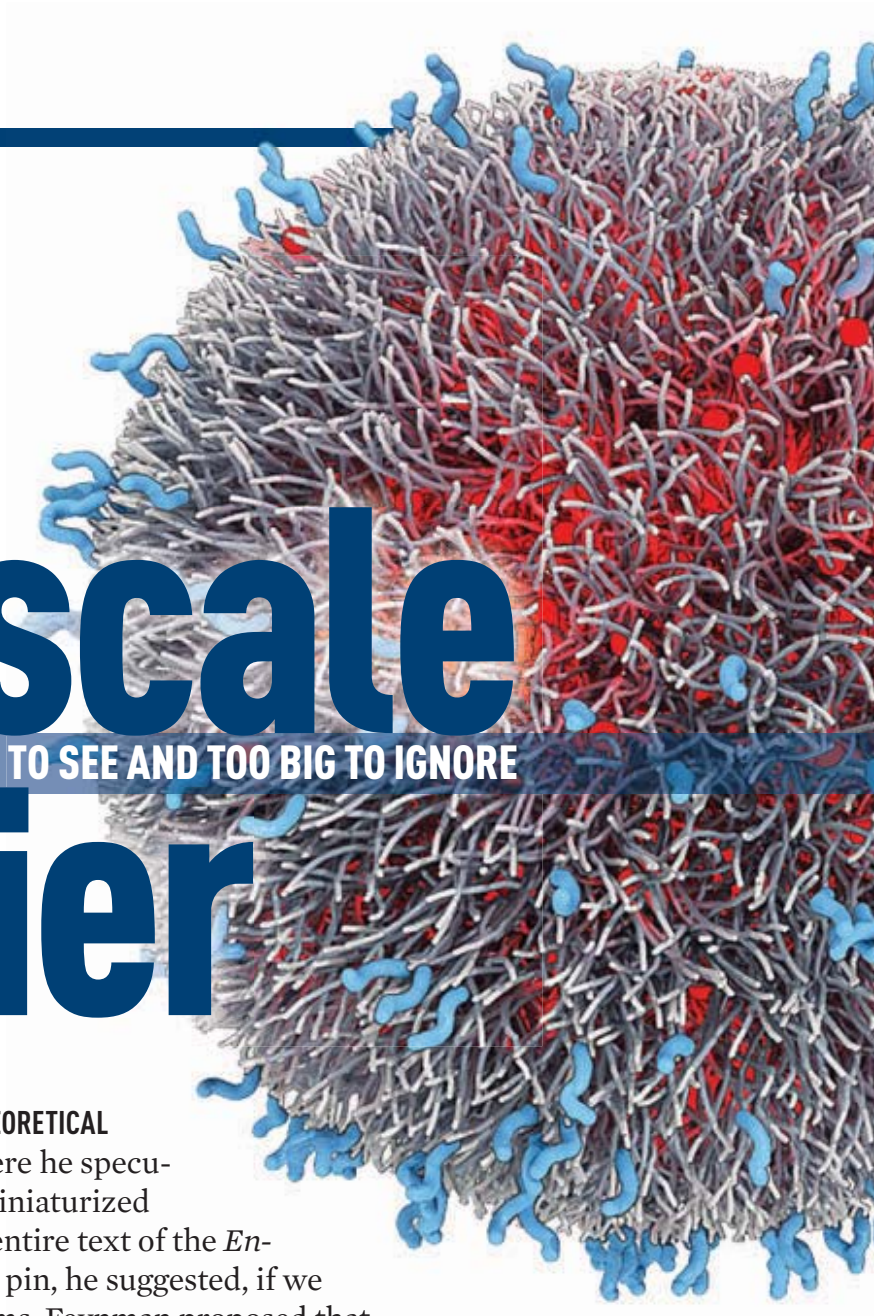
The two most energy-intensive options—desalination and long-haul transfer—can also be combined to create an even larger energy requirement for water. Natural water flows occur by gravity, but for seawater desalination, the opposite is true. By definition, coastal waters are at sea level, so moving the water inland requires pumping water uphill. One such desalination project under development in the United States is a coastal facility along the Gulf of Mexico that is designed to provide freshwater for San Antonio, Texas. That means the water would be moved nearly 150 miles inland, increasing in elevation nearly 775 feet.

While trading energy for water makes a lot of sense in places like the Middle East or Libya, where there is an abundance of energy and a scarcity of freshwater, that tradeoff is not obviously a good value in places like the United Kingdom or the United States, where other cost-effective options such as water conservation, graywater capture, and water reuse might be available.

In the end, the most important innovation we need is a new way of thinking about energy and water so that we make better decisions about those precious resources: holistic thinking that recognizes these resources as interconnected, and a systems-level approach that acknowledges how one change in one state to a water system can impact an energy system five states away.

Most important, we need long-range thinking because our energy and water decisions last decades to centuries, so it's imperative that we get them right. **ME**

MICHAEL E. WEBBER is deputy director of the Energy Institute at the University of Texas at Austin and an ASME Fellow. This article is excerpted from his book, *Thirst for Power: Energy, Water and Human Survival*, which was published in April 2016 by Yale University Press.



The Nanoscale Frontier

TECHNOLOGY THAT'S TOO SMALL TO SEE AND TOO BIG TO IGNORE

RICHARD FEYNMAN, THE NEW YORK-BORN THEORETICAL physicist, gave a lecture in 1959 where he speculated on the potential of radically miniaturized technology. It was possible to write the entire text of the *Encyclopaedia Brittanica* onto the head of a pin, he suggested, if we could shrink each pixel to just 1,000 atoms. Feynman proposed that, in time, miniature factories could be built and microscopic medical devices might transform healthcare.

"It would be interesting in surgery if you could swallow the surgeon," Feynman said. "You put the mechanical surgeon inside the blood vessel and it goes into the heart and 'looks' around."

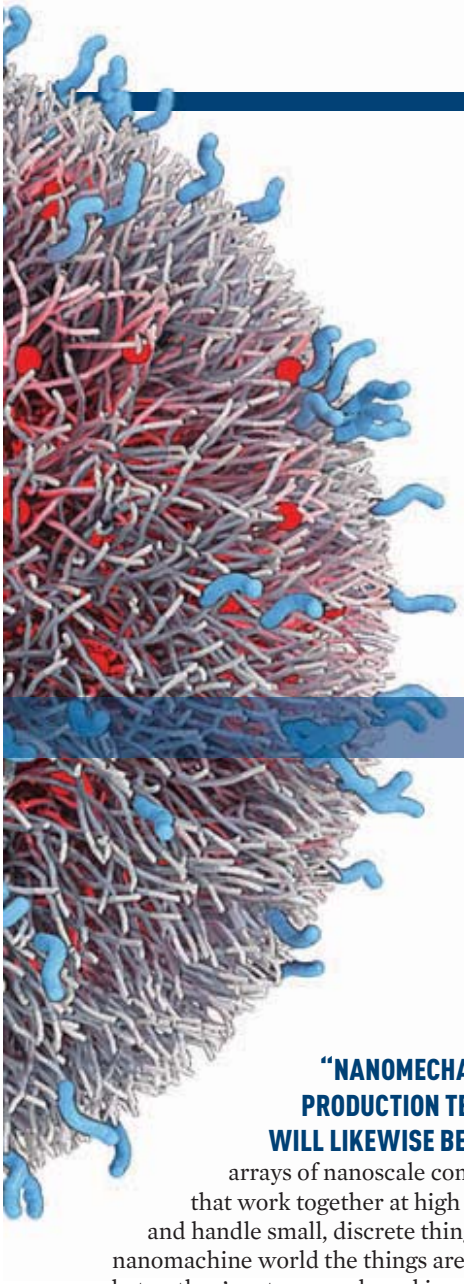
Feynman never used the term, but he was describing what we now call "nanotechnology."

The vision of powerful machines manufactured on molecular scales has intrigued technologists ever since. But in recent years, nanotechnology has left the domain of fancy and started to enter the real world. In the pages of *Mechanical Engineering*, we have featured the work of leading researchers describing their breakthroughs as well as the engineers who are bringing nanoscale products to market. To paraphrase Feynman, there's plenty of opportunity at the bottom, and these stories about nanoscale engineering have been some of our most provocative—and popular—articles.

In October, as part of the celebration of National Nanotechnology Day, an event sponsored by the federal government's National Nanotechnology Coordination Office to raise awareness of the field, *Mechanical Engineering* magazine and ASME.org published a page with links to 15 of our best nanotechnology feature articles since 2010. Over the next four pages, we provide some excerpts from those articles, which hint at the excitement these technologists feel about nanotechnology's potential. The research and breakthroughs they describe could lead to new ways to store energy, probe the human brain, or even cure cancer.

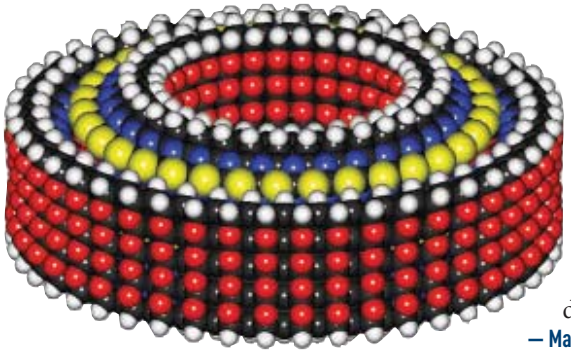
And we extend our invitation to check out **http://www.asme.org/events/celebrating-national-nanotechnology-day/the-nanoscale-frontier**, which has links to PDFs of the feature articles we've curated.

JEFFREY WINTERS is a senior editor at *Mechanical Engineering* magazine.



This illustration of a nanoparticle encapsulating time-released drugs accompanied "Rebuilding Ourselves," February 2013.

"NANOMECHANICAL PRODUCTION TECHNOLOGY WILL LIKEWISE BE BASED on arrays of nanoscale components that work together at high frequencies and handle small, discrete things. But in the nanomachine world the things aren't bits packaged in bytes, they're atoms packaged in molecules."
— K. Eric Drexler,
"Nothing Small About Nanotechnology,"
August 2014

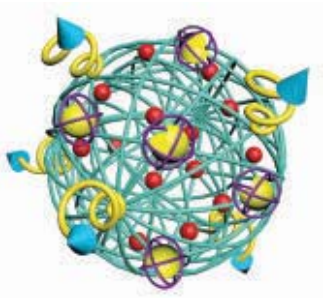


"MECHANICAL ENGINEERING AT THE NANOSCALE IS AIDING cutting-edge applications in oncological diagnosis and treatment."
— Mauro Ferrari,
"Infernal Mechanism,"
March 2010

"DESIGN ENGINEERS WILL BE ABLE TO CUSTOMIZE MATERIALS to their design in much the same way they select and change part geometries today. ... What we're envisioning is to allow engineers to define their own materials rather than use those already discovered."
— Yan Wang,
"CAD at the Nano Scale,"
August 2014

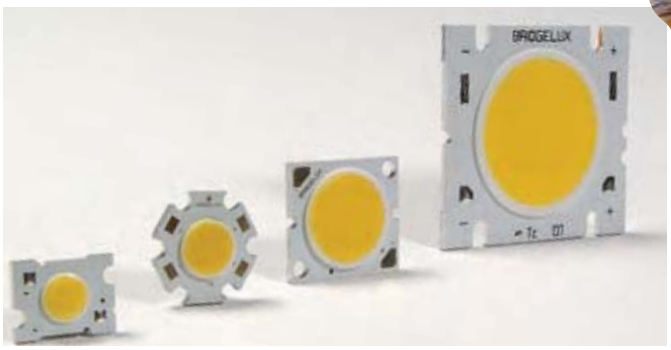
"OVER THE PAST DECADE, BIOENGINEERS HAVE TRANSFORMED the design of DNA scaffold origami from art to engineering."
— Hai-Jun Su and Carlos E. Castro,
"The Rise of the DNA Nanorobots,"
August 2016

TO PARAPHRASE FEYNMAN, THERE'S PLENTY OF OPPORTUNITY AT THE BOTTOM.



"YOU CAN HAVE THE FANCIEST IDEAS AND MOLECULES. But if you can't get them into the cell, they are of no use."
— Matthew Porteus, quoted in "Neat Little Packages," February 2016

"A NANOSTRUCTURED ENGINEERED MATERIAL BASED on gecko-foot reusable adhesive would have a wide range of applications, from everyday objects such as adhesive tapes and fasteners to exotic items such as wall-climbing robots. But engineering such a material isn't straightforward."
— Bharat Bhushan, "Nature's Nanotechnology," December 2012

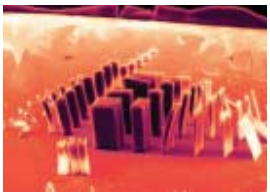


"WE'RE AT THE BEGINNING STAGES OF EXPONENTIAL GROWTH of nano-enabled product innovation.... That's where innovation is going to occur, at the molecular level."
— Steve Waite, quoted in "Nanotech Unbound," November 2012

"WHILE THE PROSPECT OF AUTOMATONS PATROLLING our capillaries is still far away, much more exquisite control of nanoparticles is already under development."
— Guy M. Genin and Ram V. Devireddy, "MEs in Nanomedicine," June 2012

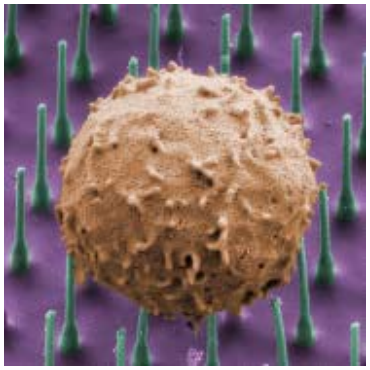
"ONCE CANCERS METASTASIZE, THEY ARE ALMOST ALWAYS FATAL. Researchers are looking at the nanoscale mechanics of tumors to discover means to attack—and kill—all kinds of cancer cells. If successful, this will be a cure for even metastatic cancer."
— Mauro Ferrari, "Slaying the Dragon," April 2015

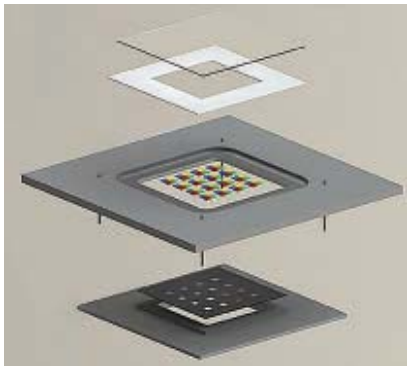
"CARBON NANOTUBES LET US USE 30 PERCENT LESS CARBON FIBER. We get the same results as a conventional composite, but the part is lighter and we don't have the brittleness."
— Roberto Velozzi, quoted in "Positive Reinforcement," March 2010



"TO STORE MACROSCOPICALLY SIGNIFICANT AMOUNTS OF ENERGY, you need to deform large numbers of carbon nanotubes. It is more challenging still to deform them in a way that maintains high energy density of the overall system."
— Carol Livermore, "Carbon Super-Springs," March 2010

"WOULDN'T IT BE COOL TO MAKE A MORE POWERFUL PROBE that was so small, it would cause little damage when it was implanted? There would be a good chance of implanting it in paraplegic patients, and using it to control devices that help them get around and take care of themselves."
— Sotiris Masmanidis, quoted in "Nanotechnology for the Brain," February 2014

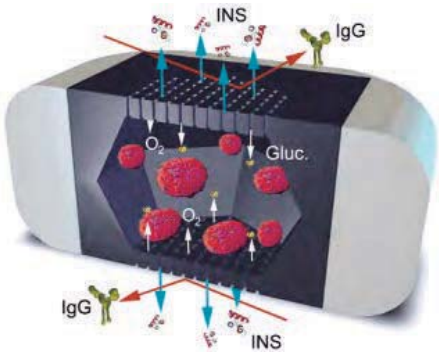




"MICRO- AND NANOSCALE STRUCTURES HAVE GIVEN us capabilities to interact with cells and pathogens at their level as never before and helped us understand how they live, grow, multiply, differentiate, and die."
— Yunus Alapan, Ismail Sayin, and Umut Atakan Gurkan, "Making the Smallest Medical Devices," February 2014

"NANOTECHNOLOGY CAN ALSO HELP US ALTER NATURAL DESIGNS. Carbon nanotubes act like a reinforcement to give synthetic tissue the strength, stiffness, and viscoelastic performance of natural membranes."
— Rohit Karnik and Robert S. Langer, "Rebuilding Ourselves," February 2013

"AS OPPOSED TO THE MACROSCALE, WHERE WATER molecules next to a pipe wall have zero velocity, in nanochannels fluid molecules slip at the channel surface, experiencing an enhanced convective transport."
— Alessandro Grattoni, Scott Parazynski, and Fazle Hussain, "Building Nanoglands," February 2011



CELEBRATE ENGINEERING

ASME 2016 HONORS

CRISTINA AMON

Honorary Membership

Cristina Amon, P.Eng., Sc.D., dean of the Faculty of Applied Science and Engineering, and alumni chair professor of bioengineering in the department of mechanical and industrial engineering at the University of Toronto, is honored for extraordinary contributions as a researcher focusing on heat transfer, as dean of engineering at U of T, as a leader in ASME and the broader engineering community, and as a champion for increased diversity in the profession.

Dr. Amon joined U of T in 2006. As dean, she provides leadership for the faculty's academic, budgetary and planning processes; and is responsible for the visionary and strategic leadership of one of the world's leading engineering schools. Previously she was with Carnegie Mellon University in Pittsburgh (1988-2006).

Dr. Amon's achievements in education cover the whole spectrum of integrating education, research and engineering practice. She is a pioneer in the development of computational fluid dynamics for formulating and solving thermal design problems subject to multidisciplinary competing constraints. Her research focuses on nanoscale thermal transport in semiconductors, energy systems and bioengineered devices.

Dedicated to outreach, Dr. Amon co-developed Engineering Your Future, the Society of Women Engineers workshop for female and minority high school students; and Moving 4th into Engineering, an outreach program targeted toward fourth graders. She is co-founder of Women In Non-traditional Graduate Studies and served as its first faculty adviser.

She has authored/co-authored more than 350 refereed articles and has delivered invited/keynote lectures worldwide. She currently serves on the advisory board of the *International Journal of Thermal Sciences* and the editorial board of *Heat and Mass Transfer*.

Dr. Amon is an independent director of MKS Instruments, chair of the Research Committee of the National Council of Deans of Engineering and Applied Science in Canada, and founding chair of the Global Engineering Deans Council. She has served on external advisory boards for several universities, and foundations focused on science, engineering and technology around the world.

An ASME Fellow, Dr. Amon was inducted into four academies and is a member and Fellow of a number of other societies.

Dr. Amon received her mechanical engineering diploma from Simón Bolívar University in Caracas, Venezuela, in 1981. She earned her master's degree and her Sc.D. from the Massachusetts Institute of Technology in Cambridge in 1985 and 1988, respectively.

JAMES J. DUDERSTADT

Ralph Coats Roe Medal

The Ralph Coats Roe Medal, established in 1972, recognizes an outstanding contribution toward a better public understanding and appreciation of the engineer's worth to contemporary society.

James J. Duderstadt, Ph.D., president emeritus and university professor of science and engineering at the University of Michigan in Ann Arbor, is recognized for outstanding public service as a professor and university administrator; for leadership roles in defining the science and technology agenda for the nation; and for efforts to grow underrepresented groups in our educational institutions.

With U-M since 1968, Dr. Duderstadt currently teaches in the Science, Technology and Public Policy program; and directs the Millennium Project, a research center that explores the impact of over-the-horizon technologies on society. Under his leadership, as dean of engineering (1981-85), provost (1986-88) and president of U-M (1988-96), many new programs were initiated, a modern engineering campus was created, and research expenditures increased through fostered university–industry–government collaborations. Dr. Duderstadt led the effort to make U-M a leader in the area of underrepresented minority and women students and faculty with the launch of the Michigan Mandate and the Michigan Agenda for Women campaigns.

His teaching and research interests have spanned a wide range of subjects in science, mathematics and engineering, and he has authored/co-authored over 30 books and 200 technical publications.

Dr. Duderstadt currently serves as chair of the Policy and Global Affairs Division of the National Academies, co-director of the Glion Colloquium (Switzerland), nonresident Senior Fellow of the Brookings Institution, and director of the board of directors of the U.S. Department of Energy CASL (Consortium for Advanced Simulation of Light Water Reactors) Nuclear Energy Innovation Hub. He also serves on several major national boards and study commissions in areas such as federal science policy, higher education, information technology, energy sciences and national security; and as a member of the advisory boards of several colleges and universities. He has been elected to numerous societies.

Dr. Duderstadt received his bachelor's degree in engineering, summa cum laude, from Yale University in New Haven, Conn., in 1964. He earned his master's degree in engineering science and his Ph.D. in engineering science and physics from the California Institute of Technology in Pasadena in 1965 and 1967, respectively. He has received numerous honorary degrees.

ASHWANI K. GUPTA

Honorary Membership

Ashwani K. Gupta, Ph.D., Distinguished university professor at the University of Maryland in College Park, is honored for distinguished research and educational contributions, particularly those related to energy and environmental sustainability; for mentoring high school students; and for providing services to government and industry.

Dr. Gupta has more than 40 years of experience in combustion engineering. Since 1983 he has been with UMD, where he founded and is director of the Combustion Laboratory.

He has contributed to the fundamental understanding of high temperature air combustion called HiTAC, which is now used in many industrial furnaces for significant energy savings (~30 percent), pollution reduction (~50 percent), low noise (6dB) and improved quality of the product. He discovered colorless combustion and green color flame using hydrocarbon fuels without any additive. This is the first time in the history of fossil fuel combustion that flames can be colorless and provide uniform temperature distribution in the entire combustion zone to form a uniform thermal reactor. Dr. Gupta used elements of HiTAC for clean fuel reforming of wastes and low grade fuels. He successfully developed meso-scale combustors with sustained flames in dimensions smaller than quenching distances of flames (~1 or 2 millimeters in size) using gas and liquid fuels under fuel lean conditions. His current focus is on the development of near zero emission combustion with uniform thermal field under high intensity combustion conditions for stationary gas turbines.

