Message from the Dean

Larry Larson

The new Engineering Research Center building, which opened this October, was designed to support cutting-edge research, but it also boasts significant new community spaces and two state-of-the-art learning environments. These new spaces embody key aspects of our innovative teaching and learning principles here in engineering at Brown.

Most of the classrooms found in traditional engineering spaces here - and across campus - are set up in the “classic” one-to-many configuration, designed for a faculty member to lecture from the front, and for students to listen and record notes. While this classroom format still serves us well in many topics, there is growing emphasis within engineering on experiential learning - linking class lectures to hands-on research, design, or team-based problem solving.

Brown has long been a leader in student driven learning, and our faculty are keenly interested in pedagogy and how teaching and learning can evolve to best serve our students. Providing students with the opportunity to be introduced to concepts through lectures and readings, and then immediately practice articulating and applying these concepts, has been demonstrated to most effectively teach these concepts and for students to more effectively learn and retain these ideas.

One example of how these teaching methodologies helped shape the planning for the new building is the first-floor undergraduate chemistry and biochemistry teaching lab, sponsored by the Sorensen family. The lab is thoughtfully designed to allow more intensive laboratory analysis using actual samples from the field. This laboratory is three times larger than any of our existing teaching labs, and can better accommodate student projects, and multiple lab groups working at one time.

This teaching lab is also so special in that it contains professional quality research equipment, including fume hoods and snorkels for chemical reactions, as well as environmental and climate sensing equipment, combustion monitors, air quality sensors, metal and elemental analysis equipment for testing and analysis using actual samples from the field. This laboratory is three times larger than any of our existing teaching labs, and can better accommodate student projects, and multiple lab groups working at one time.

This lab is thoughtfully designed to allow more intensive laboratory teaching which could not be accommodated in the existing engineering facilities, and the teaching environment is as flexible as possible. This teaching laboratory was designed to host multiple disciplines including environmental, chemical, materials and biomedical engineering laboratories. It provides students with a state-of-the-art teaching environment which allows them to apply and expand their knowledge, build skills transferable to industry, and enrich their learning experience in engineering.

The second such space in the new building is the project-based seminar room, located on the ground floor. This room was designed as a flexible, flipped classroom, in which the professor can speak and present from multiple perspectives throughout the room, encouraging discussion-based learning and more interactive engagements. The room also features tables and chairs with multiple possible configurations suitable for specific team and project based learning scenarios. The room is also designed with displays on three walls, including a primary projector display for the presenter and smaller LCD displays designed for students to wirelessly connect to and co-present or work collaboratively in a team environment. This environment is designed to promote team-based learning, which mimics the environment engineering students will encounter in their careers and also encourages peer-to-peer learning scenarios in which students are encouraged to formulate and articulate ideas to their peers. This type of concept understanding, articulation, and application has been proven to contribute to deeper understanding of principles and longer term retention of concepts.

The new building has allowed engineering faculty to conceive of and create specialized environments to house teaching and research that was not possible in our previous spaces. Our entire engineering community is truly excited to have these wonderful new spaces that are a representation of the future directions of engineering and will serve to host the next generation of engineers.

School of Engineering Magazine
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Give to Brown Engineering
Let the Move-In Begin

Engineering Research Center Opens its Doors

With high-tech spaces for 15 faculty research groups and more than 100 research associates and graduate students, the building is designed to encourage the kind of interdisciplinary research for which Brown is known.

Two years almost to the day after ground was broken for Brown University’s new Engineering Research Center, major construction work has wrapped up and the new state-of-the-art facility opened for business on Friday, October 20, 2017. A formal dedication will take place on May 24, 2018. Over the next few months, research groups will continue moving into the 80,000-square-foot building, which adjoins existing engineering facilities in the Barus and Holley building and Prince Lab. When fully up and running, approximately 13 faculty research groups, 20 research associates and 80 graduate students will call the Research Center home.

“This is an incredibly exciting time for the School of Engineering,” Sorensen Family Dean of Engineering Larry Larson said. “The building is spectacular and we’ll be doing great science here very soon.”

Padture says he is also looking forward to the ways in which the new space will encourage creativity within his research group. The lab spaces are versatile and open, designed to foster collaboration.

“The commons is just spectacular,” Larson said. “It’s a great open space with a café where anybody can come and have a cup of coffee and talk to friends in a convivial, welcoming environment.”