Dr. Gupta has provided services to government agencies and international organizations and universities. He provides research training to local high school students in his labs and teaches students from more than 20 countries via e-learning through the APEC Mentoring Center for the Gifted in Science.

He has authored/co-authored more than 700 technical papers, three books and 13 book chapters; has edited 12 books; and has delivered over 100 plenary/keynote presentations since 1990. He holds three patents.

An ASME Fellow, Dr. Gupta serves as chair of the Power Division's Fuels and Combustion Technologies Committee.

Dr. Gupta earned his master's degree in combustion and high temperature gas dynamics from the University of Southampton, U.K., in 1970; and his Ph.D. in combustion from the University of Sheffield, U.K., in 1973. He was awarded the higher doctoral degree, D.Sc., from Sheffield and Southampton in 1986 and 2013, respectively.

BERNARD E. HRUBALA

Melvin R. Green Codes and Standards Medal

The Melvin R. Green Codes and Standards Medal was established in 1976 as the Codes and Standards Medal and renamed in 1996 to honor the memory and extraordinary contributions of an ardent supporter of industrial standards.

Bernard E. Hrubala, the global business development manager for pressure equipment certification at TÜV Rheinland AIA Services, LLC in Houston, is recognized for exceptional leadership in ASME Standards and Certification.

Mr. Hrubala has 39 years of extensive experience in the pressure equipment industry in areas including international conformity assessment, ASME codes and standards compliance, jurisdictional requirements, inspection and auditing. He has been with TÜV Rheinland, a world-renowned global provider of technical services for testing, inspection, certification, consultation and training, since 2002.

Earlier experience includes 23 years with The Hartford Steam Boiler Inspection and Insurance Company, the oldest and largest ASME authorized inspection agency.

An ASME Fellow, Mr. Hrubala has made enormous contributions to Standards and Certification during the last 39 years. Over the last two decades, he has traveled around the globe with ASME staff and volunteer leaders to promote the Society's Conformity Assessment programs and global acceptance of its codes and standards. Mr. Hrubala oversaw the implementation of several key initiatives including the realignment of the 95-year-old Boiler and Pressure Vessel Code organization; the elimination of the codes and standards addenda subscription service; the use of a single mark for equipment under the conformity assessment program now that ASME codes and standards are accepted in more than 100 countries, thus replacing the 22 specific marks that had been an inherent feature since 1920; and the expansion of authorized inspection agency eligibility to better support the global growth of the Society's Conformity Assessment programs.

Mr. Hrubala is currently assisting several state departments and jurisdictional authorities on proposed legislative changes so they are consistent with current procedures and practices under ASME Qualifications for Authorized Inspection (QAI-1-2016).

He has been an active member of The National Board of Boiler and Pressure Vessel Inspectors since 1983.

Mr. Hrubala earned his bachelor's and master's degrees in education from Eastern Kentucky University in Richmond in 1974 and 1975, respectively.

SHIV G. KAPOOR

Honorary Membership

SHIV G. KAPOOR, PH.D., GRAYCE WICALL Gauthier chair in mechanical science and engineering at the University of Illinois at Urbana-Champaign, is honored for more than three decades of pioneering contributions to manufacturing engineering through basic and applied research with close collaboration with industrial users, the education and mentoring of young talent, and lifelong service to ASME and other professional societies.

With UIUC since 1979, Dr. Kapoor's prior positions include director of the College of Engineering's manufacturing engineering education program (1989-2010) and UIUC's Manufacturing Research Center (1995-2012).

Dr. Kapoor also served as director of the National Science Foundation's Industry/University Cooperative Research Center for Machine Tool Systems Research (1993-2003). The center's research led to advances in mechanistic machining process models that UIUC is renowned for. The modeling work, when implemented in software, is detailed enough to design machines and machined parts, and is used by researchers in academe and industry as well as by educational institutions in the training of manufacturing engineers.

His work on the micro/mesoscale manufacturing factory of the future has set a significant milestone in the micro and precision machine tool design arena. Dr. Kapoor, his colleagues and his students have been pioneers in understanding the physics of microcutting and developing models to predict the machining performance of microscale systems. Based on their success in designing micro-machine tools, two of his students started a company in 2005 that now employs more than two dozen engineers to design and build a variety of these tool products.

Dr. Kapoor has published more than 350 journal and conference papers, and authored/co-authored many book chapters. He holds several patents.

An ASME Fellow, Dr. Kapoor has been serving as chair of the Society's Technical Committee on Publications and Communications since 2011. He made countless contributions as chair of the Manufacturing Engineering Division (1992-93), member-at-large on the Manufacturing Operating Board (1994-95) and vice president for the manufacturing technical group on ASME's Council on Engineering (1996-99).

Dr. Kapoor earned three degrees in mechanical engineering: his bachelor's degree from the Indian Institute of Technology, Varanasi (formerly know as IT-BHU) in 1969; his master's degree from the Indian Institute of Technology, Kanpur in 1971; and his Ph.D. from the University of Wisconsin–Madison in 1977.

EVANGELOS TRIFON LASKARIS

Nancy DeLoye Fitzroy and Roland V. Fitzroy Medal

THE NANCY DELOYE FITZROY AND ROLAND V. Fitzroy Medal, established in 2011, recognizes pioneering contributions to the frontiers of engineering leading to a breakthrough(s) in existing technology or leading to new applications or new areas of engineering endeavor.

Evangelos Trifon Laskaris, Ph.D., chief engineer in diagnostics imaging and biomedical technologies at GE Global Research Center in Niskayuna, N.Y., is recognized for pioneering contributions to the design and construction of superconducting magnets for MRI systems and energy applications, and for continued efforts to increase affordability and penetration of MRI equipment in underserved regions of the world.

Dr. Laskaris joined GE Power Systems in 1967 and transferred to GE Global Research in 1973 to lead the research activities in applied superconductivity. His primary research efforts have focused on applications including large electrical machines from 20-100 MW, high-power density homopolar inductor alternators, and MRI magnets. Continued research in the area of superconducting power generation holds promise for improved efficiency and more compact designs.

Dr. Laskaris has been involved, virtually every step of the way, in developing or directing the development of the magnets at the heart of a succession of industry-leading products — from GE's first MRI system to a series of increasingly sophisticated ones, both open and closed, with higher and higher field strengths that are key to improved image quality. His technical accomplishments in this field are documented in more than 200 patents and over 60 refereed publications.

In recent years Dr. Laskaris has been leading the technology development of hermetically sealed low cryogen MRI magnets for 1.5T whole body and 3.0T head-only MRI scanners. His work is focused on advancing the technology of MRI magnets to enable their operation with a hermetically sealed charge of helium, like common refrigerators, so that they can be sited in underserved areas of the world where access to liquid cryogens is limited. The first prototype of this technology, a 3.0T head-only MRI scanner, has been operational at the Mayo Clinic in Rochester, Minn., since March 2016.

He is a member of the National Academy of Engineering.

Dr. Laskaris earned his bachelor's degree in mechanical and electrical engineering from the National Technical University of Athens in Greece in 1966. He earned his master's degree and Ph.D. in mechanical engineering from Rensselaer Polytechnic Institute in Troy, N.Y., in 1971 and 1974, respectively.

J.N. REDDY

ASME Medal

The ASME Medal was established in 1920 and is awarded for eminently distinguished engineering achievement.

J.N. Reddy, Ph.D., distinguished professor, regents professor and holder of the Oscar S. Wyatt endowed chair at Texas A&M University in College Station, is honored for lasting contributions to applied mechanics through authored textbooks and the development of shear deformation plate and shell finite elements for the accurate determination of interlaminar stresses in composite structures, which have had a major impact on engineering education and practice.

A leader in the field of applied mechanics for more than four decades, Dr. Reddy has been a member of the faculty at Texas A&M since 1992. Previously he was a faculty member at Virginia Polytechnic Institute and State University in Blacksburg (1980-92) and The University of Oklahoma in Norman (1975-80).

Dr. Reddy's early research focused primarily on mathematics of finite elements, variational principles of mechanics, shear deformation and layerwise theories of laminated composite plates and shells, modeling of geological and geophysical phenomena, penalty finite elements for flows of viscous incompressible fluids, and least-squares finite element models of fluid flows. His pioneering work on the development of shear deformation theories (referred to in literature as the Reddy third-order plate theory) has led to new research developments and applications; and his finite element models of shear deformation theories and penalty finite elements of fluid flows have been implemented into commercial finite element computer programs like ABAQUS, NISA and HyperXtrude.

In recent years Dr. Reddy's research has focused on nonlocal and nonclassical continuum mechanics problems and ordered constitutive theories in the theoretical mechanics of solids and fluids.

Dr. Reddy has authored/co-authored over 550 journal papers; and more than 20 well-received textbooks on the finite element method, plates and shells, and composite materials and structures.

An ASME Fellow and an Honorary Member (2011), Dr. Reddy is also a Fellow and member of numerous other societies.

Dr. Reddy received his bachelor's degree in mechanical engineering from Osmania University in Hyderabad, India, in 1968. He earned his master's degree in mechanical engineering from Oklahoma State University in Stillwater in 1970 and his Ph.D. in engineering mechanics from The University of Alabama in Huntsville in 1974. He holds two honorary degrees.

HELEN LOUISE REED

Kate Gleason Award

The Kate Gleason Award, established in 2011, recognizes outstanding achievements by a female engineer. It honors the legacy of the first woman to be welcomed into ASME as a full member.

Helen Louise Reed, P.E., Ph.D., a professor at Texas A&M University in College Station, is honored for lifetime achievements in the fundamental understanding and control of boundary layer transition for high-efficiency aerospace vehicles, and in pioneering small satellite design and implementation.

Dr. Reed joined the Texas A&M faculty in 2004 and served as head of the department of aerospace engineering for four years before returning to full-time teaching and research. She holds the titles of regents professor, presidential professor for teaching excellence, and holder of the Edward "Pete" Aldridge '60 professorship. Dr. Reed is also co-founder, board member and chief technology officer for Chandah Space Technologies, a commercial-space company that specializes in on-orbit inspection capabilities.

She has 39 years of experience in physics-based understanding of the receptivity, stability and transition of boundary layers, enabling for high-altitude long-endurance unmanned vehicles, transports, and hypersonic trans-atmospheric vehicles. As lead computationalist, Dr. Reed has teamed with experimentalists throughout her career to achieve closure between theory and experiment, mature drag-reducing technologies, and advance modeling for 3-D configurations. In parallel, over the past 23 years she has pioneered important contributions to engineering education through her small-satellite design/build/fly programs, first at Arizona State (ASUSat Lab) and then at Texas A&M (AggieSat Lab). Dr. Reed and her students have completed four major missions and teamed on two others, all launched.

An ASME Fellow, Dr. Reed is a member and Fellow of a number of other societies.

Since 2013 Dr. Reed has been leading a subgroup for NATO's Technical Team (AVT ET 136) for Hypersonic Boundary Layer Transition Prediction, and serving as chair of the American Institute of Aeronautics and Astronautics' Transition Discussion Group. She has been a consultant to the Institute for Defense Analysis since 2014, and has been serving on the National Academies' Intelligence Science and Technology Experts Group since 2015.

Dr. Reed earned her bachelor's degree in mathematics from Goucher College in Baltimore in 1977. She earned her master's degree and Ph.D. in engineering mechanics from Virginia Polytechnic Institute and State University in Blacksburg in 1980 and 1981, respectively.

LIJIE GRACE ZHANG

Sia Nemat-Nasser Early Career Award

The Sia Nemat-Nasser Early Career Award recognizes research excellence in experimental, computational or theoretical aspects of mechanics of materials by a young investigator within 10 years following receipt of their Ph.D. degree. Established by the Materials Division in 2008, it was elevated to a Society award in 2012.

Lijie Grace Zhang, Ph.D., an associate professor at The George Washington University in Washington, D.C., is recognized for pioneering research in tissue engineering and biomechanics for the development of novel biologically inspired nanomaterials; and for research in the integration of nanobiomaterials with advanced 3-D bioprinting for complex tissue and organ regeneration.

An associate professor in the department of mechanical engineering and aerospace engineering, the department of biomedical engineering and the department of medicine at GW, Dr. Zhang is also director of the Bioengineering Laboratory for Nanomedicine and Tissue Engineering. She joined GW in 2010 after completing her postdoctoral training at Rice University in Houston and Harvard Medical School in Boston.

In her research, Dr. Zhang applies a range of interdisciplinary technologies and advanced approaches in 3-D bioprinting, nanobiomaterials, tissue engineering, biomechanics and stem cells to design biologically inspired complex tissues such as neural, bone, cartilage, osteochondral, and vascular tissues.

Dr. Zhang has authored/co-authored three books and over 80 peer-reviewed publications; and she has presented her work at more than 200 conferences, and at universities and institutes. She holds four patents.

An ASME member, Dr. Zhang serves on the Bioengineering Division's Cellular and Tissue Engineering Committee.

Dr. Zhang is also a member of more than a dozen other societies.

Her recent honors include the National Institutes of Health Director's New Innovator Award (2014), and the GW School of Engineering and Applied Science's Faculty Recognition Award (2014) and Outstanding Young Researcher Award (2015). Dr. Zhang was named a 2015 CMBE Young Innovator by the Biomedical Engineering Society's *Cellular and Molecular Bioengineering* journal.

Dr. Zhang earned her bachelor's degree in chemical engineering and her master's degree in applied chemistry from Tianjin University in China in 2001 and 2004, respectively. She earned her Ph.D., with distinction, in biomedical engineering from Brown University in Providence, R.I., in 2009.

Adaptive Structures and Material Systems Award

RALPH C. SMITH

The Adaptive Structures and Material Systems Award recognizes significant contributions to the sciences and technologies associated with adaptive structures and/or material systems. The award honors a senior researcher for a lifetime of achievement and sustained impact in the field. Established by the Aerospace Division in 1993, it was elevated to a Society award in 2014.

Ralph C. Smith, Ph.D., a distinguished professor of mathematics at North Carolina State University in Raleigh, is honored for extraordinary contributions in the development of smart materials and adaptive structures through constitutive model development, modeling and nonlinear control, and uncertainty analysis; and for modeling research that has been validated across a broad range of smart materials.

Dr. Smith joined the faculty at NC State in 1998. He has published nearly 80 journal articles, 45 refereed proceedings papers and 80 proceedings publications; and has given more than 180 presentations, the large majority invited lectures.

Bergles-Rohsenow Young Investigator Award in Heat Transfer

PATRICK E. HOPKINS

The Bergles-Rohsenow Young Investigator Award in Heat Transfer, established in 2003, recognizes a young engineer who is committed to pursuing research in heat transfer and demonstrates the potential to make significant contributions in the field.

Patrick E. Hopkins, Ph.D., an associate professor in the department of mechanical and aerospace engineering at the University of Virginia in Charlottesville, is recognized for significant heat transfer research that has produced experimental and analytical advancements in areas including thermal transport across interfaces, reduced thermal conductivity materials, electron-phonon coupling, and transport of electrons and phonons.

Educated at UVA, Dr. Hopkins joined the faculty in 2011. He has published 130 papers in refereed journals, and is an active reviewer for various journals. Dr. Hopkins has served on various ASME Heat Transfer Division committees and has been chair of K-8–Theory and Fundamental Research since 2014.

Per Bruel Gold Medal for Noise Control and Acoustics

PATRICIA DAVIES

The Per Bruel Gold Medal for Noise Control and Acoustics was established in 1987 in honor of Dr. Per Bruel, who pioneered the development of sophisticated noise and vibration measuring and processing equipment. The medal recognizes eminent achievement and extraordinary merit in the field.

Patricia Davies, Ph.D., a professor of mechanical engineering, and director of the Ray W. Herrick Laboratories at Purdue University in West Lafayette, Ind., is recognized for exceptional leadership and educational mentorship in the field of noise control and acoustics; and for outstanding contributions to noise control engineering in the areas of signal processing, nonlinear dynamic modeling, product sound quality, and human response to noise and vibration.

Dr. Davies has been with Purdue since 1987. In 2005 she became director of the Herrick Laboratories, where 90 graduate students and 20 faculty focus on graduate student research with an emphasis on technology transfer. Dr. Davies also has a courtesy appointment in psychological sciences.

Edwin F. Church Medal

KAREN A. THOLE

The Edwin F. Church Medal, established in 1972, is awarded to an individual who has rendered eminent service in increasing the value, importance and attractiveness of mechanical engineering education.

Karen A. Thole, Ph.D., a professor of mechanical engineering and head of the department of mechanical and nuclear engineering at The Pennsylvania State University in University Park, is honored for the creation and development of the Engineering Ambassadors Network, an innovative program that provides undergraduate students with professional skills and, at the same time, serves as a highly effective mechanism for recruiting women and underrepresented minority students into engineering.

At Penn State since 2006, Dr. Thole has also made significant contributions to the field of gas turbine heat transfer as a researcher, educator and administrator. She founded the Steady Thermal Aero Research Turbine Laboratory in 2011.

Daniel C. Drucker Medal

KYUNG-SUK KIM

The Daniel C. Drucker Medal, established in 1997, is conferred in recognition of distinguished contributions to the field of applied mechanics and mechanical engineering through research, teaching and service to the community.

Kyung-Suk Kim, Ph.D., a professor in the School of Engineering at Brown University in Providence, R.I., is honored for seminal contributions to the field of mechanics of materials through creative research that bridges experiments and mechanics theories to understand the motion and deformation of interfaces as well as the formation and assembly of nanostructures.

A professor at Brown since 1989, Dr. Kim has also been director of the Center for Advanced Materials Research since 2014. He recently initiated ruga mechanics, a new thrust in applied mechanics research for understanding wrinkling and folding processes.

William T. Ennor Manufacturing Technology Award

YUSUF ALTINTAS

The William T. Ennor Manufacturing Technology Award was established in 1990 by the ASME Manufacturing Engineering Division and the Alcoa Company to recognize an individual or team for developing or contributing significantly to an innovative manufacturing technology, the implementation of which has resulted in substantial economic or societal benefits.

Yusuf Altintas, P.Eng., Ph.D., a professor at The University of British Columbia in Vancouver, is honored for the pioneering development of novel models and algorithms for predicting and controlling machining operations that resulted in substantial productivity increases, and for designing higher performance machine tools.

Dr. Altintas joined UBC in 1986 and founded the Manufacturing Automation Laboratory. Since 1994 he is the founding coordinator of the mechatronics engineering option at UBC. He holds the NSERC–P&WC (National Sciences and Engineering Research Council of Canada–Pratt & Whitney Canada) industrial research chair professorship since 2002, and since 2010 he has been directing the NSERC's Canadian Network for Research and Innovation in Machining Technology.

Fluids Engineering Award

PATRICK J. ROACHE

The Fluids Engineering Award was established by the Fluids Engineering Division in 1968. In 1978 it was elevated to an ASME award recognizing outstanding contributions over a period of years to the engineering profession and, in particular, to the field of fluids engineering through research, practice and/or teaching.

Patrick J. Roache, Ph.D., a consultant, is recognized for pioneering contributions including publishing books on computational fluid dynamics and on verification and validation, and developing the method of manufactured solutions and the grid convergence index.

Dr. Roache's career spans nearly 50 years. An independent consultant since 1997, he previously was president of Ecodynamics Research Associates, Inc. in Albuquerque, N.M. (1975-96). Earlier he was with Science Applications, Inc. and Sandia National Laboratories, also in Albuquerque. Throughout his career he has simultaneously held various academic positions.

Freeman Scholar Award

GOODARZ AHMADI

The Freeman Scholar Award is given biennially in even-numbered years. Established in 1926, it is bestowed upon a person of wide experience in fluids engineering. The recipient is expected to review a coherent topic in his or her specialty, including a comprehensive statement of the state of the art, and suggest future research needs.

Goodarz Ahmadi, Ph.D., Clarkson distinguished professor and Robert R. Hill '48 professor of mechanical and aeronautical engineering at Clarkson University in Potsdam, N.Y., is recognized for the paper titled "Particle Transport, Deposition and Removal – Environmental and Biological Applications."

Prior to joining the faculty at Clarkson in 1982, Dr. Ahmadi was with Shiraz University in Iran (1970-81). He has published three books and nearly 600 papers in archival journals, and he has given more than 1,100 conference presentations and 150 invited presentations at various institutions. He holds four patents.

Y.C. Fung Young Investigator Award

TRIANTAFYLLOS STYLIANOPOULOS

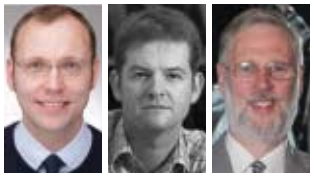
The Y.C. Fung Young Investigator Award, established in 1985, recognizes a young investigator who is committed to pursuing research in bioengineering and has demonstrated significant potential to make substantial contributions to the field.

Triantafyllos Stylianopoulos, Ph.D., an assistant professor of mechanical engineering and the head of the Cancer Biophysics Laboratory at the University of Cyprus in Nicosia, is recognized for outstanding research on the fluid and solid mechanics of tumors and on the design of novel drug delivery systems to enhance therapy; and for educating and mentoring students, and contributing to the profession through service activities.

Following postdoctoral training, Dr. Stylianopoulos joined UCY in 2010. He has secured more than $2.4 million in research funding, mainly from the European Commission, including a highly selective $1.6 million starting grant from the European Research Council.

Gas Turbine Award

ROBERT P. GREWE
ROBERT J. MILLER
HOWARD P. HODSON



Established in 1963, the Gas Turbine Award recognizes outstanding contributions to the literature of combustion gas turbines or gas turbines thermally combined with nuclear or steam power plants. The award is sponsored by the ASME International Gas Turbine Institute.

Robert P. Grewe, Dr.-Ing., an aerodynamic specialist at Siemens' Power and Gas Division in Muelheim an der Ruhr, Germany; Robert J. Miller, D.Phil., professor of aerothermal technology at the University of Cambridge, U.K., and the director of the Rolls-Royce University Technology Centre at Cambridge's Whittle Laboratory; and Howard P. Hodson, Ph.D., are recognized for the paper titled "The Effect of Endwall Manufacturing Variations on Turbine Performance."

Following submission of his doctoral thesis (same title as recognized paper) in December 2013, Dr. Grewe remained at the University of Cambridge, U.K., as a postdoctoral research associate. With Siemens since March 2015, he focuses on aerodynamic methods.

Dr. Miller's research at Cambridge covers a wide range of flows in aero engines, gas turbines, tidal turbines and domestic appliances. He works extensively with industry, presently undertaking collaborative research projects with Rolls-Royce, Mitsubishi, Siemens and Dyson.

Educated at Cambridge, Dr. Hodson continued to work at the Whittle Laboratory after earning his Ph.D. in turbomachinery in 1983. He retired from the position of chair of aerothermal technology in 2012.

Heat Transfer Memorial Awards

The Heat Transfer Memorial Award was established in 1959 by the Heat Transfer Division. In 1974, it was elevated to a Society award recognizing outstanding contributions to the field of heat transfer through teaching, research, practice and design, or a combination of such activities.

BRENT W. WEBB – SCIENCE

Brent W. Webb, Ph.D., academic vice president and professor of mechanical engineering at Brigham Young University in Provo, Utah, is recognized for outstanding research contributions in the field of gas radiation, jet impingement and microscale convection; for developing methods that have significantly affected the practice of gas radiation modeling; and for teaching the foundational principles of heat transfer to

more than 2,100 students.

A member of the faculty at BYU since 1986, Dr. Webb has spent nearly half of his career in university administration. He has been a research advisor for 30 master's and 12 Ph.D. students, and three postdoctoral fellows; and has been principal/co-principal investigator for over $6 million in research activity.

RAJ M. MANGLIK – ART

Raj M. Manglik, Ph.D., a professor of mechanical engineering and the director of the Thermal-Fluids and Thermal Processing Laboratory at the University of Cincinnati, is recognized for the pioneering and seminal advancement of the science and engineering of interfacial transport phenomena, boiling, thermal processing of non-Newtonian media, enhanced heat transfer and microscale compact heat exchangers, leading to transformative contributions to archival literature as well as engineering design practice.

Dr. Manglik joined the faculty at UC in 1991. He has obtained nearly $8.5 million in funding from various highly competitive sponsors. Among his more than 250 publications is the co-authored classical and acclaimed textbook titled "Principles of Heat Transfer."

JAYATHI Y. MURTHY – GENERAL

Jayathi Y. Murthy, Ph.D., dean of the Henry Samueli School of Engineering and Applied Science at the University of California, Los Angeles, is recognized for significant contributions to the development of advanced computational techniques for flow, heat and mass transfer across scales; and the translation of these techniques into software that has transformed industrial practice and enhanced the understanding of heat transfer in emerging technologies.

Dr. Murthy became dean on January 1, 2016. Her prior experience includes positions in both industry (Fluent Inc.–1988-98) and academia (various beginning in 1984). She also served as director of PRISM (2008-14), a large National Nuclear Security Administration-funded center dedicated to uncertainty quantification in microsystems.

Mayo D. Hersey Award

IZHAK ETSION

The Mayo D. Hersey Award, established in 1965, is bestowed for distinguished and continued contributions over a substantial period of time to the advancement of the science and engineering of tribology. Distinguished contributions may result from significant original research in one or more of the many scientific disciplines related to lubrication.

Izhak Etsion, D.Sc., professor emeritus at Technion–Israel Institute of Technology in Haifa, is honored for distinguished contributions to the fields of tribology, contact mechanics and lubrication including the creation of groundbreaking elastic-plastic contact models and pioneering research on surface texturing for hydrodynamic lubrication.

Educated at Technion, Dr. Etsion joined the faculty after earning his doctoral degree in 1974. Since 2010 he is professor emeritus. In 1996 Dr. Etsion invented laser surface texturing, now recognized worldwide as a promising technology for energy conservation. He also made original contributions in micro/nano tribology and in biotribology.

Patrick J. Higgins Medal

FRANK BAKOS

The Patrick J. Higgins Medal recognizes an individual who has contributed to the enhancement of standardization through contributions to the development and promotion of ASME codes and standards or Conformity Assessment Programs. It was established in 2007 in remembrance of ASME's past vice president of the standardization department.

Frank Bakos, president of Frank Bakos Associates in Maryville, Tenn., is recognized for outstanding dedication and effectiveness in developing and promoting a broad range of standards spanning geometric dimensioning and tolerancing, and engineering specifications; and for consensus building leadership to align national and international standards development in these areas.

Mr. Bakos started his own consulting firm in 1988. Among his prior positions, he was a GD&T specialist at Eastman Kodak Company. Mr. Bakos has been an ASME GD&T subcommittee member since 1983, and he has served in numerous related leadership roles.

Soichiro Honda Medal

BAHRAM KHALIGHI

The Soichiro Honda Medal recognizes an individual for an outstanding achievement or a series of significant engineering contributions in developing improvements in the field of personal transportation. This medal was established in 1983 in recognition of Soichiro Honda's exemplary achievements in the field of personal transportation.

Bahram Khalighi, Ph.D., a manager and technical fellow in the Vehicle Systems Research Laboratory at General Motors Global Research & Development in Warren, Mich., is recognized for career efforts that have produced impactful innovations and inventions in the areas of automotive vehicle aerodynamics, thermal management, fluid flows, engine flows and combustion.

Dr. Khalighi has been conducting basic and applied research since joining GM in 1984. He currently holds 18 U.S. patents, with others pending.

Internal Combustion Engine Award

TERRENCE F. ALGER II

The Internal Combustion Engine Award, established in 1966, is given in recognition of eminent achievement or distinguished contribution over a substantial period of time, which may result from research, innovation or education in advancing the art of engineering in the field.

Terrence F. Alger II, Ph.D., the director of spark ignited engine research and development in the Engine, Emissions and Vehicle Research Division at Southwest Research Institute in San Antonio, is recognized for exceptional technical and business leadership that has led to multiple innovations in internal combustion engine technologies and the transition of these innovations to production engines for significant real-world impact on vehicle fuel economy.

Dr. Alger joined SwRI in 2003 and has been in his current position since 2014. He holds 20 patents and has published more than 50 papers on topics covering engine efficiency and emissions.

Warner T. Koiter Medal

PEDRO PONTE-CASTAÑEDA

The Warner T. Koiter Medal was established in 1996 to recognize distinguished contributions to the field of solid mechanics with special emphasis on the effective blending of theoretical and applied elements, and on a high degree of leadership in the international solid mechanics community. The medal honors the late Dr. Warner T. Koiter, world-renowned authority in the field of solid mechanics, and it commemorates his vast contributions as research engineer and teacher.

Pedro Ponte-Castañeda, Ph.D., Raymond S. Markowitz faculty fellow and a professor in the department of mechanical engineering and applied mechanics, and a member of the graduate group in applied mathematics and computational science at the University of Pennsylvania in Philadelphia, is recognized for distinguished contributions as a world leader in the development of theoretical tools, with practical importance, for the analysis of the nonlinear response of composite materials.

Dr. Ponte-Castañeda has been a member of the faculty at Penn since 1990. He has held numerous visiting positions in Europe.

Robert E. Koski Medal

KIM A. STELSON

The Robert E. Koski Medal recognizes an individual who has advanced the art and practice of fluid power motion and control through education and/or innovation. It was established in 2007 by the Fluid Power Systems and Technology Division to honor Mr. Koski's contributions to the field of design engineering and dynamic systems and control.

Kim A. Stelson, Sc.D., College of Science and Engineering distinguished professor in the department

of mechanical engineering at the University of Minnesota in Minneapolis, is honored for sustained and inspiring leadership of the Center for Compact and Efficient Fluid Power, the largest concentration of fluid power research in the United States, which is changing the way fluid power is researched, applied and taught.

A member of the faculty at U of M since 1981, Dr. Stelson has also been director of the National Science Foundation-funded CCEFP since its inception in 2006.

Allan Kraus Thermal Management Medal

RAVI MAHAJAN

The Allan Kraus Thermal Management Medal, established in 2009, recognizes individuals who have demonstrated outstanding achievements in thermal management of electronic systems and their commitment to the field of thermal science and engineering.

Ravi Mahajan, Ph.D., a senior principal engineer at Intel Corporation in Chandler, Ariz., is recognized for outstanding leadership in establishing and delivering the cooling technology solutions roadmap for high-power microprocessors in mobile, desktop and server systems; and for developing effective university–industry collaborations to enable advanced experimental and analytical techniques in semiconductor thermal management.

Dr. Mahajan is in the path finding group, part of Intel's Assembly and Test Technology Development. He is Intel's representative on the Semiconductor Research Corporation's technical advisory board. Dr. Mahajan holds several patents in the area of microelectronics packaging.

Frank Kreith Energy Award

ALDO STEINFELD

The Frank Kreith Energy Award was established in 2005 to honor an individual for significant contributions to a secure energy future with particular emphasis on innovations in conservation and/or renewable energy. Contributions may be through research, education, practice, or significant service to society that will lead to a sustainable energy future. The award was established by the Solar Energy and Advanced Energy divisions to honor Dr. Frank Kreith's contributions to solar energy and heat transfer, and was funded by Holocaust Settlement Claim No. 4931 for Nazi victims and by the Kreith family.

Aldo Steinfeld, Ph.D., a professor in the department of mechanical and process engineering at ETH Zurich, where he holds the chair of renewable energy carriers, is honored for outstanding scholastic contributions to solar energy education through teaching and mentoring, scientific research, service as journal editor, and the supervision of more than 35 Ph.D. and 200 M.Sc. theses in the field of applied thermodynamics and solar engineering.

Dr. Steinfeld has authored more than 300 papers in refereed journals, and he holds 28 patents.

Bernard F. Langer Nuclear Codes and Standards Award

CHARLES BRUNY

The Bernard F. Langer Nuclear Codes and Standards Award was established in 1977 and is presented to an individual who has contributed to the nuclear power plant industry through the development and promotion of ASME nuclear codes and standards or the ASME Nuclear Certification Program.

Charles Bruny is recognized for key contributions to various codes and standards efforts as an active ASME committee member for more than 40 years; and for providing component design and analysis expertise to Nuclear Codes and Standards colleagues.

Mr. Bruny retired from Babcock & Wilcox Co. in Lynchburg, Va., in 2006 after 40 years of service that included a two-year military leave early in his career, when he served as a lieutenant in the U.S. Army Corps of Engineers. Mr. Bruny began serving on ASME Boiler and Pressure Vessel Code committees in 1974.

Gustus L. Larson Memorial Award

KENNETH T. CHRISTENSEN

The Gustus L. Larson Memorial Award was established in 1974 and honors Gustus L. Larson, Fellow and founder of Pi Tau Sigma. It is awarded to the engineering graduate who has demonstrated outstanding achievement in mechanical engineering within 10 to 20 years following graduation.

Kenneth T. Christensen, Ph.D., assistant dean of faculty development in the College of Engineering, and a professor and the collegiate chair in fluid mechanics in the department of aerospace and mechanical engineering, and the department of civil and environmental engineering and earth sciences at the University of Notre Dame in Indiana, is honored for outstanding achievements in mechanical engineering.

At Notre Dame since 2014, Dr. Christensen directs a research program that pursues experimental studies of turbulence, geophysical flows and microfluidics with significant practical importance in engineering applications. He is also a World Premier Institute principal investigator in the Carbon Dioxide Storage Division of the International Institute for Carbon-Neutral Energy Research (I^2CNER) based at Kyushu University in Japan.

H.R. Lissner Medal

ROGER C. HAUT

The H.R. Lissner Medal was established in 1977 and is presented for outstanding accomplishments in the area of bioengineering.

Roger C. Haut, Ph.D., a university distinguished professor in the departments of radiology and mechanical engineering at Michigan State University in East Lansing, and director of the Orthopaedic Biomechanics Laboratories in the MSU College of Osteopathic Medicine, is honored for long-term bioengineering contributions through the development and implementation of innovative methods of basic engineering science to the fields of impact trauma and orthopaedics.

While most of Dr. Haut's career has been devoted to studies related to automobile and athletic injuries, more recent research has focused on forensics as related to pediatric cranial and long bone traumas. Prior to joining the faculty at MSU in 1986, he was with GM Research Laboratories in Warren, Mich.

Machine Design Award

SUNIL K. AGRAWAL

The Machine Design Award, established in 1958, recognizes eminent achievement or distinguished service in the field of machine design.

Sunil K. Agrawal, Ph.D, a professor of mechanical engineering and director of the Robotics and Rehabilitation Laboratory at Columbia University in New York, is honored for seminal contributions to the field of machine design through the innovative design of robotic exoskeletons for gait retraining of stroke patients and of mobility-assist robots for the training of developmentally delayed infants and toddlers.

Prior to joining the faculty at Columbia in 2013, Dr. Agrawal was a professor of mechanical engineering and director of the Mechanical Systems Laboratory and Rehabilitation Robotics Laboratory at the University of Delaware in Newark. He co-holds 13 patents.

Charles T. Main Student Leadership Awards

The Charles T. Main Award was established in 1919 to recognize, at the Societywide level, an undergraduate ASME student member whose leadership and service qualities have contributed, for a period of more than one year, to the programs and operations of a Student Section. In 1983, the award was expanded to include a second-place award.

HIND HAJJAR – GOLD

Hind Hajjar, a part-time research assistant at the American University of Beirut's Munib and Angela Masri Institute of Energy and Natural Resources, is recognized for dedicated ASME efforts including service

as vice chair of the Student Section at AUB; and for assisting more than 20 university sections as student regional chair for Africa and the Middle East.

Ms. Hajjar earned her bachelor's degree in mechanical engineering from AUB in May 2016. Since May she has been serving on an ASME Task Force on increasing membership engagement for students and early career engineers.

EDUARDO GUEVARA – SILVER

Eduardo Guevara, CEO of Volition Co. and manager of the Operations and Logistics Division of SAK Shop.Arch.Kids, both in Mexico City, is recognized for contributions to ASME including service as chair of the Student Section at the National and Autonomous University of Mexico, chair of the Student Section Enterprise Committee for Mexico, and event director for HPVC Mexico and Latin America.

Mr. Guevara earned his bachelor's degree in mechanical engineering from UNAM in June 2016. An entrepreneur, he founded two companies while pursuing his education; Volition Co., his second endeavor, now designs and manufactures carbon fiber products.

McDonald Mentoring Award

LUCIANO CASTILLO

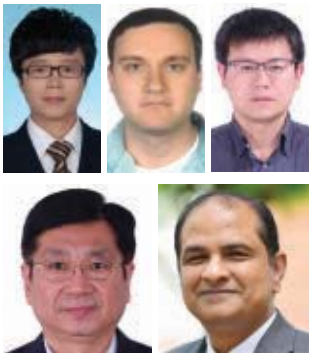
The McDonald Mentoring Award, established in 2007, recognizes the outstanding mentoring of other professionals by an engineer in industry, government, education or private practice.

Luciano Castillo, Ph.D., the Don-Kay-Clay Cash distinguished engineering chair in wind energy at Texas Tech University in Lubbock, is honored for dedicated mentoring of underrepresented students, including K-12, and faculty in STEM fields; and for initiating unique programs that have opened new opportunities for an inclusive population of students and faculty.

Dr. Castillo joined the mechanical engineering department at TTU as a strategic cluster hire in 2011. He was founding director of the National Wind Resource Center until 2014. From 1999 to 2011 he was at Rensselaer Polytechnic Institute in Troy, N.Y.

Melville Medal

XIANBO LIU
NICHOLAS VLAJIC
XINHUA LONG
GUANG MENG
BALAKUMAR BALACHANDRAN



The Melville Medal was first awarded in 1927 and is the highest honor for the best original technical paper published in the *ASME Transactions* in the past two years.

Xianbo Liu, a master's and Ph.D. candidate at Shanghai Jiao Tong University; Nicholas Vlajic, Ph.D., a staff scientist at the National Institute of Standards and Technology in Gaithersburg, Md.; Xinhua Long, Ph.D., an associate professor in the School of Mechanical Engineering at Shanghai Jiao Tong University; Guang Meng, Ph.D., a chair professor in the School of Mechanical Engineering at Shanghai Jiao Tong University; and Balakumar Balachandran, Ph.D., a Minta Martin professor of engineering and a faculty member of the applied mathematics and scientific computation program at the University of Maryland in College Park, are recognized for the paper titled "State-Dependent Delay Influenced Drill-String Oscillations and Stability Analysis."

Mr. Liu expects to earn his degrees in mechanical engineering from SJTU in November 2016. His research interests include nonlinear phenomena, time-delay effects, rotor dynamics, vibrations and control in mechanical systems, with a recent focus on the complex dynamics of deep-hole drilling systems used for oil and gas exploration.

Dr. Vlajic's research interests are in dynamics, vibrations and controls, with particular emphasis on applications in precision metrology. He is currently working in the area of dynamic force metrology at NIST.

Dr. Long joined the faculty at SJTU in 2006. His research interests include vibrations, nonlinear dynamics and control, with recent efforts focused on the nonsmooth and delay effects on the vibrations of a mechanical system.

Dr. Meng's research interests at SJTU include vibrations, rotor dynamics, smart materials, nonlinear dynamics and control. He has authored/co-authored nearly 300 journal papers, and authored a book titled "Micro-Electromechanical System Dynamics."

A member of the faculty at UMD since 1993, Dr. Balachandran's research interests include nonlinear phenomena, dynamics and vibrations, and control. Among his publications are two co-authored textbooks and a co-edited book, and he holds five patents.

M. Eugene Merchant Manufacturing Medal of ASME/SME

JYOTIRMOY MAZUMDER

The M. Eugene Merchant Manufacturing Medal was established in 1986 by ASME and SME to honor an exceptional individual who has had significant influence and responsibility for improving the productivity and efficiency of the manufacturing operation.

Jyotirmoy Mazumder, Ph.D., the Robert H. Lurie professor of engineering in the department of mechanical engineering and materials science, and director of the Center for Laser Aided Intelligent Manufacturing at the University of Michigan in Ann Arbor, is recognized for outstanding contributions to manufacturing operations, particularly productivity and quality improvements, as a creative inventor, foremost scholar and educator, prolific author, scientist and pioneering leader in quality assured manufacturing and closed-loop metallic additive manufacturing.

Dr. Mazumder holds 20 U.S. patents. Some of his laser welding patents are licensed to Ford Motor Company. He has published more than 375 papers, co-authored two books and edited/co-edited 10 books.

Van C. Mow Medal

BETH A. WINKELSTEIN

The Van C. Mow Medal was established by the ASME Bioengineering Division in 2004. It is presented for significant contributions to the field of bioengineering through research, education, professional development, leadership in the development of the profession, mentoring of young bioengineers, and service to the bioengineering community.

Beth A. Winkelstein, Ph.D., vice provost for education, and professor of bioengineering and neurosurgery at the University of Pennsylvania in Philadelphia, is recognized for scholarly contributions through research dedicated to elucidating the mechanisms of subfailure cervical spine injuries and the cellular events surrounding the etiology of chronic pain; and for dedication as an educator and mentor, and in service to the profession.

Dr. Winkelstein's work is multidisciplinary, melding engineering and biology to bridge the gaps between basic neuroscience, tissue biomechanics and clinical application. She joined the faculty at Penn in 2002.

Nadai Medal

YONGGANG HUANG

The Nadai Medal was established in 1975 to recognize significant contributions and outstanding achievements which broaden the field of materials engineering.

Yonggang Huang, Ph.D., the Walter P. Murphy professor at Northwestern University in Evanston, Ill., is recognized for fundamental and applied contributions to transient electronics and materials.

Dr. Huang joined the faculty at Northwestern in 2007. His recent research focuses on stretchable and curvilinear electronics for biomedical applications, transient electronics that can dissolve at a programmed rate/triggered time, and mechanics-

driven deterministic 3-D assembly. He has authored/co-authored nearly 500 journal papers.

Burt L. Newkirk Award

AARON GRECO

The Burt L. Newkirk Award was established in 1976 and is presented to an individual who has made a notable contribution in tribology research or development, as evidenced by important tribology publications prior to his or her 40th birthday.

Aaron Greco, Ph.D., a principal materials scientist in the Energy Systems Division at Argonne National Laboratory in Illinois, is honored for notable contributions to the field of tribology through scientific publications and presentations, leadership roles in professional societies, and as a technical ambassador for the field through roles in project management and science policy.

With Argonne since 2010, Dr. Greco currently leads projects that focus on improving the reliability of wind turbine drivetrains through advanced tribological testing and materials. His other research areas include surface engineering, nanocolloidal lubricant additives and contact failure investigation.

Edward F. Obert Award

SARA COSENTINO
ADRIANO SCIACOVELLI
VITTORIO VERDA

The Edward F. Obert Award was established in 1987 by the Advanced Energy Systems Division to recognize an outstanding paper on thermodynamics. It was elevated to a Society award in 1996.

Sara Cosentino, a Ph.D. student at Politecnico di Torino in Italy; Adriano Sciacovelli, Ph.D., a research fellow at the Birmingham Centre for Energy Storage within the School of Chemical Engineering at the University of Birmingham, U.K.; and Vittorio Verda, Ph.D., a professor in the energy department at Politecnico di Torino in Italy, are recognized for the paper titled "Thermoeconomic Design of Borehole Thermal Energy Storage Systems."

Ms. Cosentino earned her master's degree in energy and nuclear engineering from Politecnico in 2013 and is currently pursuing a Ph.D. in energetics in the energy department. She gives lectures in a course on applied energy and collaborates on research projects funded by various industrial companies.

Prior to his position at Birmingham, Dr. Sciacovelli was a research associate (2010-14) at Politecnico di Torino. His research focuses on the formulation of material for thermal energy storage and the design of thermal storage devices, and their optimal integration into energy systems. He closely collaborates with both academic partners and industrial stakeholders.

In addition to teaching at the graduate level at Politecnico and performing research in a number of different areas of thermodynamics and heat transfer, Dr. Verda is the coordinator for two European projects in the energy department's research group and for the department's Student Mobility Program. He is chair of the ASME Advanced Energy Systems Division's Executive Committee (2016-17).

Old Guard Early Career Award

NATHANIEL TAYLOR

The Old Guard Early Career Award was established in 1994 to help the young engineer bridge the gap between college and professional life. Its intent is to bring that individual closer to the activities of ASME by providing encouragement for graduating student members to upgrade to member and actively become involved in the work of the Society.