Construction on the new facility was originally scheduled to wrap up early next year. But the project was completed three months ahead of schedule and right on the $88 million budget. Larson says that is due in large part to the relatively new approach to design and building the structure known as integrative project delivery, or IPD. IPD brings all the stakeholders in the project — the architect, builders, the end users and others — together to make decisions collectively from the beginning of the project to the end.

“The result of all that work and planning, Larson says, is a building that will not only enhance the research capacity of the School of Engineering, but one that is simply a beautiful space inside and out.

From the new green space unfurling from the building’s entrance toward Brook Street to the panoramic vistas afforded by the building’s floor-to-ceiling windows, Brown has a new showpiece in the middle of its College Hill campus.

Larson says he looks forward to more students coming by and getting acquainted with the new space.

“It’s just incredible,” Larson said. “We couldn’t be more excited.”

- Kevin Stacey
Researchers Show How Nanoscale Patterning Can Decrease Metal Fatigue

A new study in the journal *Nature* shows how metals can be patterned at the nanoscale to be more resistant to fatigue, the slow accumulation of internal damage from repetitive strain.

The research focused on metal manufactured with nanotwins, tiny linear boundaries in a metal's atomic lattice that have identical crystalline structures on either side. The study showed that nanotwins help to stabilize defects associated with repetitive strain that arise at the atomic level and limit the accumulation of fatigue-related damage.

“Ninety percent of failure in metal components and engineering structures is through fatigue,” said Huajian Gao, a professor in Brown University’s School of Engineering and corresponding author of the new research. “This work represents a potential path to more fatigue-resistant metals, which would be useful in nearly every engineering setting.”

To understand the mechanism behind this fatigue resistance, the researchers performed supercomputer simulations of the metal’s atomic structure. At the atomic level, material deformation manifests itself through the motion of dislocations — line defects in the crystalline structure where atoms are pushed out of place. The simulations showed that the nanotwin structures organize strain-related dislocations into linear bands called correlated necklace dislocations (named for their beaded-necklace-like appearance in simulation). Within each crystal grain, the dislocations remain parallel to each other and don’t block each other’s motion, which is why the effects of the dislocations are reversible, Gao says.

“In a normal material, fatigue damage accumulates because dislocations get tangled up with each other and can’t be undone,” he said. “In the twinned metal, the correlated necklace dislocations are highly organized and stable. So when the strain is relaxed, the dislocations simply retreat and there’s no accumulated damage to the nanotwin structure.”

The metals aren’t entirely immune to fatigue, however. The fatigue resistance demonstrated in the study is within each crystalline grain. There is still damage that accumulates at the boundaries between grains. But the within-grain resistance to fatigue “slows down the degradation process, so the structure has a much longer fatigue life,” Gao said.

Gao co-authored the study with Hao-Fei Zhou, a postdoctoral researcher at Brown, along with Quingsong Pan, Qiu-Hong Lu and Lei Lu from the Chinese Academy of Sciences.

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Gao co-authored the study with Hao-Fei Zhou, a postdoctoral researcher at Brown, along with Quingsong Pan, Qiu-Hong Lu and Lei Lu from the Chinese Academy of Sciences. "We hope that if we point out the benefits you can get from twinning, it might stimulate fabrication experts to find new ways of creating nanotwins in metals. The electroplating method used to fabricate the copper for this study is not practical for making large components. And while there are some forms of twinned metal available now (twinning-induced plasticity or TWIP steel is an example), scientists are still looking for cheap and efficient ways to make metals and alloys with twin structures."

"It's still more of an art than a science, and we haven't mastered it yet," said Lu, one of the corresponding authors from the Chinese Academy of Sciences. "We hope that if we point out the benefits you can get from twinning, it might stimulate fabrication experts to find new ways that will twin easily."

The work was supported by the U.S. National Science Foundation (DMR-1709318) and the National Natural Science Foundation of China. Computer simulation resources were provided by the U.S. NSF’s Extreme Science and Engineering Discovery Environment (XSEDE).

Huajian Gao's research group has worked extensively on nanotwinned metals, previously showing that nanotwin structures can improve a metal’s strength — the ability to resist deformation — and hardness. The research focused on metal manufactured with nanotwins, tiny linear boundaries in a metal’s atomic lattice that have identical crystalline structures on either side. The study showed that nanotwins help to stabilize defects associated with repetitive strain that arise at the atomic level and limit the accumulation of fatigue-related damage.