Nathaniel Taylor, EIT, Ph.D., a lecturer in engineering sciences at the Harvard John A. Paulson School of Engineering and Applied Sciences in Cambridge, Mass., is recognized for more than eight years of inspirational leadership within ASME that has had an impact on young engineers; and for extraordinary qualifications for a career in academia that will have a long-term impact on the profession.

Dr. Taylor completed his education at Drexel University in Philadelphia, earning his Ph.D. in mechanical engineering in September 2016. Among his ASME service, he was chair of the Student Section at Drexel (2009-10); and, as of 2016, is chair of the Human Powered Vehicle Challenge Committee.

Rufus Oldenburger Medal

JEAN-JACQUES SLOTINE

The Rufus Oldenburger Medal was established in 1968 and is given in recognition of significant contributions and outstanding achievements in the field of automatic control.

Jean-Jacques Slotine, Ph.D., professor of mechanical engineering and information sciences, and brain and cognitive sciences at the Massachusetts Institute of Technology in Cambridge, is honored for significant contributions to control theory of nonlinear systems and robotics through seminal work on sliding mode control, adaptive nonlinear control and contraction analysis, which have influenced engineers and scientists worldwide.

Dr. Slotine joined the faculty at MIT in 1984. One of the most cited researchers in both systems science and robotics, he has published more than 80 peer-reviewed archival journal papers and over 100 conference papers, and is co-author of two popular graduate textbooks. Dr. Slotine holds five U.S. and two German patents.

Outstanding Student Section Advisor Award

KOK-KEUNG LO

The Outstanding Student Section Advisor Award, established in 1990 as the Faculty Advisor Award, is awarded to an ASME member who is a current or former Student Section advisor whose leadership and service qualities have contributed, for at least three years, to the programs and operations of a Student Section of the Society.

Kok-Keung Lo, CEng, R.P.E., an expert witness (self-employed), is recognized for more than 10 years of outstanding service as advisor for the ASME Student Section at The Hong Kong Polytechnic University, inspiring students through dedicated leadership and endless encouragement.

Mr. Lo served as ASME Student Section advisor at PolyU from 2002 until his retirement in 2015 after 40 years as a faculty member. Since 1994 he has been serving as an expert witness in the Hong Kong courts of law, providing testimony and evidence related to accidents and mechanical engineering defects.

Performance Test Codes Medal

MATTHEW J. DOOLEY

The Performance Test Codes Medal, established in 1981, is awarded to an individual or individuals who have made outstanding contributions to the development and promotion of ASME Performance Test Codes, including the Supplements on Instruments and Apparatus.

Matthew J. Dooley, CEM, P.E., an independent consultant with Horizon Engineering, LLC in Granby, Conn., is recognized for significant contributions to performance test codes, particularly for the testing of overall power plant performance; and for exceptional efforts in the area of steam generator performance testing.

Throughout his nearly 40 years in the power generation industry, Mr. Dooley has been active in the testing, analysis and optimization of a variety of power generation equipment. He previously held positions at Combustion Engineering, ABB, Alstrom Power and GE Power.

Marshall B. Peterson Award

HARMANDEEP S. KHARE

The Marshall B. Peterson Award, established in 1997, is given to a young engineer in recognition of an early-career achievement and for promising research within the field of tribology.

Harmandeep S. Khare, Ph.D., manager of research projects at the

University of Pennsylvania in Philadelphia, is recognized for fundamental, multiscale, in situ research on the tribology of solid and liquid lubricants including interfacial tribofilm formation, nanoparticle additive anti-wear behavior and instrument development; and for active engagement in the engineering community including organizing research symposia, providing research mentoring and through public outreach.

After earning his Ph.D. in mechanical engineering from the University of Delaware in Newark in 2014, Dr. Khare joined the Carpick Nanotribology Group at Penn as a postdoctoral research associate. His current position is in the lab of Dr. Robert W. Carpick.

Pi Tau Sigma Gold Medal

DAVID L. HENANN

The Pi Tau Sigma Gold Medal was established in 1938 by Pi Tau Sigma in coordination with ASME to recognize outstanding achievements by a young engineering graduate in mechanical engineering within 10 years following receipt of the baccalaureate degree.

David L. Henann, Ph.D., an assistant professor of engineering in solid mechanics at Brown University in Providence, R.I., is recognized for outstanding achievements in mechanical engineering.

Over the last 10 years Dr. Henann's research has focused on the modeling of amorphous materials such as metallic glasses, granular materials and polymeric elastomers; and addressing issues of large deformations, material time-dependence, size effects and multi-physics coupling. He has been at Brown since 2013.

James Harry Potter Gold Medal

DEREK BRADLEY

The James Harry Potter Gold Medal was established in 1980 in recognition of eminent achievement or distinguished service in the appreciation of the science of thermodynamics and its applications in mechanical engineering.

Derek Bradley, Ph.D., a research professor in the School of Mechanical Engineering at the University of Leeds, U.K., is recognized for outstanding contributions to the fundamental and applied developments on lean combustion and thermodynamic performance, which has resulted in improved design of engines and power plants; and for lifelong dedication to the education of students.

Educated at Leeds, Dr. Bradley has been a member of the faculty since 1955 and has held his current position since 1992. He has also contributed as a consultant in the area of fire and explosion hazards, and in the general area of combustion.

Prime Movers Committee Award

WEIZHONG FENG

The Prime Movers Committee Award, established in 1954, recognizes outstanding contributions to the literature of thermal electric station practice or equipment which are available through public presentation and publication.

Weizhong Feng, general manager, Shanghai Waigaoqiao No. 3 Power Generation Co., Ltd. in Shanghai, is recognized for the paper titled "Developing Green, Highly Efficient Coal-Fired Power Technologies."

Concurrently Mr. Feng serves as general manager of Shanghai Shenergy Energy Technology Co., Ltd. He is also an adjunct professor at three universities. Previously he was in charge of the engineering and construction of Shanghai Waigaoqiao Phases I, II and III. Mr. Feng holds 42 patents and has published 45 academic studies.

Dixy Lee Ray Award

JERALD L. SCHNOOR

The Dixy Lee Ray Award, established in 1998, recognizes significant achievements and contributions in the broad field of environmental protection. It honors not only those who have contributed to the enhancement of environmental engineering, but also those who have contributed to disciplines outside environmental engineering where accomplishments have indirectly impacted environmental protection.

Jerald L. Schnoor, P.E., Ph.D., the Allen S. Henry chair professor in engineering at The University of Iowa in Iowa City, is honored for groundbreaking research on phytoremediation that led to the cost-effective degradation of organic chemicals in the environment; for research and practice leading to more sustainable water supplies; and for modeling the effects of acid precipitation that contributed to the passage of the Clean Air Act of 1990.

Dr. Schnoor joined the College of Engineering faculty at UI in 1977. He co-founded the university's Center for Global and Regional Environmental Research in 1990 and serves as co-director.

Charles Russ Richards Memorial Award

KENNETH E. GOODSON

The Charles Russ Richards Memorial Award, established in 1944, was named in honor of a founder of Pi Tau Sigma. It is given to an engineering graduate who has demonstrated outstanding achievement in mechanical engineering for 20 years or more following graduation.

Kenneth E. Goodson, Ph.D., the Davies family provostial professor and the Robert Bosch chairman of the mechanical engineering department at Stanford University in California, is honored for outstanding achievements in mechanical engineering.

Dr. Goodson joined the faculty at Stanford in 1994. He is a heat transfer specialist with interests ranging from electronics cooling to waste heat harvesting. His lab pioneered phonon free path measurements using silicon nanolayers and has highly cited papers on conduction physics and metrology, novel conduction materials and microfluidic heat sinks. Current projects are extending the extreme heat flux limits for power electronics and exploring thermoelectric-powered silicon sensors for buildings. Dr. Goodson holds 34 patents.

Safety Codes and Standards Medal

MICHAEL MILLS

The Safety Codes and Standards Medal was established in 1986 to recognize contributions to the enhancement of public safety through the development and promotion of ASME safety codes and standards or through ASME safety accreditation activity.

Michael Mills, ARM, CRIS, CSP, technical director for construction and energy at Liberty Mutual Insurance in Boston, is recognized for dedication to the enhancement of public safety in the load handling industry; and for leadership in improving load handling practices, and in the establishment of the P30 Committee and the development of the Planning for Load Handling Activities Standard.

With Liberty Mutual since 1987, Mr. Mills is currently responsible for overseeing technical quality of the risk control services provided to customers in the construction and energy sectors nationwide. He has been active on various ASME standards committees since 2000.

R. Tom Sawyer Award

NICHOLAS CUMPSTY

The R. Tom Sawyer Award, established in 1972, is bestowed upon an individual who has made important contributions toward the advancement of the gas turbine industry, as well as the ASME International Gas Turbine Institute, over a substantial period of time.

Nicholas Cumpsty, Ph.D., emeritus professor at Imperial College London, is honored for outstanding contributions to the gas turbine industry through compressor aerodynamics research and university laboratory leadership, the publication of exemplary texts for students and practicing engineers, technological advancements for a major gas turbine manufacturer, and unceasing efforts to achieve technical excellence within IGTI and the ASME journals.

Emeritus professor at Imperial since 2008, Dr. Cumpsty was previously with Rolls-Royce Ltd. (1969-72; 2000-05) and the University of Cambridge (1972-2000). He continues to

contribute to research at Imperial and at Cambridge's Whittle Laboratory; and works with the Osney Thermo-Fluids Laboratory at the University of Oxford and the Gas Turbine Laboratory at the Massachusetts Institute of Technology.

Milton C. Shaw Manufacturing Research Medal

STEVEN Y. LIANG

The Milton C. Shaw Manufacturing Research Medal, established in 2009, recognizes significant fundamental contributions to the science and technology of manufacturing processes.

Steven Y. Liang, Ph.D., the Morris M. Bryan Jr. professor of advanced manufacturing systems at the Georgia Institute of Technology in Atlanta, is honored for significant contributions to manufacturing science and technology through studies on physics-based analysis and modeling of machining and grinding processes.

A member of the faculty at Georgia Tech since 1990, Dr. Liang has held his current position since 2005. His research, with the involvement of a large number of academic advisees, has led to the publication of more than 400 archival articles including 86 papers and two books in just the last three years alone.

Ben C. Sparks Medal

ALLEN H. HOFFMAN

The Ben C. Sparks Medal, established in 1990, recognizes eminent service by an individual or collaborative team in promoting innovative, authentic, practice-based, engineering design/build experiences in undergraduate mechanical engineering or mechanical engineering technology education.

Allen H. Hoffman, P.E., Ph.D., a professor of mechanical engineering at Worcester Polytechnic Institute in Massachusetts, is recognized for long-term leadership in the development and implementation of the WPI Plan, an undergraduate project-based, experiential design education curriculum; and for numerous publications that describe the methods and outcomes of student projects that solve real-world problems.

A member of the faculty at WPI since 1970, Dr. Hoffman currently serves as group leader of the design faculty within the mechanical engineering department. In 1999 he cofounded WPI's Assistive Technology Resource Center; the center solicits projects from agencies that provide services to persons with disabilities, and students develop devices as part of their academic programs.

Ruth and Joel Spira Outstanding Design Educator Award

KATHRYN W. JABLOKOW

The Ruth and Joel Spira Outstanding Design Educator Award was established as a division award in 1998. Elevated to a Society award in 2001, it recognizes a person who exemplifies the best in furthering engineering design education.

Kathryn W. Jablokow, Ph.D., an associate professor of mechanical engineering and engineering design at The Pennsylvania State University's Great Valley School of Graduate Professional Studies in Malvern, is recognized for significant and sustained contributions to design education and innovation research, design education in residence and online programs, and the development of a new multidisciplinary engineering design degree program.

Dr. Jablokow now directs the multidisciplinary engineering design option of Penn State's undergraduate general engineering degree. Her groundbreaking research on cognition-based design, ideation flexibility and engineering innovativeness is supported by multiple grants from the National Science Foundation. She has been with Penn State since 1990.

Spirit of St. Louis Medal

INDERJIT CHOPRA

The Spirit of St. Louis Medal was established in 1929 by Philip D. Ball, ASME members and citizens of St. Louis. It is awarded for meritorious service in the advancement of aeronautics and astronautics.

Inderjit Chopra, Sc.D., the Alfred Gessow professor in aerospace engineering, distinguished university professor and director of the Alfred Gessow Rotorcraft Center at the University of Maryland in College Park, is honored for seminal contributions to rotorcraft aeromechanics that led to the development of smart rotor systems with active flaps capable of vibration reduction; for the development of innovative micro aerial vehicles; and for leadership in rotorcraft education and the innovative design of human powered helicopters.

Dr. Chopra has been a member of the faculty at UMD since 1981. His direct graduate advising has resulted in 50 Ph.D. and 91 master's degrees, and his students now hold key positions in the rotorcraft industry, in academia and at federal labs.

J. Hall Taylor Medal

JON E. BATEY

The J. Hall Taylor Medal was established in 1965 by the ASME Codes and Standards Board as a gift from Taylor Forge and Pipe Works to commemorate the pioneering work of J. Hall Taylor in the standardization of industrial products and safety codes for their usage. It is awarded for distinguished service or eminent achievement in the codes and standards area pertaining to the broad fields of piping and pressure vessels.

Jon E. Batey is honored for distinguished leadership and professionalism in the technical advancement of ASME codes and standards for nondestructive examination and postconstruction of pressure components; and for dedication to engineering and public safety as evidenced by committed service on ASME standards development committees.

Mr. Batey retired from The Dow Chemical Company on September 30, 2016 with 35 years of service with Union Carbide Corporation and, following the 2001 merger, Dow. Concurrently, he spent 26 years as a reservist in the U.S. Navy Seabees, retiring as a master chief petty officer in August 2013.

Robert Henry Thurston Lecture Award

ROMESH C. BATRA

The Robert Henry Thurston Lecture Award was established in 1925 in honor of ASME's first president. It provides an opportunity for a leader in pure and/or applied science or engineering to present to the Society a lecture that encourages stimulating thinking on a subject of broad interest to engineers. The Robert Henry Thurston Lecture Award was elevated to a Society award in 2000.

Romesh C. Batra, Ph.D., Clifton C. Garvin professor at Virginia Polytechnic Institute and State University in Blacksburg, is honored for outstanding contributions to the understanding of the physics of adiabatic shear banding phenomenon including proposing shear band initiation criterion, thermomechanical material models and shear band width definition, and delineating the effects of material parameters on its acceleration and deceleration.

Dr. Batra's work has wide-ranging applications in both defense and civilian industries including improved design of armor and anti-armor components, and lightweight composites. He has been a member of the faculty at Virginia Tech since 1994.

Timoshenko Medal

RAY OGDEN

The Timoshenko Medal was established in 1957 and is conferred in recognition of distinguished contributions to the field of applied mechanics. Instituted by the Applied Mechanics Division, it honors Stephen P. Timoshenko, world-renowned authority in the field, and it commemorates his contributions as author and teacher.

Ray Ogden, Ph.D., the George Sinclair professor of mathematics at the University of Glasgow, U.K., is honored for distinguished work that transformed the research area of nonlinear elasticity into a well-established discipline; and for stimulating the work of a large number of practitioners in the multiphysical

behavior of materials and modeling in biomechanics.

Dr. Ogden has held his current position at Glasgow since 1984 with the exception of two years (2010-12) as sixth century chair in solid mechanics at the University of Aberdeen, U.K. He has published more than 250 papers in international journals, and several books.

Worcester Reed Warner Medal

ISAAC ELISHAKOFF

The Worcester Reed Warner Medal was established in 1930 and is awarded for outstanding contributions to the permanent literature of engineering. Contributions may be single papers, treatises or books, or a series of papers.

Isaac Elishakoff, Ph.D., distinguished research professor in the department of ocean and mechanical engineering at Florida Atlantic University in Boca Raton; and visiting distinguished professor in the faculty of civil engineering at Technion–Israel Institute of Technology in Haifa, is honored for seminal contributions to the permanent literature of engineering research through highly praised books on probabilistic theory of structures, elastic stability, the stochastic finite element method, safety factors and reliability of composite structures; and numerous breakthrough research papers over the past 40 years.

Dr. Elishakoff has been a member of the tenured faculty at FAU since 1991. Previously he was at Technion, where he was a faculty member since 1972.

George Westinghouse Medals

The George Westinghouse Medals were established to recognize eminent achievement or distinguished service in the power field of mechanical engineering to perpetuate the value of the rich contribution to power development made by George Westinghouse, honorary member and 29th president of the Society. The Gold Medal was established in 1952 and the Silver Medal in 1971.

KENNETH BRAY – GOLD

Kenneth Bray, Ph.D., emeritus professor at the University of Cambridge, U.K., is honored for outstanding and lasting contributions to the power field through fundamental research and novel combustion model development that have significantly improved the efficiency and performance of gas turbine combustors; and for significant educational contributions that have produced world-class engineers and scientists.

Dr. Bray joined Cambridge in 1985 as Hopkinson and Imperial Chemical Industries professor of applied thermodynamics. Since 1997 he is emeritus professor. Previously he was with Southampton University, U.K. (1956-85).

ELIA MERZARI – SILVER

Elia Merzari, Ph.D., a principal nuclear engineer at Argonne National Laboratory in Lemont, Ill., is recognized for dedicated leadership and tireless support of ASME technical committees and conferences; and for outstanding contributions to the simulation of complex thermal-hydraulic phenomena in advanced nuclear reactor fuel bundles to enhance the safety and efficiency of next-generation advanced reactor designs.

With Argonne since 2009, Dr. Merzari currently holds a joint appointment in the Mathematics and Computer Science and the Nuclear Engineering divisions.

Arthur L. Williston Medal

LEONG KA LONG KAREN

The Arthur L. Williston Medal, established in 1954, recognizes the best paper submitted on a subject chosen to challenge the abilities of engineering students. The annual competition is open to any ASME student member or member who received a baccalaureate degree within two years of the submission deadline.

Leong Ka Long Karen, a graduate trainee at ATAL Engineering Limited in Hong Kong, is recognized for the paper titled "Fuel Choice Regulation – The Way to Narrow the Gap Between Current IMO Marine Standard and 2025 Greenhouse Gas Emission Target."

Ms. Leong graduated from The Hong Kong University of Science and Technology in June 2016 with a bachelor's degree in mechanical engineering. She served as vice chair (2014-16) of the ASME Student Section at HKUST and is now Student Section advisor (2016-17).

Savio L-Y. Woo Translational Biomechanics Medal

B. BARRY LIEBER

The Savio L-Y. Woo Translational Biomechanics Medal, established in 2015, recognizes an individual who has translated meritorious bioengineering science to clinical practice.

B. Barry Lieber, Ph.D., a professor in the department of neurosurgery at Stony Brook University, and the director of the Cerebrovascular Center for Research at Stony Brook University Medical Center in New York, is recognized for significantly advancing brain aneurysm treatment through the engineering and development of flow diversion technology that, to date, has been used to treat more than 50,000 patients worldwide.

Dr. Lieber's prior affiliations include the University of Miami (2001-09) and the State University of New York at Buffalo (1987-2001). He has a strong background in engineering, animal models, and endovascular methods and devices, with specific expertise in cerebrovascular disease and stroke. His establishment of strong ties within the industry and with health care providers has enabled the rapid translation of his research to clinical practice.

Henry R. Worthington Medal

BRUNO SCHIAVELLO

The Henry R. Worthington Medal, established in 1980, is bestowed for eminent achievement in the field of pumping machinery.

Bruno Schiavello, research fellow, hydraulics at Flowserve Corporation in Bethlehem, Pa., is honored for four decades of technical leadership in the pump industry through contributions to hydraulic research, design and innovative technical solutions; for specific studies in the field of cavitation that are referenced in scientific literature; and for promoting scientific knowledge dissemination as lead organizer of ASME's Pumping Machinery symposia over the last decade.

Mr. Schiavello started his pump hydraulic research in 1973 while working on his bachelor's thesis at Worthington SpA in Desio, Italy. After earning his master's degree he worked at Worthington SpA before joining Worthington Corporation in New Jersey in 1982. He served as director, fluid dynamics through various acquisitions, working at the Dresser Pump Division, Ingersoll-Dresser Pumps and Flowserve. In his current position since 2013, Mr. Schiavello leads computational fluid dynamic research and design.

S.Y. Zamrik PVP Medal

ARTIN A. DERMENJIAN

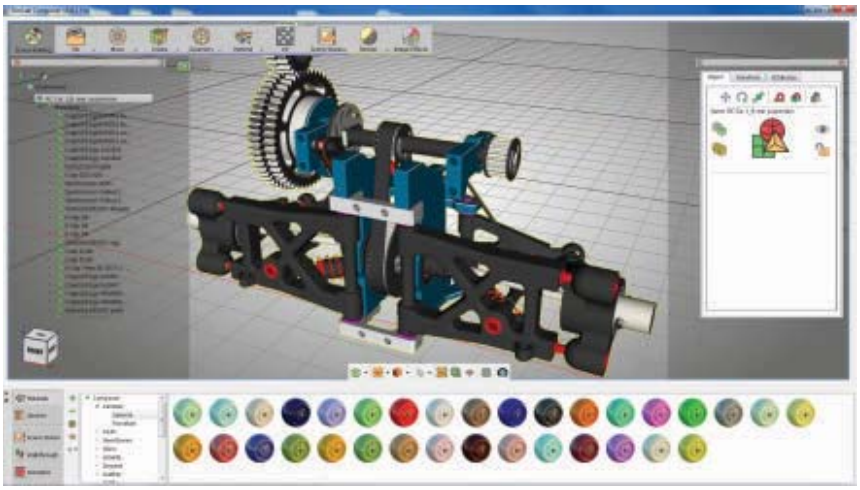
The Pressure Vessel and Piping Medal was established in 1980. Renamed the S.Y. Zamrik PVP Medal in 2010, it is bestowed for outstanding contributions in the field of pressure vessel and piping technology including, but not limited to, research, development, teaching, and significant advancements of the state of the art.

Artin A. Dermenjian is honored for providing numerous services to ASME including Codes and Standards, and the Pressure Vessels and Piping Division; and for significant contributions to the design, analysis and maintenance of nuclear power plants worldwide.

Mr. Dermenjian joined the staff at Sargent & Lundy in Chicago in 1973. During nearly 40 years with the firm, he held positions with increasing levels of responsibility in the design, analysis and evaluation of nuclear power plant systems and components. He retired in 2012. Mr. Dermenjian has supported ASME activities for more than 30 years.

ENGINEERING VISUALIZATION

SIMULATION LAB SOFTWARE, AMMAN, JORDAN.



Version 7.1 of the company's flagship Simlab Composer application features detachable menus intended to streamline the workflow, as well as an updated real-time renderer that is four times faster than previous versions. The application has the ability to work with 3-D models in a wide variety of formats and can produce animations and walk-throughs of interiors, exteriors, or product designs. The publisher says Simlab Composer has an easy-to-learn scene-building capability and intuitive texture-baking tools. The company sells multiple editions, including one intended for product design engineers to create high-quality visualizations and to run dynamic simulation analysis.

BUILDING INFORMATION MODELING

GRAPHISOFT, BUDAPEST.

Archicad 20, the latest version of the building information modeling application for architects and designers, features a new "flat-design" graphical user interface and several functional improvements. The application supports the IFC 4 open-source standard, which enables the coordination of workflows and provides help when coordinating with professionals in other disciplines. Information can be shared via purpose-made tools such as BIMx or generic tools such as Excel. Archicad 20 also facilitates informative design visualization, which ensures efficiencies throughout the design and construction phases. With the help of

smart filters and brand new graphical override, designers can freely change the representation of any 2-D or 3-D views of elements with similar properties.

POLYGON MODELING

MACHINEWORKS, SHEFFIELD, U.K.

Polygonica, the polygon modeling component application, is now offered with support for the Linux and Macintosh operating systems. The full range of Polygonica functionality, including automatic mesh healing, Boolean operations, mesh offsetting, mesh simplification, mesh analysis and rendering, will be available across all platforms. The company said that the application is suited to cloud-based mesh processing tasks for 3-D printing and CAE, and many cloud platforms are based on Linux. The mesh modeling application is intended for use in such fields as 3-D printing, bio-medical visualization, design, and geotechnical services.

CLOUD-BASED CAD

SIEMENS PLM, PLANO, TEXAS.

Solid Edge ST9 provides flexible access to the full capabilities of Solid Edge with cloud-based licensing, user preferences, and collaboration tools. Licenses and user preferences can be stored on the cloud enabling users to access their personal environment from anywhere. The new release also adds data storage options via cloud-enabled vaulting so users can store and share design data in a controlled manner with external suppliers and customers, using popular services such as Dropbox, OneDrive, Google Drive, and Box. In addition, new migration tools enable rapid conversion of legacy design data from many CAD systems.

SUBMISSIONS

Submit electronic files of new products and images by e-mail to **memag@asme.org**. Use subject line "New Products." *ME* does not test or endorse the products described here.

ADVANCED NESTING

HYPERTHERM, HANOVER, N.H.

Hypertherm, the manufacturer of plasma, laser, and waterjet cutting systems, has upgraded its ProNest CAD/CAM nesting software for automated cutting. ProNest 2017 contains a number of improvements, including drag array, anchor part to cursor, and automatic bumping functionality for greater control and faster nesting. The redesigned drill machine interface for plasma or oxyfuel machines incorporates drilling, tapping, and other spindle operations to tackle jobs directly in the application. Native 64-bit support allows ProNest to take advantage of the extra accessible memory available on a 64-bit CPU/operating systems.

INTERNET OF THINGS

PTC, NEEDHAM, MASS.

PTC has released ThingWorx 7, the latest version of its Internet of Things platform. New features include an enhanced set of tools for managing connected products, new analytics capabilities, support of public clouds, and simplified platform components that make it easier for developers to use their preferred tools to experiment with, prototype, and develop new IoT solutions. The company has begun integrating ThingWorx with public device clouds to provide an open IoT platform, beginning with Amazon Web Services IoT. Companies can use AWS's device cloud to connect devices, send data to and from a device, and auto-provision the device directly from ThingWorx.

SHEET OPTIMIZATION

BOBCAD-CAM, CLEARWATER, FLA.

Nesting Standard and Nesting Pro are two recently released CAD-CAM software modules intended to offer advanced nesting capability with intelligent sheet optimizing technology. The company says these modules can increase material usage by as much as 15 percent for sheet cutting on CNC mill, router, laser, plasma, and waterjet machines. The modules have new nesting optimizers, which can be used to create either a fast nest or an optimal nest. Without any optimization, nests can be completed within seconds. The new nesting CAD-CAM also includes all new options for working with remnant sheets and custom sheet shapes.

WEB-BASED VISUALIZATION

KISTERS AG, AACHEN, GERMANY.

Kisters has developed 3DViewStation WebViewer, its 3-D computer aided design visualization tool, to enable viewing complex assemblies in real time on mobile devices. The application can be customized so as to integrate into the user interface of leading CAD software. Its XML-API allows for the dynamic unloading of parts and assemblies and the recoloring of geometric shapes. 3DViewStation WebViewer's XML-API also allows users to create dimensions automatically. Kisters 3DViewStation WebViewer client requires an HTML5 browser and runs on most operating systems, including Windows, iOS, Android, Linux, and macOS.

FLOW METER

TITAN ENTERPRISES, SHERBORNE, U.K.

The Process Atrato is based on Titan's standard Atrato meter but packaged to address the more challenging process and control environment. The body is 316 stainless steel, rated at 20 Bar and the electronics are built-in and sealed to IP65. The only other wetted materials are PEEK and the customer's choice of elastomers. The Process Atrato is calibrated with a pre-set 'K' factor so all meters of the same flow range are fully interchangeable, with the goal of simplifying assembly and set-up procedures for OEM manufacturers. There are two adaptable frequency outputs, one PNP and NPN. Two multicolor LEDs indicate signal strength, power malfunctions, and pulse outputs. Electrical connections are through a standard M12, four pin, sensor connector. Four flow ranges are available from 2 ml/min. to 15 l/min., and accuracy is ±1 percent over the whole flow range.

AMMONIA DETECTOR

NEO MONITORS, SKEDSMOKORSET, NORWAY.

NEO Monitors introduces a new generation of the safest and most precise instrument to measure ammonia for any type of DeNOx system. The LaserGasTM III ammonia analyzer is designed to operate in hazardous areas to increase efficiency of the DeNOx-processes and minimize emissions. The single-path configuration is a transmitter/receiver solution for cross-duct installation. The measuring principal is based on Tunable Diode Laser Absorption Spectroscopy. The company suggests the analyzer can be used in such industries as chemical, petrochemical, power, and steel, where emissions of toxic chemicals is being discouraged due to the strict enforcement of regulations.

RFID TAG READER

TRIMBLE, SUNNYVALE, CALIF.

The ThingMagic Sargas reader is a networked, 2-antenna-port, UHF reader in a low profile enclosure. Built around the ThingMagic Micro reader module, the device reads more than 750 tags per second at distances over 9 m (30 ft.) when configured with appropriate antennas. The ThingMagic Sargas reader is pre-configured for a wide range of regions including FCC/Americas, ETSI/EU, TRAI/India, KCC/Korea, ACMA/Australia, SRRC-MII/ China, MIC/Japan, and an additional Open or customizable range in the 865-869 MHz and 902-928 MHz bands. Full regulatory certification for FCC & IC (North America), EU, and India is available with other certification coming later. With an onboard processor, memory, and removable flash storage, the reader has features designed for a wide range of enterprise applications from retail and warehouse inventory to cold chain food management and healthcare.

SUBMISSIONS

Submit electronic files of new products and images by e-mail to **memag@asme.org**. Use subject line "New Products." *ME* does not test or endorse the products described here.

THE CATHOLIC UNIVERSITY OF AMERICA

Associate/Assistant Professor of Mechanical Engineering

The Department of Mechanical Engineering seeks to fill an Associate or Assistant Professor tenure track position beginning August 21, 2017. Duties include teaching both undergraduate and graduate courses in mechanical engineering, developing externally funded research programs, supervising both graduate and undergraduate students, and pursuing scholarly publications and professional activities. Qualifications are an earned Ph.D. in mechanical engineering and a strong background in one of the traditional subareas of mechanical engineering.

The Catholic University of America, located in Washington D.C. is composed of 12 schools offering a wide variety of undergraduate, graduate, and professional degrees. The Department of Mechanical Engineering offers BME (ABET accredited), MSE, and PhD programs, and enrolls approximately 160 undergraduates and 50 graduate students. (visit http://mechanical.cua.edu.) We seek candidates who understand, are enthusiastic about, and will make a significant contribution to the mission of the University, which can be found here: https://www.cua.edu/about-cua/mission-statement.cfm.

Applications should include a cover letter that explains the applicant's interest in the position, a statement of teaching interests, a statement of research interests, a complete resume, and a one- to two-page personal statement indicating how the applicant's research, teaching, and service will make a distinctive contribution to the University's mission and to the vision of Catholic education outlined in the Apostolic Constitution on Catholic Universities *Ex Corde Ecclesiae*, which can be found here: http://w2.vatican.va/content/john-paul-ii/en/apost_constitutions/documents/hf_jp-ii_apc_15081990_ex-corde-ecclesiae.html

The University will perform background checks on all new faculty hires prior to making the final offer of employment. Applications will be reviewed as they are received and will be accepted until the position is filled. Candidates should upload a cover letter with a detailed resume, a clear statement of specific teaching and research interests, and the names and contact information of at least three references to http://engineering.cua.edu/facultyapp/mechanical

Further inquiries should be sent to vignola@cua.edu.

The Catholic University of America is an Equal Opportunity Employer.

UNIVERSITY OF ILLINOIS AT CHICAGO

ASSISTANT/ASSOCIATE/FULL PROFESSOR

Mechanical Engineering

The Department of Mechanical and Industrial Engineering at the University of Illinois at Chicago (UIC) invites applications for several tenure-track faculty positions in various areas of Mechanical Engineering. Individuals will also be considered at associate or full professor rank if they possess outstanding qualifications commensurate with the rank.

Successful applicants are required to have an earned PhD in Mechanical Engineering or a related field, and are expected to develop and maintain an active, externally-funded research program as well as teach courses at both the undergraduate and graduate levels.

The Department offers BS, MS, and PhD degrees in Mechanical Engineering, and Industrial Engineering and Operations Research, and currently has an undergraduate enrollment of about 770 and a graduate enrollment of about 470. More information about the Department can be found at **http://www.mie.uic.edu**. Applicants are required to send a letter of application indicating their qualifications, an up-to-date CV including the names and contact information of three references, and separate one-page statements outlining their future teaching and research plans.

For fullest consideration, applications must be submitted online at **http://jobs.uic.edu/job-board/job-details?jobID=66284** by **December 1, 2016**. Applications will be accepted until the positions are filled. Expected starting date is August 2017.

UIC is an EOE/AA/Minority/Female/Disabled/Veteran.

The University of Illinois conducts background checks on all job candidates upon acceptance of contingent offer of employment. Background checks will be performed in compliance with the Fair Credit Reporting Act.

MECHANICAL AND INDUSTRIAL ENGINEERING
COLLEGE OF ENGINEERING
UIC

Chair Department of Mechanical Engineering

BAYLOR UNIVERSITY

Baylor's School of Engineering and Computer Science invites applications for the position of Chair of Mechanical Engineering. The new Chair will communicate a clear vision for the future of education and research to a constituency that includes academia, government, industry and alumni. The successful candidate will hold an earned doctorate in Mechanical Engineering or a closely related field, and will demonstrate proven leadership, research achievement, excellent teaching, a commitment to professional activities, and outstanding English communication skills. The Department Chair reports to the Dean of the School and will be tenured as Professor of Mechanical Engineering.

Baylor's ABET accredited ME program now has 14 tenured/tenure-track faculty members, a clinical professor of innovation, and 4 lecturers/senior lecturers, with plans to grow to 27 total faculty by 2023. The faculty are internationally recognized in Biomechanical Experimentation, Design, and Simulation; Thermal and Energy Engineering; and Advanced Materials Engineering. Mechanical Engineering faculty conduct research in well-established laboratories and consortia housed within the Baylor Research and Innovation Collaborative (BRIC) (see www.baylor.edu/bric). The department offers B.S., M.S., and Ph.D. degrees in Mechanical Engineering. Jointly with the Department of Electrical and Computer Engineering, the department also teaches Pre- Engineering majors and offers B.S. in Engineering, M.S. in Biomedical Engineering and Master of Engineering degrees. Current enrollment is 220 pre-engineering, 341 undergraduate ME, and 37 full-time ME graduate students. Additional information regarding the Baylor ME department is available at http://www.ecs.baylor.edu/mechanicalengineering/.

The mission of the program is to educate students within a caring Christian environment in the discipline of Mechanical Engineering. Our graduates are to be equipped with the fundamental technical, communication, and teamwork skills to succeed in their chosen careers. They are to be empowered by innovative problem-solving creativity and an entrepreneurial mindset, and motivated by Christian ideals and a vocational calling to improve the quality of life worldwide.

To receive full consideration, please submit a cover letter and the following:

1) A current curriculum vitae
2) A vision statement to grow our new PhD program and maintain excellence in undergraduate education
3) An individualized statement of teaching and research interests related to Baylor's programs
4) A statement describing your personal and active Christian faith
5) Contact information for at least three professional references

Application review begins January 9, 2017 and will continue until the position is filled. Please submit materials to apply.interfolio.com/31180.

Chartered in 1845 by the Republic of Texas, Baylor University is the oldest university in Texas and the world's largest Baptist university. It is a member of the Big XII Conference and holds a Carnegie classification as a "high-research" institution. Baylor's mission is to educate men and women for worldwide leadership and service by integrating academic excellence and Christian commitment within a caring community. New faculty will have a strong commitment to the classroom and to discovering knowledge as Baylor aspires to become a top tier research university as described in Pro Futuris (http://www.baylor.edu/profuturis/).

Baylor University is a private not-for-profit university affiliated with the Baptist General Convention of Texas. As an Affirmative Action/Equal Opportunity employer, Baylor is committed to compliance with all applicable anti-discrimination laws, including those regarding age, race, color, sex, national origin, marital status, pregnancy status, military service, genetic information, and disability. As a religious educational institution, Baylor is lawfully permitted to consider an applicant's religion as a selection criterion. Baylor encourages women, minorities, veterans and individuals with disabilities to apply.

WICHITA STATE UNIVERSITY

Mechanical Engineering Department

FOUR TENURE TRACK FACULTY POSITIONS

The Mechanical Engineering department at Wichita State University is seeking to fill four tenure eligible faculty positions at the Assistant Professor rank. Duties include teaching, securing externally funded research, scholarship, and service. Exceptional applicants may be considered at the rank of Associate Professor.

Requirements for each position include an earned doctorate in mechanical engineering or a closely-related engineering field by the time of appointment, a notable record of journal publications and scholarly activities, evidence of potential to attract external funding and conduct research, effective communication skills, evidence of teaching potential and disposition to work with diverse populations are required for each position. A BS degree in mechanical engineering is strongly preferred.

Research areas preferred for the four positions include, but are not limited, to:

1) Energy Systems **(Position # 998592)** energy efficiency, energy conversion, energy storage for renewable power, clean water and environment, energy-water-food nexus, energy sustainability, and thermal transport processes.

2) Materials and Manufacturing **(Position # 996723)** materials engineering and processing, production and application of nanomaterials, recycling and recovery of materials, nano manufacturing, green manufacturing, environmental protection and clean up.

3) Robotics and Control **(Position # 996731)** robotics, prosthetics, sensors, cancer and heart failure detection systems, distance health monitoring.

4) Mechatronics and Dynamics **(Position # 996742)** controls–experimental, intelligent systems using big data, structural health monitoring, UAV, and MEMS.

Wichita is known as the "Air Capital of the World" that is home to major companies such as Airbus, Bombardier Learjet, Cessna, Chance Industries, Johnson Controls, Koch, Siemens and Spirit AeroSystems. Successful candidates will have opportunities to interact with these companies. Currently, the ME Department has nearly 600 undergraduate and 125 graduate (M.S. and Ph.D.) students. Interested candidates must apply online, at https://jobs.wichita.edu, by submitting a letter of application explaining how his/her expertise and experiences could contribute to a specific position #, resume, statements of teaching and research plans and lists of at least three professional references. For full consideration, the application must be submitted by **January 2, 2017** but the search will continue until the positions are filled.

Wichita State University does not discriminate in its employment practices, educational programs or activities on the basis of age, color, disability, gender, gender expression, gender identity, genetic information, marital status, national origin, political affiliation, pregnancy, race, religion, sex, sexual orientation, or status as a veteran. Retaliation against an individual filing or cooperating in a complaint process is also prohibited. Sexual misconduct, relationship violence and stalking are forms of sex discrimination and are prohibited under Title IX of the Education Amendments Act of 1972. Complaints or concerns related to alleged discrimination may be directed to the Director of Equal Opportunity or the Title IX Coordinator, Wichita State University, 1845 Fairmount, Wichita KS 67260-0138; telephone (316) 978-3187. Offers of employment are contingent upon completion of a satisfactory criminal background check as required by Board of Regents policy.

THE UNIVERSITY OF TENNESSEE KNOXVILLE

DEPARTMENT OF MECHANICAL, AEROSPACE & BIOMEDICAL ENGINEERING

POSITION ANNOUNCEMENT

Richard Rosenberg Endowed Professorship In Mechanical Engineering

The Department of Mechanical, Aerospace and Biomedical Engineering (MABE) at the University of Tennessee is seeking an exceptionally qualified candidate with significant expertise in an area of mechanical engineering for the appointment to the position of Professor and holder of the Richard Rosenberg Endowed Professorship. The successful candidate will be an internationally recognized leader in mechanical engineering; a team player; and able to build multi-participant research programs. The successful candidate will also be able to obtain major research sponsorship, and recruit high-quality graduate students. Applications and nominations are invited for this senior position. The successful candidate will have a doctorate in mechanical engineering, a proven track record of developing research funding, and a substantial and active research program with archival publications in mechanical engineering. Specific interest and experience related to automotive engineering is highly desirable but not required. Prior academic experience is highly desirable, but not required. Applicants with outstanding industrial research accomplishments are welcomed. The Richard Rosenberg Endowed Professor will be a leader in the research efforts of MABE and the College of Engineering. The successful candidate is expected to lead and expand MABE research activities, including but not limited by automotive systems and engineering; to be active in the graduate and undergraduate curricula, and to attract research funding and support for graduate students.

The University of Tennessee, Knoxville (UTK), a Carnegie Research I institution, is the state's comprehensive, land grant, research institution. The College of Engineering is undergoing a period of substantial growth in both physical infrastructure and research expenditures as it seeks to become a Top-25 ranked Public Institution.

The MABE Department currently has 41 tenured or tenure track faculty, as well as, 3 lecturers, 2 Clinical Associate Professors and a Professor of Practice. MABE enrolls some 1,108 undergraduate and 149 graduate students, offering degrees at all levels in mechanical engineering, aerospace engineering and biomedical engineering (http://www.mabe.utk.edu).

The Knoxville and regional areas in general have outstanding opportunities for research collaboration. The University of Tennessee is home to the $259M Institute for Advanced Composite Manufacturing Innovation (IACMI). IACMI is the fifth Institute in the National Network of Manufacturing Innovation, supported by the US Department of Energy's Advanced Manufacturing Office. IACMI will be the leader in advanced composite materials and will offer major opportunities for research collaboration to the successful candidate.

The Department of Energy's Oak Ridge complex that includes the Oak Ridge National Laboratory (http://www.ornl.gov) is located 25 miles from the campus of the University of Tennessee, Knoxville. The National Transportation Research Center (http://web.ornl.gov/sci/transportation/) and the Manufacturing Demonstration Facility (http://web.ornl.gov/sci/manufacturing/) have extensive opportunities for collaboration in all aspects of transportation and advanced manufacturing. Additionally, state of Tennessee is home to more than 900 manufacturers and suppliers. Tennessee is ranked #1 for automotive manufacturing strength by business facilities magazine four of the last five years. The Nissan plant is Smyrna is actually the most productive manufacturer in the country. 20 automotive projects have committed 4.565 new jobs across the state and nearly $1.1 billion investment in 2015 alone. Volkswagen has plans to establish a North American market focused R&D Center at their Chattanooga manufacturing plant, which is about an hour's drive from Knoxville. The new R&D Center will offer unique opportunities for technology innovation with one of the world's largest automotive corporations. Review of applications and nominations will begin upon receipt, and will continue until the position is filled. Applications should include a concise letter of intent outlining the applicant's research goals and objectives, current curriculum vitae, in addition to the names, addresses, and telephone numbers of four references. Applications and nominations should be sent to rosensearch2@utk.edu

AUBURN UNIVERSITY
SAMUEL GINN
COLLEGE OF ENGINEERING
AEROSPACE

Multiple Tenure-track Faculty Positions

The Department of Aerospace Engineering at Auburn University invites applications for multiple tenure track faculty positions at the assistant or associate professor level. Candidates with expertise in flight dynamics & control or orbital mechanics are particularly encouraged to apply. Other areas of consideration include aerospace systems, design, guidance & control, unmanned and manned aerial systems, structural dynamics and other areas related to aerospace engineering. Candidates will be expected to fully contribute to the department's mission and the development of a strong, nationally recognized, funded research program. The candidate is expected to have a demonstrated track record of scholarship, an active interest in engineering education and strong communication skills. Candidates must have an earned doctorate in aerospace engineering or a closely related field.

Candidates can login and submit a cover letter, CV, research vision, teaching philosophy, and three references at: https://aufacultypositions.peopleadmin.com/postings/1871 Cover letters may be addressed to: Dr. Brian Thurow, Search Committee Chair, 211 Davis Hall, Auburn University, AL 36849. The review process will begin on December 2, 2016 and will continue until the positions are filled. Candidates may continue to apply until the search has ended. The successful candidate must meet eligibility requirements to work in the U.S. at the time the appointment begins and continue working legally for the proposed term of employment. Additional information about the department may be found at: http://www.eng.auburn.edu/aero/

Auburn University is an EEO/Vet/Disability employer.

LEHIGH

LEHIGH UNIVERSITY
DEPARTMENT OF MECHANICAL ENGINEERING & MECHANICS

Lehigh University is accepting applications for a faculty position at the Assistant Professor level in the field of Solid Mechanics, with an emphasis on structural failure and the mechanics of fracture. The ideal candidate will have a doctoral degree in Mechanical Engineering, or a related field, with a strong background in experimental or theoretical/computational aspects in one or more of areas of solid mechanics, and will be expected to develop a vigorous research program, accompanied by excellence in teaching at both the graduate and undergraduate levels. Multidisciplinary research programs are an important priority at Lehigh University, and include strong interactions with government agencies, industry, and existing research centers on campus. Candidates should provide curriculum vitae that include: a statement of professional experience and goals; detailed plans for research and funding; a list of refereed publications and presentations; a summary of teaching experience and plans; and the names and contact information of four references. This material should be submitted electronically using our online application found at https://academicjobsonline.org/ajo/jobs/8034. For questions regarding this position, please contact Barbara McGuire, bcm208@lehigh.edu. Review of applications will begin upon receipt and will continue until the position is filled.

Lehigh University is an affirmative action/equal opportunity employer and does not discriminate on the basis of age, color, disability, gender, gender identity, genetic information, marital status, national or ethnic origin, race, religion, sexual orientation, or veteran status. Lehigh University provides comprehensive benefits including partner benefits.

Lehigh is an NSF ADVANCE Institution: http://www.lehigh.edu/luadvance/

Lehigh offers excellent benefits including domestic partner benefit: http://www.lehigh.edu/~inprv/faculty/worklifebalance.html

***Lehigh Valley Inter-regional Networking & Connecting (LINC)** is a network of diverse organizations designed to assist new hires with dual career, community and cultural transition needs: infdcap@lehigh.edu*

THE UNIVERSITY OF TENNESSEE KNOXVILLE
DEPARTMENT OF MECHANICAL, AEROSPACE & BIOMEDICAL ENGINEERING

POSITION ANNOUNCEMENT

Tenure Track Position In Mechanical Engineering

The Mechanical, Aerospace and Biomedical Engineering (MABE) Department at the University of Tennessee is seeking an exceptionally qualified candidate with expertise in an area of mechanical engineering for the appointment to the position of Assistant or Associate Professor. Applications and nominations are invited for this position.

All outstanding candidates with a strong background in fundamental science and engineering relevant to mechanical engineering will be considered. Candidates applying for this position are expected to have a strong commitment to teaching excellence at both the undergraduate and graduate levels, demonstrate research capabilities that will enable the development of robust externally funded research programs, and produce archival publications in leading scholarly journals. A Ph.D. in Mechanical Engineering or a related field of engineering is required. It is expected that the candidate will develop graduate courses in his/her area of research to complement the departmental growth. Research interests and capabilities can span the entire solid mechanics and dynamical systems spectrum of mechanical engineering or mechanical/biomedical applications. Applicants with industrial experience and suitable academic background are also welcomed.

The University of Tennessee, Knoxville (UTK), a Carnegie Research I institution, is the state's comprehensive, land grant, research institution. The College of Engineering is undergoing a period of substantial growth in both physical infrastructure and research expenditures as it seeks to become a Top-25 ranked Public Institution. The College of Engineering presently has seven departments with 184 faculty, 2,965 undergraduates and 932 graduate students. College of Engineering Research expenditures are currently $68.2M per year.

The MABE Department currently has 41 tenured or tenure track faculty as well as 3 Lecturers, 2 Clinical Associate Professors and a Professor of Practice. MABE enrolls some 1,108 undergraduate and 149 graduate students, offering degrees at all levels in mechanical engineering, aerospace engineering and biomedical engineering (http://www.mabe.utk.edu). Extensive opportunities for collaboration with faculty from across the university, Oak Ridge National Lab (ORNL), and industry exist at UTK and the surrounding region (UTSI, ORNL, AEDC, AMDEC, NASA-Marshall). Other opportunities can exist with the newly established Institute for Advanced Composite Manufacturing Innovation (IACMI), led by UTK in conjunction with ORNL and over a hundred industrial partners. IACMI is the fifth Institute in the National Network of Manufacturing Innovation, supported by the US Department of Energy's Advanced Manufacturing Office.

Review of applications will begin January 2, 2017, and will continue until the position is filled. The anticipated start date of the new position is August 1, 2017. Salary is commensurate with the position and experience of the applicant, and highly competitive with Top-25 institutions. Applications should include (1) a concise letter of intent outlining the applicant's research and teaching goals and objectives; (2) a comprehensive curriculum vitae; (3) a statement of research and teaching interests; and (4) the names, addresses and telephone numbers of at least five references. All components of the application package (1-4) should be emailed to mesearch2016@utk.edu as a single PDF.

Faculty opportunity at Illinois

The Department of Mechanical Science and Engineering at the University of Illinois at Urbana-Champaign invites applications for multiple faculty positions in all ranks. Emphasis is on the areas of (i) manufacturing and (ii) energy and sustainability; however, excellent candidates will be considered in all areas related to mechanical science and engineering.

A doctoral degree is required, and salary is commensurate with qualifications and experience. Applications received by December 4, 2016, will receive full consideration. Early applications are encouraged. Interviews may take place before the given date; applications received after that date may be considered until positions are filled. The expected start date of a position offered/accepted through this search is August 16, 2017, but other start dates will be considered.

A full position description and information on how to apply can be found at on the University of Illinois Urbana-Champaign online jobsite **http://jobs.illinois.edu**. For further information regarding application procedures, please address questions to: **mechse-facultyrecruiting@illinois.edu**.

The University of Illinois conducts criminal background checks on all job candidates upon acceptance of a contingent offer. Illinois is an EOE employer/Vet/Disabled www.inclusiveillinois.illinois.edu.

ILLINOIS

MARQUETTE UNIVERSITY

MARQUETTE UNIVERSITY'S DEPARTMENT OF MECHANICAL ENGINEERING invites applications for a **tenure-track position in Mechanical Systems at the Assistant Professor level.** Applicants must have a doctorate in ME or related area. Candidates are expected to teach undergraduate and graduate (MS/PhD) courses in the area of mechanical systems, and establish an externally funded research program. Preference will be given to candidates who can contribute to the newly established Flexible Assembly Systems Network (FASN). FASN activities include guiding, coordinating, and performing basic and applied research directed toward making manufacturing assembly operations smarter and more flexible, i.e., more responsive to product/process change.

Applicants must submit their CV, research plan, teaching philosophy, and the names and contact information of at least three references to:

http://employment.marquette.edu/postings/6659

Deadline for applications is December 15, 2016 with review of applications thereafter. Interested persons can visit: http://www.marquette.edu/engineering/mechanical/ or contact Dr. Philip Voglewede, Chair, Mechanical Systems Search Committee, MEEN Dept., 1515 W. Wisconsin Ave., Milwaukee, WI 53233; Phone (414) 288-7278; Fax (414)288-7790; email: philip.voglewede@marquette.edu .

Marquette's College of Engineering, the largest Catholic, Jesuit College of Engineering in the nation with over 1,250 undergraduate and 200 graduate students, is committed to preparing graduates to be leaders in innovation and research on a global stage. Marquette Engineering is currently undergoing a transformation in teaching and research facilitated by the recent construction of a new building (the $50 million Engineering Hall) and a significant increase in multi-institution collaboration (including a multi-million dollar investment in the Flexible Assembly Systems Network). Marquette is an EO/AAE.

School of Engineering

VANDERBILT UNIVERSITY

Faculty Position

Mechanical Engineering Department Vanderbilt University

The Department of Mechanical Engineering at Vanderbilt University invites applications for a tenure/tenure-track faculty position to begin in the fall of 2017. Applications will be considered for positions at all ranks commensurate with qualifications. Applicants must possess a Ph.D. in Mechanical Engineering or closely related discipline. The Department is particularly interested in candidates with research experience and interests in rehabilitation robotics and/or medical robotics.

The School of Engineering strives for an active culturally and academically diverse faculty of the highest caliber, skilled in scholarship and teaching. The Department of Mechanical Engineering has 15 tenured/tenure-track faculty members with reputations for excellence in research fields including nanoengineering, rehabilitation engineering, and medical robotics, with an annual research expenditure of $7.5 million. The department encourages interdisciplinary research and the faculty is affiliated with 8 cross-campus research centers. The School of Engineering is immediately adjacent to the Vanderbilt University Medical Center, which greatly facilitates collaboration between the schools of engineering and medicine. Successful candidates are expected to (1) teach at the undergraduate and graduate levels, (2) establish vigorous research programs with extramural funds, and (3) contribute to synergistic efforts within the School of Engineering. Applications consisting of a cover letter, a complete curriculum vitae, statements of teaching and research interests, and the addresses of at least three references (include email address) should be submitted on-line at https://academicjobsonline.org/ajo/jobs/8005

Ranked in the top 15 nationally, Vanderbilt University is a private, internationally recognized research university located on 330 park-like acres 1.5 miles from downtown Nashville, Tennessee. Its 10 distinct schools share a single cohesive campus that nurtures interdisciplinary activities. The university has a student body of over 12,500 undergraduate, graduate, and professional students, including over 25% minority students and 1,170 international students from 84 countries. The School of Engineering currently comprises 90 tenured and tenure-track faculty, operates with an annual budget of over $100 million, including $70 million from externally funded research, and serves over 1,400 undergraduate and nearly 500 graduate students. In the 2017 rankings of graduate engineering programs by U.S. News & World Report, the School ranks in the top three among programs with fewer than 100 faculty (behind Caltech and Harvard) and has risen steadily in the rankings over the past decade.

With a metro population of approximately 1.8 million people, Nashville has been named the "It" city by Time magazine, one of the 15 best U.S. cities for work and family by Fortune magazine, was ranked as the #1 most popular U.S. city for corporate relocations by Expansion Management magazine, and was named by Forbes magazine as one of the 25 cities most likely to have the country's highest job growth over the coming five years. Major industries include tourism, printing and publishing, manufacturing technology, music production, higher education, finance, insurance, automobile production and health care management.

AUBURN UNIVERSITY

Department of Mechanical Engineering
Multiple Tenure-Track Faculty Positions

The Department of Mechanical Engineering at Auburn University invites applications for multiple tenure-track faculty positions to begin in August 2017. Candidates with expertise in all areas related to mechanical engineering are invited to apply. Applicants must have a Ph.D. in Mechanical Engineering or a closely related field. Candidates will be considered at the Assistant, Associate, and Full Professor levels. Applicants at the Associate and Full Professor levels must have active nationally or internationally recognized research programs.

In addition to soliciting candidates for multiple positions in all areas of mechanical engineering, the Department seeks to fill one position in support of the multidisciplinary university-level Cluster Hire Initiative in the area of Scalable Energy. For this position, candidates should have expertise within the broad areas of thermal and energy sciences. The selected candidate will be expected to participate actively in the ongoing Scalable Energy initiative, and participation in cluster activities will be an important component in faculty annual reviews. For more information regarding the Cluster Hires, please see the following link: http://www.auburn.edu/academic/provost/strategic_hire.html.

The ME Department currently has 40 full-time faculty members and supports strong graduate and undergraduate programs in Mechanical Engineering and Materials Engineering. Enrollments during the Fall Semester 2016 include 810 undergraduate students in major and 195 graduate students. Current departmental areas of research strength include unmanned and robotic systems, electronic packaging and reliability, solid mechanics and advanced materials, electronics cooling and thermal management, tribology, advanced powertrains, additive manufacturing, biomechanics, MEMS, and energy systems. The Auburn University College of Engineering has several unique opportunities to enable faculty success including (1) strong connection with the defense industry, (2) local automotive and aerospace companies including production additive manufacturing, (3) a class 10 clean room for electronics manufacturing and packaging, (4) MRI center, (5) automotive test track, and (6) collaborations with faculty in veterinary medicine and a new medical school. Additional information can be found at http://www.eng.auburn.edu/mech/.

Auburn University was chartered in 1856 and was designated a land grant institution in 1872. The Fall 2016 university enrollment is over 27,000 students. Auburn is located 100 miles southwest of Atlanta, has an excellent public school system, and has been nationally ranked as one the "best small towns in America."

The individuals selected for these positions will be expected to contribute to the growth of the department by developing a strong externally-funded research program, collaborating on interdisciplinary research projects, publishing research results in appropriate scholarly outlets, directing graduate students, teaching undergraduate and graduate courses, and being involved in service to the department and profession. Excellent communication skills and a high level of personal motivation are required.

Applicants should submit a cover letter, current CV, statements of research vision and teaching philosophy, and three references at: http://aufacultypositions.peopleadmin.com/postings/1928. Review of applications will begin on November 1, 2016 and continue until successful candidates have been identified.

The candidates selected for these positions must be able to meet eligibility requirements to work in the United States at the time appointment is scheduled to begin and continue working legally for the proposed term of employment.

AU is an EEO/Vet/Disability employer.

1865 THE UNIVERSITY OF MAINE

Tenure-Track Assistant Professor: Design Mechanical Engineering Department College of Engineering, University of Maine

The Mechanical Engineering Department at the University of Maine invites applications for a tenure track assistant professor in mechanical engineering. The candidate must have a demonstrated track record in engineering design, with an ability to do applied and/or basic research in traditional or emerging areas of interest in mechanical engineering. Candidates with a background in materials science, metallurgy, control systems, engineering education, or manufacturing are strongly encouraged to apply. The successful candidate is expected to develop a strong externally funded research program, and have the ability to teach core undergraduate and graduate courses with emphasis on capstone, mechanical design and design related electives. Preference will be given to candidates with industrial experience. Applications, including a cover letter, a full curriculum vita, statements of teaching and research interests, and contact information for at least three potential references should be sent to the Department of Human Resources via https://umaine.hiretouch.com. Review of applications will begin on Jan. 04, 2017. The expected start date is September 2017. Salary and benefits are competitive and dependent on qualifications. A B.S. and Ph.D. in Mechanical Engineering or a closely related field is required at time of appointment. Underrepresented minorities and women are strongly encouraged to apply.

The University of Maine is an EEO/AA employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, sexual orientation, age, disability, protected veteran status, or any other characteristic protected by law.

THE UNIVERSITY OF UTAH®

FACULTY POSITIONS IN MECHANICAL ENGINEERING

The Department of Mechanical Engineering at the University of Utah invites applications for **3 tenure track positions at the assistant or associate rank** with a July 1, 2017 starting date. Candidates with exceptional background and experience may be considered at a higher rank. Candidates with interest and expertise in the areas of i) **solid mechanics,** ii) **design and/or manufacturing,** and iii) **thermal sciences** are strongly encouraged to apply. Candidates are expected to develop and maintain an active, externally funded research program that complements existing university research. Collaborations in the Department, College of Engineering, School of Medicine, and elsewhere across campus are highly encouraged. Applicants are expected to have an earned Ph.D. or Sc.D. in mechanical engineering or a closely related field prior to start date. The Department of Mechanical Engineering currently has 38 tenure-line faculty members, over 920 undergraduate and 220 graduate students. The University of Utah is a tier 1 research institution that has ranked in the top 5 nationally for start-up companies in the last 5 years. The campus is situated in Salt Lake City, a diverse, cosmopolitan city with a population of 1M nestled against the backdrop of the beautiful Wasatch Mountains. Salt Lake City residents have unparalleled access to national parks (8 within a few hours drive), skiing/snowboarding (7 resorts within 30 min), hiking, biking, rafting/ kayaking, NBA basketball, MLS soccer, and cultural events including opera, dance, symphony, theatre, and outdoor concerts. Review of applications will begin on December 1, 2016 and continue until positions are filled. Please check the complete position announcements at http://mech.utah.edu/department/open-positions/.

The University of Utah is an Equal Opportunity/Affirmative Action employer and educator. Minorities, women, veterans, and those with disabilities are strongly encouraged to apply. Veterans' preference is extended to qualified veterans. Reasonable disability accommodations will be provided with adequate notice. For additional information about the University's commitment to equal opportunity and access see: http://www.utah.edu/nondiscrimination/.

Frontier Faculty

The College of Engineering at The Pennsylvania State University announces openings for two tenure-system Frontier Faculty positions in, but not restricted to, the areas of Optimal and Secure Cyberenvironments (e.g. cybersecurity, cyberphysical engineering and healthcare systems, cultural technical system integration), Resilient Infrastructure Systems (e.g., autonomous, optimized and adaptive systems; advanced land, air and sea vehicles) and Sustainable Water-Energy-Food Nexus (e.g., modeling, optimization and management of interacting water-energy-food systems; optimized and socially responsible energy, water and food production and distribution). Senior and mid-career faculty as well as exceptional junior faculty in emerging areas in engineering are invited to apply. This Frontier Faculty search is being conducted at the College of Engineering level and is led by the Dean's office. The academic home of the successful candidates will be determined during the hiring process. Additional information about these positions and the College's plan for growth may be found at www.engr.psu.edu/frontier. Review of applicants will begin on November 15, and will continue until the positions are filled. Applicants should submit a statement of professional interests, a curriculum vitae, and contact information for four references. Please submit these items in one pdf file.

Apply to **http://apptrkr.com/882114**

CAMPUS SECURITY CRIME STATISTICS: For more about safety at Penn State, and to review the Annual Security Report which contains information about crime statistics and other safety and security matters, please go to http://www.police.psu.edu/clery/, which will also provide you with detail on how to request a hard copy of the Annual Security Report.

Penn State is an equal opportunity, affirmative action employer, and is committed to providing employment opportunities to all qualified applicants without regard to race, color, religion, age, sex, sexual orientation, gender identity, national origin, disability or protected veteran status.

EMBRY-RIDDLE Aeronautical University
PRESCOTT, ARIZONA

Mechanical Engineering Department Chair

The College of Engineering at Embry-Riddle Aeronautical University in Prescott, Arizona, invites applications for the position of Chair of the Mechanical Engineering Department. The position is anticipated to start in Fall 2017. The successful candidate shall have strong leadership and administrative skills and a willingness to teach undergraduate courses while promoting undergraduate research. Candidates with either a MS/ME or AE and significant industry management service or PhD/DEng. are encouraged to apply. For additional information, see https://embryriddle.taleo.net/careersection/002/jobdetail.ftl?job=160345

Embry-Riddle Aeronautical University is dedicated to building a culturally diverse faculty and staff. We strongly encourage minorities, women, and members of under-represented groups to apply.

Embry-Riddle Aeronautical University is an Equal Opportunity Employer.

NJIT New Jersey Institute of Technology

Tenure-Track Faculty Position
Assistant Professor - Mechanical Engineering at NJIT

The Department of Mechanical and Industrial Engineering (MIE) of the Newark College of Engineering at **New Jersey Institute of Technology (NJIT)** invites applications for a tenure-track Assistant Professor position in **Robotics**. By the time of appointment, successful candidates must have earned a Ph.D. (or equivalent) degree, with a record of pertinent high-quality research. All areas of robotics research will be considered, but we are particularly interested in individuals focused on one of the following areas: intelligent manufacturing and mechatronics, additive manufacturing, robot learning, robots in education, rehabilitation and assistive robotics, physical human-robot interaction (pHRI), and autonomous robot/s.

The successful candidate is expected to carry out high quality scholarly research and collaborate with other faculty members. He or she should have a clear plan to establish a vibrant research program, secure external research funding, and participate actively in guiding, educating and teaching graduate and undergraduate students.

Applications should be submitted online and include a complete curriculum vitae, statement of research interests, statement of teaching interests, and the names of three references. Review of applicants will begin on September 15, 2016, and will continue until the position is filled. The expected start date is September 1, 2017.

Applications must be posted at **https://njit.jobs** using **Job Posting Number 0603517**. Questions may be directed to **nce@njit.edu**.

To build a diverse workforce, NJIT encourages applications from individuals with disabilities, minorities, veterans and women. EEO employer.

NEW JERSEY INSTITUTE OF TECHNOLOGY
UNIVERSITY HEIGHTS, NEWARK, NJ 07102-1982

LEHIGH

LEHIGH UNIVERSITY
DEPARTMENT OF MECHANICAL ENGINEERING & MECHANICS

Lehigh University is accepting applications for a faculty position at the Assistant Professor level in the field of Thermal-Fluids, with an emphasis on transport phenomenon related to propulsion and transportation and/or the energy-water nexus. The ideal candidate will have a doctoral degree in Mechanical Engineering, or a related field, with a strong background in experimental and/or theoretical/computational aspects in one or more areas of Thermal-Fluids, and will be expected to develop a vigorous research program, accompanied by excellence in teaching at both the graduate and undergraduate levels. Multidisciplinary research programs are an important priority at Lehigh University and include strong interactions with government agencies, industry, and existing research centers on campus. Candidates should provide curriculum vitae that includes: a statement of professional experience and goals; detailed plans for research and funding; a list of refereed publications and presentations; a summary of teaching experience and plans; and the names and contact information of four references. This material should be submitted electronically using our online application found at https://academicjobsonline.org/ajo/jobs/8032. For questions regarding this position, please contact Barbara McGuire, bcm208@lehigh.edu. Review of applications will begin upon receipt and will continue until the position is filled.

Lehigh University is an affirmative action/equal opportunity employer and does not discriminate on the basis of age, color, disability, gender, gender identity, genetic information, marital status, national or ethnic origin, race, religion, sexual orientation, or veteran status. Lehigh University provides comprehensive benefits including partner benefits.

Lehigh is an NSF ADVANCE Institution: http://www.lehigh.edu/luadvance/

Lehigh offers excellent benefits including domestic partner benefit: http://www.lehigh.edu/~inprv/faculty/worklifebalance.html

***Lehigh Valley Inter-regional Networking & Connecting (LINC)** is a network of diverse organizations designed to assist new hires with dual career, community, and cultural transition needs: infdcap@lehigh.edu*

Penn Engineering

The School of Engineering and Applied Science at the University of Pennsylvania is growing its faculty by 33% over a five year period. As part of this initiative, the **Department of Mechanical Engineering and Applied Mechanics** is engaged in an aggressive, multi-year hiring effort for multiple tenure-track positions at the Assistant, Associate, and Full Professor levels.

We seek applicants with exceptional research achievement and future promise, a commitment to excellence in undergraduate and graduate education in mechanical engineering, and dedication to service and collegiality. Candidates should couple with the department's core disciplinary strengths in mechanical systems, mechanics of materials, fluid mechanics, and thermal sciences. The specific research areas for this search, and a link to apply for the position, can be found here: http://www.me.upenn.edu/faculty-staff/

The Department maintains strong collaborations with all other engineering departments, the School of Arts and Sciences, the Perelman School of Medicine, the Wharton School of Business, and the School of Design. Our faculty engage strongly with leading centers including the General Robotics, Automation, Sensing, and Perception (GRASP) Laboratory, the Penn Institute for Computational Science (PICS), and the Laboratory for Research on the Structure of Matter (LRSM). The Department encourages candidates who can leverage and add to these relationships. Successful candidates will conduct innovative, leading research programs benefiting from Penn's strong interdisciplinary tradition and excellent facilities such as the new Singh Center for Nanotechnology. The Department encourages applicants whose research aligns with the School's new strategic plan (http://www.seas.upenn.edu/PennEngineering2020). Candidates who enrich the diversity of our community are strongly encouraged to apply.

The University of Pennsylvania is an affirmative action/equal opportunity employer. All qualified applicants will receive consideration for employment and will not be discriminated against on the basis of race, color, religion, sex, sexual orientation, gender identity, creed, national or ethnic origin, citizenship status, disability, veteran status, or any other characteristic protected by law.

Stanford | ENGINEERING

Faculty Opening

STANFORD UNIVERSITY
DEPARTMENT OF AERONAUTICS AND ASTRONAUTICS

The Department of Aeronautics and Astronautics at Stanford University invites applications for a tenure track faculty position at the Assistant or untenured Associate Professor level. We will also consider senior candidates with outstanding research and teaching track records.

Research advances in the fundamental areas of aerospace engineering are critical for future air and space transportation systems that will provide efficiency, safety, and security, while protecting the environment. We are seeking exceptional applicants who will develop a program of high-impact research, contribute to an innovative undergraduate curriculum, and develop graduate courses at the frontier of areas such as aerospace system design, autonomous vehicle technologies, and breakthroughs in aerospace propulsion concepts. We will place higher priority on the impact, originality, and promise of the candidate's work than on the particular sub-area of specialization within Aeronautics and Astronautics.

Evidence of the ability to pursue a program of innovative research and a strong commitment to graduate and undergraduate teaching is required. Candidates whose research programs in Aeronautics and Astronautics will involve the development of sophisticated computational and/or mathematical methods may be considered for an appointment with an affiliation with the Institute for Computational and Mathematical Engineering (http://icme.stanford.edu/).

All candidates should apply online at https://aa.stanford.edu/job-openings. Applications should include a brief research and teaching plan, a detailed resume including a publications list, and the names and addresses of at least five references. Applications will be accepted until the position is filled. However, the review process will begin on January 1, 2017.

Stanford University is an equal opportunity employer and is committed to increasing the diversity of its faculty. It welcomes nominations of and applications from women, members of minority groups, protected veterans and individuals with disabilities, as well as from others who would bring additional dimensions to the university's research, teaching and clinical missions.

THE UNIVERSITY OF MEMPHIS

Chair – Mechanical Engineering

Applications and nominations are invited for the position of **Professor and Chair of the Department of Mechanical Engineering** at the **University of Memphis.**

Primary responsibilities of the chair are to provide visionary leadership; to encourage excellence and innovation in research, instruction and service; to advance professional development of faculty, staff and students; to promote productive relationships with all constituents including students, parents, alumni, industry and government agencies; and to foster productive interdisciplinary relationships with a variety of entities across the University community and beyond.

Applicants must hold an earned doctorate degree in mechanical engineering or a closely related field. In addition, candidates must be eligible for appointment at the rank of Professor. Commitment to, and knowledge of, affirmative action, equal employment opportunity and diversity are required. The successful candidate will have a proven record of scholarly and administrative leadership, as well as the vision and ability to foster growth in academic programs, external support, and research programs, such as the College's advanced manufacturing initiative.

Salary will be competitive and the University also provides a comprehensive benefits package and a research incentive compensation program. Information about most of these programs is available at www.memphis.edu. Candidates with exceptional credentials may be considered for an endowed position commensurate with their level of achievement.

Letters of nomination and applications are to be submitted via https://workforum.memphis.edu. Click on the faculty box to find the posting for the Chair position. Applications must include a letter detailing personal qualifications and experience as related to the position, a comprehensive curriculum vita, and the full names and contact information (the address, phone number, and email address) of three professional references. The committee will begin screening applications on October 15, 2016 and will continue until the position is filled.

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FACULTY POSITION IN BIOMEDICAL SENSORS AND NANOTECHNOLOGY

San Diego State University
Mechanical Engineering

The Department of Mechanical Engineering seeks to fill a tenure-track position at the Assistant or Associate Professor level in the area of biomedical sensors and nanotechnology starting Fall 2017. Mechanical Engineering is one of the four departments in the College of Engineering at San Diego State University with an EAC, ABET-accredited B.S. degree program in Mechanical Engineering, as well as M.S. and Ph.D. programs in Mechanical and Bioengineering. This faculty member will work collaboratively on research projects with engineering, science, and rehabilitation faculty in the Smart Health (sHealth) Institute, a newly established Area of Excellence at San Diego State University. The ideal candidate will have strengths working with and building relationships with and collaborations among engineering, science and biomedical research faculty. This faculty member would spearhead and support translational research with biomedical sensor technologies. The research program would ideally focus on medical, biological and environmental nanosensors or micro/nanofabrication technology. The department shares with the College of Engineering and the University a strong commitment to excellence in undergraduate and graduate education. He or she is expected to supervise teams of undergraduate as well as graduate students in our M.S. and Ph.D. programs. Applicants must have a demonstrated ability to teach undergraduate and graduate level classes in the department.

For more information about the department, college and university, please visit: http://mechanical.sdsu.edu, http://engineering.sdsu.edu, and http://www.sdsu.edu.

Applicants must have an earned Ph.D. degree in mechanical engineering or a closely related discipline. Applications must be received by November 15, 2016 to receive full consideration; the position will remain open until filled. Candidates must apply via Interfolio at http://apply.interfolio.com/36514. Questions may be directed to the Search Committee Chair at MESHsearch@engineering.sdsu.edu.

SDSU is a Title IX, equal opportunity employer.

THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Faculty Position in Mechanical Design:
Mechanical and Aerospace Engineering at The Ohio State University

The Department of Mechanical and Aerospace Engineering at The Ohio State University invites applications from outstanding individuals for a tenured or tenure-track faculty position in the broad disciplinary area of **mechanical design**. Successful applicants for the position will possess expertise in one or more of the following topics: digital design, design theory, design automation, precision engineering & dimensional metrology, mechanical product design, kinematic and geometric modeling. The search preference is for individuals at the assistant or associate professor level.

Research application areas under consideration include, but are not limited to: design computing, design for manufacturing, design for additive manufacturing, methods/tools for design ideation, structural and topological optimization, compliant mechanisms, self-assembling technologies, design of medical devices, intelligent product design, digital simulation technologies, adaptable and reconfigurable complex systems design, and cross-cutting research areas such as bio-inspired design, eco-centric and green design, design at multiple scales and multi-material design, machine learning and informatics.

Candidates must have, by the start date, an earned doctoral degree in mechanical engineering or a closely related field. The new faculty member will be expected to teach core undergraduate and graduate courses in mechanical design (for instance product design, machine design, CAD/CAM, kinematics, mechatronic design, geometric modeling, design optimization), develop new graduate courses in his/her research area, develop and sustain active sponsored research programs, and provide intellectual leadership in his/her research field. The anticipated start date is Fall 2017 but could be earlier. Screening of applicants will begin starting October 15th, 2016 and continue until the position is filled. Interested candidates should upload a complete curriculum vitae, statements of research and teaching goals, and the names, addresses, and e-mail addresses of four references. Candidates may contact the search committee chair, Prof. Jami Shah at shah.493@osu.edu. The website link is https://mae.osu.edu/jobs/faculty-position-mechanical-design.

To build a diverse workforce, Ohio State encourages applications from individuals with disabilities, minorities, veterans, and women. Ohio State is an EEO/AA Employer. The Ohio State University is committed to establishing a culturally and intellectually diverse environment, encouraging all members of our learning community to reach their full potential. Columbus is a thriving highly-rated metropolitan community and we are responsive to dual-career families and strongly promote work-life balance to support our community members through a suite of institutionalized policies. We are an NSF ADVANCE Institution and a member of the Ohio/Western Pennsylvania/West Virginia Higher Education Recruitment Consortium. For more information about the Department of Mechanical and Aerospace Engineering at OSU, please visit http://mae.osu.edu/.

DEPARTMENT OF AEROSPACE ENGINEERING - Open Rank Faculty Search

College of Engineering

University of Illinois at Urbana-Champaign

The Department of Aerospace Engineering at the University of Illinois at Urbana-Champaign seeks highly qualified candidates for multiple faculty positions in all areas of aerospace engineering, with emphasis on the areas of orbital mechanics, space systems, multi-functional composites, and additive manufacturing. Preference will be given to qualified candidates working in emerging areas of aerospace engineering whose scholarly activities have high impact. Please visit **http://jobs.illinois.edu** to view the complete position announcement and application instructions. Full consideration will be given to applications received by **December 16, 2016**. Applications received after that date may be considered until the positions are filled.

The University of Illinois conducts criminal background checks on all job candidates upon acceptance of a contingent offer.

Illinois is an EEO Employer/Vet/Disabled - www.inclusiveillinois.illinois.edu and committed to a family-friendly environment (http://provost.illinois.edu/worklife/index.html).

AEROSPACE ENGINEERING
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

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Faculty Position in Mechanical Engineering

The Department of Mechanical Engineering (www.me.udel.edu) at the University of Delaware (UD) invites applications for an Assistant Professor level tenure-track faculty position in the area of thermal fluids with applications in energy, environment or manufacturing. Possible topics include, but are not limited to, multiphase fluid or thermal transport, complex fluids, thermofluid device design, microfluidics/MEMS, bio-inspired fluid mechanics, aerodynamics, environmental fluid dynamics, and combustion. We seek ambitious and innovative individuals with demonstrated excellence in research and the drive to become leaders in their fields while maintaining high-quality teaching and mentoring activity.

The department has 25 full-time faculty members engaged in the core research areas of biomechanics, clean energy and environment, composite and advanced materials, nanotechnology, and robotics and controls; annual research expenditures are $6.5 million. In addition to hosting the Center for Fuel Cell Research and the Center for Biomechanical Engineering Research, we have strong ties to campus-wide institutions including the Center for Composite Materials, Center for Carbon-free Power Integration, Delaware Biotechnology Institute, Delaware Environmental Institute, Delaware Rehabilitation Institute, Institute for Energy Conversion, UD Energy Institute, and the UD Nanofabrication Facility. Collaborative opportunities exist in the College of Earth, Ocean and Environment, as well as the Center for Applied Coastal Research. UD is also a member of the University Corporation for Atmospheric Research. The undergraduate program is in high demand (over 500 students enrolled) and places a strong emphasis on research and real-world design.

The University of Delaware combines a rich historic legacy in engineering (www.engr.udel.edu/) with a commitment to undergraduate education and the creation of new impactful knowledge. With external funding exceeding $200 million, the University ranks among the top 100 universities in federal R&D support for science and engineering. The main campus in Newark, Delaware, provides the amenities of a vibrant college town with convenient access to the major cities of the East Coast.

Applicants must hold a Ph.D. in mechanical engineering, or closely related field. To ensure full consideration, applications should be received at apply.interfolio.com/37616 before December 15, 2016. However, the search will continue until the position is filled.

The University of Delaware is an Equal Opportunity Employer which encourages applications from Minority Group Members, Women, Individuals with Disabilities and Veterans. The University's Notice of Non-Discrimination can be seen at: www.udel.edu/aboutus/legalnotices.html

Dare to be first.
University of Delaware

UNIVERSITY of HAWAI'I® MĀNOA

Assistant Professor

(Mechanics: Autonomous Vehicles and Robotic Systems), position number 0083205,

University of Hawaii at Manoa (UHM), College of Engineering (COE), Department of Mechanical Engineering, invites applications for a full-time, general funds, tenure track, faculty position, pending position clearance and availability of funds, to begin approximately August 1, 2017.

The University of Hawai'i is a Carnegie doctoral/research-extensive university with a strong emphasis on research and graduate education. The Department offers B.S., M.S., and Ph.D. degrees in mechanical engineering, and its undergraduate program is ABET accredited.

For more information on college research themes, please visit our college web site at www.eng.hawaii.edu. The department has active research programs in robotics, underwater vehicles, ocean and space science & exploration, control systems, dynamical systems, biomedical engineering, biotechnology, renewable energy systems & sustainability, nanotechnology, corrosion, combustion, boiling and two-phase flow, multidisciplinary design and analysis optimization, and high-performance computing.

This faculty can potentially work with UHM School of Ocean and Earth Science and Technology (SOEST) & Institute for Astronomy (IFA) and also contribute to the UH-iLab, Makers, VIP, and Entrepreneurship programs of the College. This faculty can also contribute to the following COE Research Clusters: Autonomous Systems (e.g., UAS, AUV, etc.) and Robotics, Biomedical Engineering, Renewable Energy and Island Sustainability, and Sustainable Materials and Manufacturing Technology.

Duties: Teach and develop undergraduate and graduate courses in Mechanics, Robotics, and Engineering Design. Develop externally funded research program in the area of Autonomous Vehicles and Robotic Systems that results in publications in leading scholarly journals; present research work in leading scholarly conferences; supervise graduate students; teach via various distance delivery modes as required; and serve on departmental, college, and university committees.

Minimum qualifications: An earned Ph.D. (All-But-Dissertation, ABD, cases will be considered) in Mechanical Engineering or a closely related field. The candidate should have background and experience in Mechanics as well as System Integration, Operation, and Applications of Advanced Autonomous Vehicles and Robotic Systems (including design, analysis, fabrication, system integration, testing, operation, and applications of such systems). Candidates must also show a strong commitment to teaching excellence and mentoring at the undergraduate and graduate levels.

Pay range: Commensurate with qualifications and experience.

To Apply: Only electronic applications are accepted. Applicants should follow the instructions at http://www4.eng.hawaii.edu/apply for submission instructions (The applicants should submit a cover letter specifying the position and the research area; a statement on their research interests, activities, and plans; a statement on their teaching philosophy, interests, and plan; a curriculum vitae detailing research and teaching accomplishments; copies of up to 4 relevant publications; and the names, addresses, e-mail, and telephone numbers of 4 references). For more information on the Department, please visit our website at www.me.hawaii.edu.

Inquiries: Professor Mehrdad N. Ghasemi-Nejhad, Chair, 808-956-7560, nejhad@hawaii.edu.

Review of applications will begin on January 15, 2017 and will continue until the position is filled.

The University of Hawai'i is an equal opportunity/affirmative action institution and is committed to a policy of nondiscrimination on the basis of race, sex, gender identity and expression, age, religion, color, national origin, ancestry, citizenship, disability, genetic information, marital status, breastfeeding, income assignment for child support, arrest and court record (except as permissible under State law), sexual orientation, national guard absence, or status as a covered veteran.

Individuals with disabilities who need a reasonable accommodation for the application or hiring process are encouraged to contact the EEO/AA coordinator(s) for the respective campus.

Employment is contingent on satisfying employment eligibility verification requirements of the Immigration Reform and Control Act of 1986; reference checks of previous employers; and for certain positions, criminal history record checks.

In accordance with the Jeanne Clery Disclosure of Campus Security Policy and Campus Crime Statistics Act, annual campus crime statistics for the University of Hawai'i may be viewed at: http://ope.ed.gov/security/, or a paper copy may be obtained upon request from the respective UH Public Safety or Administrative Services Office.

Mechanical Engineering
Faculty Positions Announcement: 2016-2017

The Department of Mechanical Engineering (ME), University of Michigan (U-M), Ann Arbor, seeks outstanding applicants for multiple full-time tenured or tenure-track faculty positions. The positions are open to candidates at all ranks, including junior and senior-level appointments. All who have strong backgrounds in areas relevant to mechanical engineering are welcome to apply. Areas of special interest include dynamics & dynamical systems, solid mechanics & materials, thermal sciences (with an energy & environment focus), and robotics (in partnership with the U-M Robotics Institute faculty cluster search). We are especially interested in individuals who can contribute to the excellence and diversity of our academic community. Underrepresented minorities and women are strongly encouraged to apply.

The U-M Mechanical Engineering Department is a vibrant and collegial community. It is home to 65 tenured/tenure-track faculty, 22 research faculty, over 450 graduate students (including over 250 Ph.D. students), and 750 undergraduate students. We are well known for our leadership in core mechanical engineering disciplines as well as in interdisciplinary and emerging areas. The Department is consistently ranked among the top nationwide and worldwide by various ranking systems, such as the QS World rankings, U.S. News & World Report, and the National Research Council Ph.D. Program Assessments. More information about the Department can be found at: http://me.engin.umich.edu/.

The University of Michigan has a long and distinguished history. It was founded in 1817, 20 years before the territory became a state, and was one of the first public universities in the nation. Throughout its nearly 200-year history, U-M has maintained the highest levels of education, scholarship, and research. Ann Arbor is a very attractive city, regularly rated as one of the best places to live in the nation.

Applicants should have an earned Ph.D. degree in mechanical engineering or an appropriate field. We seek scholars who will provide inspiration, leadership, and impact in research, teaching, and service. To ensure full consideration, candidates are encouraged to apply now and certainly before November 30, 2016, as applications will be reviewed immediately upon receipt.

All applicants should submit, in PDF format: (1) a detailed resume, (2) a statement of research and teaching interests, (3) up to three representative publications, and (4) the names and contact information of at least three references. Applications must be submitted electronically at http://me.engin.umich.edu/facultysearch.

The University of Michigan is a non-discriminatory/affirmative action employer and is responsive to the needs of dual career families.

LEHIGH UNIVERSITY

Technical Entrepreneurship Program
Professor of Practice in New Product Development

Lehigh University seeks applications for a full-time, non-tenure track Professor of Practice for its Master of Engineering in Technical Entrepreneurship in the Department of Mechanical Engineering and Mechanics. The term of the appointment is three years and is potentially renewable. This position reports to the director of Lehigh's Technical Entrepreneurship (TE) program. We are especially interested in candidates who can contribute through their teaching, scholarship and/or service to the diversity and excellence of the university. The TE Masters is an award-winning, cross-disciplinary program affiliated with Lehigh's Baker Institute for Entrepreneurship, Creativity and Innovation, which nurtures a culture of entrepreneurship across the university.

Candidates should have strong credentials in any STEM field and substantial experience in new product development including hardware and software systems. Desirable areas of expertise include medical devices, consumer products, mechanical systems, robotics, energy, transportation, electronics, software, informatics, etc. Ideal candidates will have experience in product development process including conceptual, detailed, and industrial design, creativity methodologies, intellectual property creation and prototype fabrication and testing. Candidates should also have experience in project management and fundraising, finance and budgeting. Demonstrable excellence in curriculum development, teaching and mentoring is critical for this position.

Successful candidates will work with the TE program director to refine the curriculum, recruit students, serve as academic advisor and work with student entrepreneurs. Candidates should also have the ability to strengthen relationships with the innovation, design, product development and entrepreneurship communities. Candidates are expected to be active participants in Lehigh's Kern Entrepreneurial Engineering Network (KEEN), supporting entrepreneurial mindset learning across the curriculum.

Lehigh University is an equal opportunity/affirmative action employer offering excellent benefits, including domestic partner benefits. For more information go to: http://www.lehigh.edu/~inprv/work_life_balance.html.

All applicants must be legally allowed to work in the United States and must apply through the academic jobs online system at:
https://academicjobsonline.org/ajo/jobs/7694

UNIVERSITY OF MISSISSIPPI, THE DEPARTMENT OF MECHANICAL ENGINEERING invites applications for a tenure track position at the Assistant Professor level starting August 2017. Applicants must possess a Ph.D. in Mechanical Engineering or related field, demonstrated teaching and communication skills, Thermo-Fluids-Energy expertise, and a research focus that complements current and planned research interests of the department; to include multiscale computational modeling of highly nonlinear problems involving turbulence, low Reynolds number, and combustion flows, and preferably thermal emphasis. The selected candidate will be expected to teach both lectures and laboratories, as well as performing laboratory development at the undergraduate level in the area of thermodynamics, fluid mechanics and energy. Graduate level instruction as well as mentoring both M.S. and Ph.D. will also be expected. The candidate is expected to develop a long term externally funded research program, and provide professional service, both external and internal, to the University. The applicant should submit a detailed curriculum vita, statement of teaching philosophy/experience and research interests, and a list of at least three references. Submissions will only be accepted electronically through the University of Mississippi jobsite: jobs.olemiss.edu. Screening of applicants will continue until the position is filled. The University of Mississippi is dedicated to the goal of building a culturally diverse and pluralistic faculty committed to teaching and working in a multicultural environment and strongly encourages applicants from minorities and women. The University of Mississippi is an EED/AA/Title VI/Title IX/Section 504/ADA/ADEA employer.

CB&I INC. seeks Sr. Mech. Eng. II in Houston, TX to perform mechanical design & analysis of complex deliverables incl rotating equipment. Requires BS in Mech. Eng. followed by 10 yrs exp in rotating equip. Position requires 20% nat'l & int'l travel. Mail resumes to Stacey Doci-Garza at Two Riverway, Ste 1300, Houston, TX 77056 & ref. job #1892.284.

BRIGHAM YOUNG UNIVERSITY'S DEPARTMENT OF MECHANICAL ENGINEERING will be filling multiple faculty positions during the coming year and is seeking outstanding faculty candidates who will challenge an exceptional student body and contribute to excellent research programs. Candidates with expertise in Computer-aided Engineering Applications, Modern Manufacturing processes (additive processes), or Mechanics of Materials are especially encouraged to apply. The department has state-of-the-art facilities in supercomputing, electron optics, acoustics, microelectronic fabrication, and manufacturing processes. Excellent research programs exist in compliant mechanisms, MEMS, autonomous vehicle control, multidisciplinary and parametric design, CAx (computer-aided applications) tools, friction stir processing, global product development, acoustics, combustion, microfluidics, biomechanics, microstructure design, robotics, materials, and experimental and computational fluid flow physics. Successful candidates will be hired at the assistant professor, associate professor, or professor level, depending on experience. Requirements include a doctorate in mechanical engineering or closely related field and a willingness to fully support and participate in the ideals and mission of BYU. Applications must be submitted online at http://yjobs.byu.edu/postings/ and must include a cover letter, curriculum vitae, statement of research interest plan, statement of teaching interests, educational transcripts, and contact information for at least three professional references. BYU, an equal opportunity employer, requires all faculty to observe the university's honor code and dress and grooming standards. Preference is given to qualified candidates who are members in good standing of the affiliated church, The Church of Jesus Christ of Latter-day Saints. For full consideration, applications should be submitted prior to December 1, 2016.

FACULTY POSITIONS in Mechanical Engineering **MASSACHUSETTS INSTITUTE OF TECHNOLOGY** Cambridge, MA.
The Massachusetts Institute of Technology (MIT) Department of Mechanical Engineering seeks candidates for faculty positions starting September 2017 or on a mutually agreed date thereafter. Appointment will be at the assistant or untenured associate professor level. In special cases, a senior faculty appointment will be considered. Our department is committed to fostering interdisciplinary research that can address grand challenges facing our society. We seek candidates who will provide inspiration and leadership in research, contribute proactively to both undergraduate and graduate level teaching in the Mechanical Engineering department and add to the diversity of the academic community.
Faculty duties include teaching at the graduate and undergraduate levels, advising students and conducting research. Candidates must hold an earned Ph.D. in Mechanical Engineering or a related field by the beginning of employment. Candidates in all areas related to Mechanical Engineering will be considered, including, but not limited to: (1) mechanics: modeling, experimentation and computation, (2) design, manufacturing, and product development, (3) control, instrumentation, and robotics, (4) energy science and engineering, (5) ocean science and engineering, (6) bioengineering, and (7) micro/nanoengineering.
In addition to searching broadly in mechanical engineering, the department is particularly interested in hiring in thermal science and ocean engineering. Please refer to special ads on our website (http://meche.mit.edu/faculty-positions) for details.
Applicants should send a curriculum vita, a research statement, a teaching statement, and copies of no more than three publications. They should also arrange for four individuals to submit letters of recommendation on their behalf. This information must be entered electronically at the following site: https://school-of-engineering-faculty-search.mit.edu/meche/register.tcl by December 1, 2016 when review of applications will begin.
MIT is an equal-opportunity/affirmative action employer. Women and underrepresented minorities are especially encouraged to apply.

THE DEPARTMENT OF MECHANICAL ENGINEERING AT THE UNIVERSITY OF CALIFORNIA, Santa Barbara invites applications for two full-time faculty positions in all core areas of Mechanical Engineering, with particular emphasis in fluid mechanics (Assistant Professor), and micro and nanoscale thermal sciences (Assistant Professor /Associate Professor). The Department is especially interested in candidates who can contribute to the diversity and excellence of the academic community through research, teaching, and service. **APPLICATIONS RECEIVED BY DECEMBER 9, 2016 WILL BE GIVEN PRIORITY CONSIDERATION.** For full details about the positions and to apply, visit https://me.ucsb.edu/open-faculty-positions. The University of California is an Equal Opportunity/Affirmative Action Employer and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability status, protected veteran status, or any other characteristic protected by law.

THREE TENURE-TRACK FACULTY POSITIONS IN MECHANICAL ENGINEERING UNIVERSITY OF NEVADA, RENO
The University of Nevada, Reno Mechanical Engineering Department has three tenured/tenure-track faculty openings. Two of the positions are at any rank with expertise in Thermal/Fluid Science; System Dynamics and Control; Advanced Manufacturing; Materials Processing; and Solid Mechanics.
For a complete position description
or to apply please go to:
https://www.unrsearch.com/postings/22099
The third position is at the Assistant professor level, with expertise in any Mechanical Engineering High Performance Computing field.
For a complete position description or to apply please go to:
https://www.unrsearch.com/postings/22093
The positions will be available July 1, 2017. Full consideration will be given to candidates who apply by January 16, 2017.
In the last five years, the College of Engineering has witnessed an unprecedented growth in student enrollment and number of faculty positions. The College is positioned to further enhance its growth of its students, faculty, staff, facilities as well as its research productivity and its graduate and undergraduate programs.
The University of Nevada, Reno recognizes that diversity promotes excellence in education and research. We are an inclusive and engaged community and recognize the added value that students, faculty, and staff from different backgrounds bring to the educational experience.
EEO/AA Women, under-represented groups, individuals with disabilities, and veterans are encouraged to apply.

LOYOLA MARYMOUNT UNIVERSITY (LMU) in Los Angeles seeks an Assistant Professor in Mechanical Engineering with expertise in bioengineering and/or advanced solid mechanics and design. Candidates should have a Ph.D. in mechanical engineering or a closely related field. Successful candidates will be dedicated to excellent teaching, developing a thriving research program, and supporting the mission of our institution. Apply online at https://jobs.lmu.edu/. LMU is an equal opportunity institution.

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RECRUITMENT

WORTHINGTON STEAM PUMPS EARN ASME DESIGNATION

Will Hoffman gives a demonstration of the replica Worthington Steam Pump.
Photo: The Mariners' Museum

The Worthington Direct-Acting Simplex Steam Pumps, which powered the famous ironclad Civil War vessel USS *Monitor*, was recognized by ASME for their role in revolutionizing the U.S. Navy's fleet. The devices, which are the earliest known surviving direct-acting steam pumps, were designated as an ASME Historic Mechanical Engineering Landmark in a ceremony in August at the Mariners' Museum and Park in Newport News, Va.

Curtiss-Wright sponsored the event with the ASME Eastern Virginia Section. Hampton Rubber Co. and Master Machine and Tool collaborated with Curtiss-Wright on a project to create a working replica of the Worthington steam pumps.

More than 115 people attended the ceremony, including a contingent comprising **Reginald I. Vachon,** ASME past president; **Richard Pawliger,** immediate past chair of the ASME History and Heritage Committee; **John W. Ralls,** chair of the ASME Eastern Virginia Section; and **Paul C. Ticco,** Northeast and Mid-Atlantic regional coordinator for the Office of National Marine Sanctuaries.

The simplex steam pumps, which were invented by Henry R. Worthington, one of ASME's founding members, were reciprocating systems that automatically sent water to the boilers that powered the ship. The pump's simple design featured directly connected steam and water pistons, which eliminated the need for the crosshead, rod, and flywheel used in earlier steam pumps. That resulted in a small and efficient device that was ideal for use in confined spaces such as ships.

For more information on the ASME Historic Mechanical Engineering Landmarks Program, or to see the complete list of ASME landmarks, visit www.asme.org/about-asme/who-we-are/engineering-history/landmarks. ME

ASME PRESENTS CONGRESSIONAL BRIEFINGS ON ADVANCED MANUFACTURING, BIOSCIENCES

The Society recently sponsored two briefings for lawmakers and their staff in Washington D.C.

"Advanced Manufacturing Communities: Encouraging Innovation and Building the Advanced Manufacturing Economy of the Future" was convened in conjunction with the House Manufacturing Caucus as part of a series of manufacturing briefings being held throughout the year.

The discussion focused on innovative solutions that can only be realized with the support of public-private partnerships that encourage the formation of manufacturing communities: places where universities, companies, and local governments work together to promote manufacturing education and innovation.

Among the speakers were **Tom Kurfess,** professor and HUSCO/Ramirez Distinguished Chair in Fluid Power and Motion Control at Georgia Tech and former assistant director for Advanced Manufacturing at the White House Office of Science and Technology Policy, and **Steve Schmid,** professor of aerospace and mechanical engineering at the University of Notre Dame and former assistant director for Research Partnerships in the Advanced Manufacturing National Program Office at the National Institute of Standards and Technology.

A video of the briefing is now online in three segments: www.youtube.com/watch?v=WCZbJ64Kels, www.youtube.com/watch?v=E5N_4uDnBM0, and www.youtube.com/watch?v=Nm1IDOWtrUk.

"Advanced Biosciences for Manufacturing: Driving Solution in Energy, Health, and the Environment," focused on how advances in biosciences can improve the nation's biomanufacturing competitiveness and address grand scientific challenges for energy, the environment, human health, and agriculture.

The speakers included **Mary Maxon,** principal deputy of the biosciences area at Lawrence Berkeley National Laboratory, and **Malin Young,** chief research officer at Pacific Northwest National Laboratory.

To watch part one of the briefing, visit www.youtube.com/watch?v=RQx0Vshvb0k. To view the second part of the session, visit www.youtube.com/watch?v=SYlhTrXhDuM. ME

MANUFACTURING INNOVATION WEBINAR IN ARCHIVE

ASME Government Relations is hosting an archive of its recent webinar, "The National Network for Manufacturing Innovation (NNMI): Striving for U.S. Global Leadership in Advanced Manufacturing."

The webinar featured two ASME Foundation Swanson Fellows who provided viewers with an update on the NNMI program and current and future NNMI opportunities, as well as highlights from their yearlong ASME Fellowships.

The speakers were **Lester Su, Shreyes Melkote,** and **Frank Pfefferkorn.** The archived webinar originated as a live event on September 15.

The NNMI is a Federal program to improve the competitiveness and productivity of U.S. manufacturing through the creation of a robust network of manufacturing innovation institutes, each focused on a specific and promising advanced manufacturing technology area. The goal of the program is to advance American manufacturing innovation by creating an effective research and development, technology transition, workforce training and education outreach infrastructure for U.S. industry and academia to solve industry-relevant manufacturing problems.

For more information on the NNMI Program, visit https://www.manufacturing.gov/nnmi.

To watch the archived recording, go to the Public Policy Education Center at http://ppec.asme.org. ME

PVP DIVISION CELEBRATES ANNIVERSARY IN VANCOUVER

The ASME Pressure Vessels and Piping Division celebrated its 50th anniversary during the 2016 Pressure Vessels & Piping Conference in Vancouver, B.C., in July.

A special anniversary plenary session, "A Sentimental Journey, the PVP History—A Story of Success," commemorated the milestone. ASME Past President and Honorary Member **Sam Zamrik**, Professor Emeritus at Penn State University, member of the PVP Division Executive Committee, and this year's conference advisor, provided a historical overview of the division during that session.


Sam Zamrik

The anniversary was also observed with an Anniversary Honors Gala and Dinner, the distribution of an anniversary book and pin, a special presentation for early career engineers covering the history and background of PVP Division activities, and an ice cream social for women engineers, early career engineers, and students. The event also featured more than 180 technical sessions including nine panel sessions, as well as a special Electric Power Research Institute workshop and several tutorials. More than 1,000 people from nearly 40 countries attended.

The Pressure Vessels and Piping Division was the primary sponsor of the conference, with additional participation by the ASME Nondestructive Evaluation, Diagnosis, and Prognosis Division.

Another highlight of the conference included a plenary session by **Sarah Patterson,** technical director of the Plastics Pipe Institute. "The Development of Polyethylene and the Use in Pressure Pipe Applications" provided attendees with a review of the history and current uses of polyethylene pipe. ME

NORRIS RECOGNIZED BY SCSPE

Marshall J. Norris, P.E., of Greenville, S.C., was recently named the 2016 Engineer of the Year by the South Carolina Society of Professional Engineers. Norris was presented with the award at the 2016 South Carolina Engineering Conference and Trade Show, which was held in North Charleston.

Norris is an ASME member and a senior design engineer at Fluor Enterprises Inc. in Greenville. As Fluor's mechanical department unit organization manager, he is responsible for leading the process mechanical engineering portion of complex large and small projects, and works on both North American and international projects.

In addition to being a member of ASME, Norris is also a member of the Project Management Institute, the National Society of Professional Engineers and SCSPE, where he is currently the president of the Piedmont Chapter. Norris also serves as treasurer of the SCSPE Educational Foundation. He received both a bachelor's degree in mechanical engineering and a master's degree in business administration from Clemson University in 2001 and 2011, respectively.

ASME IMPROVES MENTORING PROGRAM

The Society recently launched an updated version of the ASME Mentoring Program, an online member benefit that for the past five years has been matching experienced engineers with early career engineers and students in need of professional and technical advice.

The new ASME Mentoring Program site includes a number of new features that make becoming an engineering mentor—or being connected with a skilled mentor to help get your budding career on the right track—a simpler and more pleasant experience than ever before.

To learn how the program works and how to participate in the ASME Mentoring Program, view the new step-by-step instruction video on ASME.org. To sign up as a mentor or a mentee, visit http://asme.mywisdomshare.com/user to get started. ME

HIGH-IMPACT INVENTION

When Ben Harvatine's head bounced off the mat at wrestling practice five years ago, it didn't feel like much. By the end of practice he could barely stand. During the two months he spent in the hospital recovering from the concussion, Harvatine, then a junior studying engineering at MIT, promised to help athletes avoid a similar fate.

Harvatine is now CEO of Jolt Athletics, a Boston-based company he founded that's now shipping the second run of its Jolt Sensor. The device, about the size of a USB thumb drive, clips to an athlete's helmet, hat, or head band, and monitors head impacts. It streams the data in real time to a coach's or parent's smartphone app, which records and tracks the severity and frequency of the hits. They can use the information to pull an athlete off the field or alter potentially dangerous training exercises.

The device and others like it have hit the market at a time when the Center of Disease Control is calling the increase of sports-related head injuries a national epidemic. New research from the University of Arkansas found that athletes who continued playing following a concussion took almost twice as long to recover than those who stopped. They also suffered worse cognitive problems than the athletes who stopped.

"I knew I couldn't do anything that could prevent concussions, but I thought there could be some way to mitigate the damage before it got to that point," said the mechanical engineer, who suspects a series of medium hits over the years contributed to the concussion that put him in the hospital.

Harvatine decided to use his head and take a few more hits for the sake of research. He attached a handful of accelerometers to his ear protectors, connected them with a USB chord to a notebook and began measuring the head impacts a wrestler suffers during a typical training routine, which usually consists of a series of repetitive moves. The data supported his initial suspicions: the moves caused a series of whiplash-like head impacts that consistently measured between 20 and 40 g-forces, considered the result of a medium hit, while g-forces of 50 and above represent big hits, he said.

"That's when I realized that all of those things that weren't that obvious were all adding up," Harvatine said.

The current version of the sensor uses an accelerometer that recognizes an impact and measures its severity against previous hits. If the impact poses a risk, usually above 50 g-forces, the sensor vibrates and sends an alert to the app, warning both the athlete and the coach of the possible concussion. A custom communications protocol, built on top of Bluetooth Low Energy, allows a coach to track an unlimited amount of sensors within a 200-yard range.

"You can't make informed decisions without data," he said.

JEFF O'HEIR

The Jolt Sensor clips onto a head band or helmet to monitor concussion-producing impacts.

ASME E-Fests

For more information on our global E-Fest events, visit
go.asme.org/EFests

Be part of an immersive, electric experience that will connect and inspire a generation of change-makers.

The latest in Innovation & Technology

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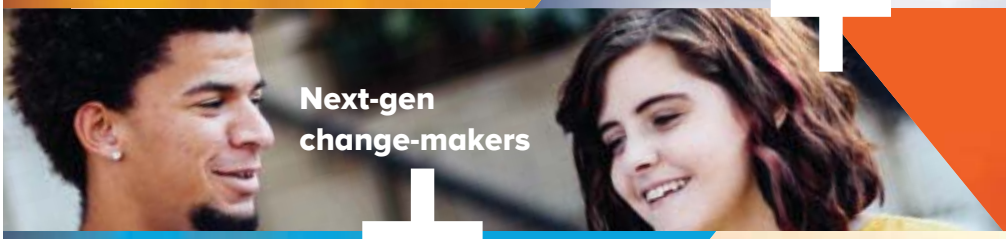


Next-gen change-makers

+

Engineering Students

A Festival

Enjoy performances, music, food and loads of fun, while meeting new people!

= E-Fests

What are ASME E-Fests?

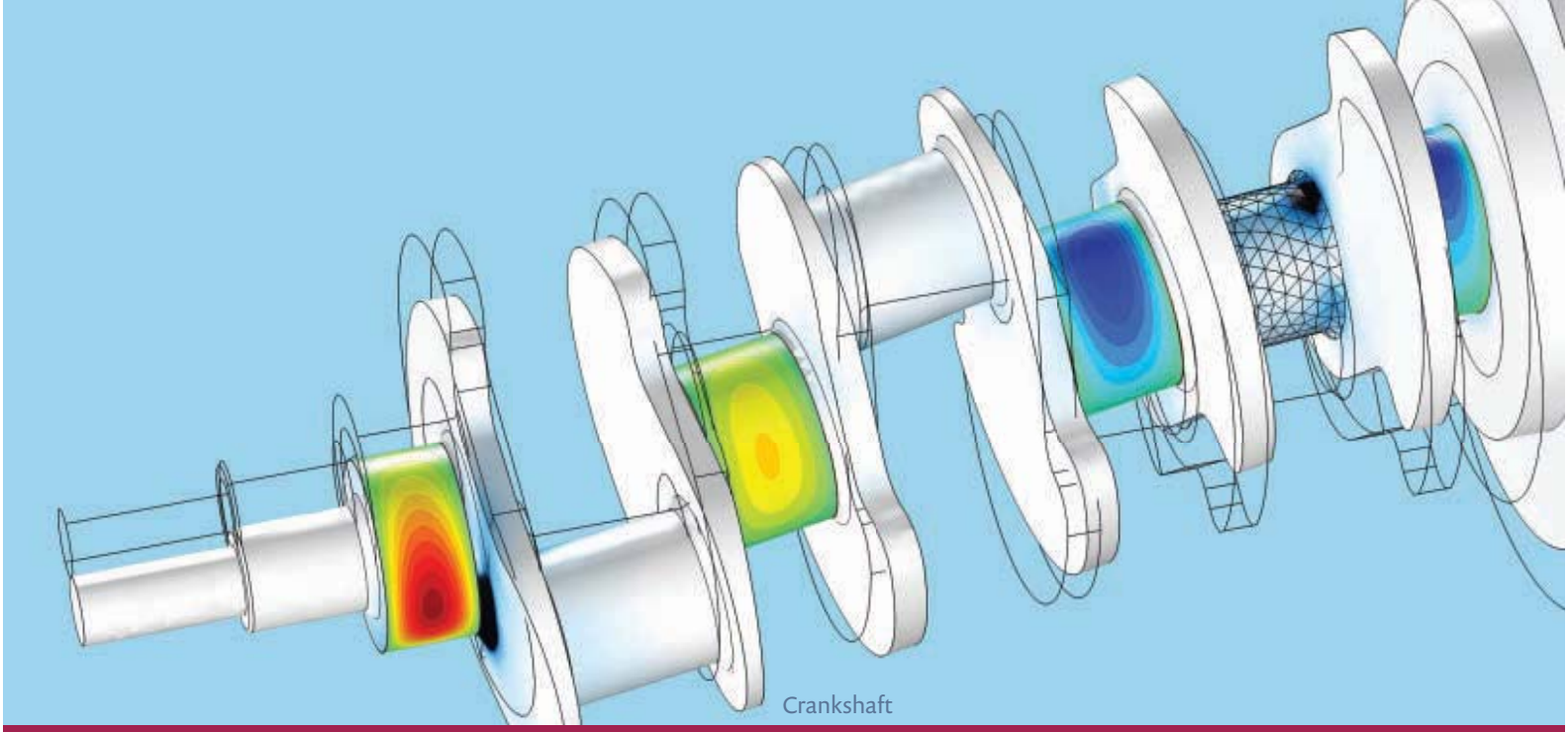
Three-day, two-night regional events built around design, advanced manufacturing and robotics technologies. They enable engineering students to expand their knowledge, test and showcase new skills and inspire innovation.

What's part of the E-Fest Program?

- ASME Competitions
- TED-style Talks on cutting edge engineering developments
- Career briefs + mentoring
- Career development events – Professional skill development and leadership training with a practical twist
- Roundtables + networking – Students team up on fast-paced brainstorming, engineering mini-challenges, hackathons, networking events, etc.

ASME

The American Society of Mechanical Engineers® (ASME®)



Crankshaft

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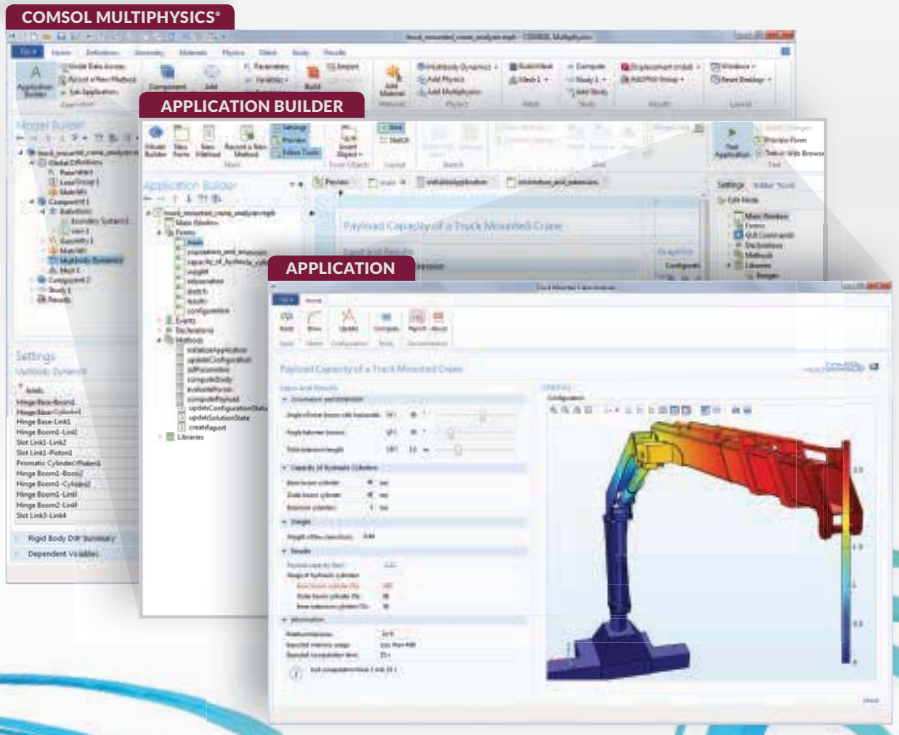

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