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Research Demonstrates Method to Alter Coherence of Light

Brown University researchers have demonstrated for the first time a method of substantially changing the spatial coherence of light. In a paper published in the journal Science Advances, the researchers show that they can use surface plasmon polaritons — propagating electromagnetic waves confined at a metal-dielectric interface — to transform light from completely incoherent to almost fully coherent and vice versa. The ability to modulate coherence could be useful in a wide variety of applications from structural coloration and optical communication to beam shaping and microscopic imaging.

“There had been some theoretical work suggesting that coherence modulation was possible, and some experimental results showing small amounts of modulation,” said Dongfang Li, a postdoctoral researcher in Brown’s School of Engineering and the study’s lead author. “But this is the first time very strong modulation of coherence has been realized experimentally.”

Coherence deals with the extent to which propagating electromagnetic waves are correlated with each other. Lasers, for example, emit light that is highly coherent, meaning the waves are strongly correlated. The sun and incandescent light bulbs emit weakly correlated light, while lasers are strongly correlated. The sun and incandescent light bulbs emit weakly correlated light, while lasers are strongly correlated. The sun and incandescent light bulbs emit weakly correlated light, while lasers are strongly correlated.

“In essence, surface plasmon polaritons are generating efficiencies of surface plasmon polaritons existing on both surfaces of the slitted screen. The research was supported by the National Science Foundation (CMMI1530547).”

“Carefully designing the metal film and the dielectric layer can significantly enhance the generation of surface plasmon polaritons,” Li said. “This is the first time we’ve been able to achieve such strong modulation of coherence.”

“The ability to control and finely tune the interactions between light and electrons in metal films is highly important,” Pacifici said. “This opens up new possibilities for applications in optical devices.”

To do that, Li and Pacifici took a classic experiment used to measure coherence, Young’s double slit, and turned it into a device that can modulate coherence of light by controlling and finely tuning the interactions between light and electrons in metal films.

In the classic double-slit experiment, an opaque barrier is placed between a light source and a detector. The light passes through two parallel slits in the barrier to reach the detector on the other side. If the light shown on the barrier is coherent, the rays emanating from the slits will interfere with each other, creating an interference pattern on the detector — a series of bright and dark bands called interference fringes. The extent to which the light is coherent can be measured by the intensity of bands. If the light is incoherent, no bands will be visible.

“We’ve broken a barrier in showing that it’s possible to do this,” Pacifici said. “This clears the way for new two-dimensional beam shapers, filters and lenses that can manipulate entire optical beams by using the coherence of light as a powerful tuning knob.”

“As this is normally done, the double-slit experiment simply measures the coherence of light rather than changing it,” Pacifici said. “But by introducing surface plasmon polaritons, Young’s double slits become a tool not just for measurement but also modulation.”

To do that, the researchers used a thin metal film as the barrier in the double-slit experiment. When the light strikes the film, surface plasmon polaritons — ripples of electron density created when the electrons are excited by light — are generated at each slit and propagate toward the opposite slit.

“The surface plasmon polaritons open up a channel for the light at each slit to talk to each other,” Li said. “By connecting the two, we’re able to change the mutual correlations between them and therefore change the coherence of light.”

In essence, surface plasmon polaritons are able to create correlation where there was none, or to cancel any existing correlation that was there, depending on the nature of the light coming in and the distance between the slits.

One of the study’s key results is the strength of the modulation they achieved. The technique is able to modulate coherence across a range from 0 percent (totally incoherent) to 80 percent (nearly fully coherent). Modulation of such strength has never been achieved before, the researchers say, and it was made possible by using nanofabrication methods that allowed researchers to maximize the coherence of light.
Brown University researchers have improved the resolution of terahertz emission spectroscopy — a technique used to study a wide variety of materials — by 1,000-fold, making the technique useful at the nanoscale.

**Terahertz Spectroscopy Goes Nano**

Brown University researchers have demonstrated a way to bring a powerful form of spectroscopy — a technique used to study a wide variety of materials — into the nano-world.

Laser terahertz emission microscopy (LTEM) is a burgeoning means of characterizing the performance of solar cells, integrated circuits and other systems and materials. Laser pulses illuminating a sample material cause the emission of terahertz radiation, which carries important information about the sample's electrical properties.

Typically, LTEM measurements are performed with resolution of a few tens of microns, but this new technique enables measurements down to a resolution of 20 nanometers, roughly 1,000 times the resolution previously possible using traditional LTEM techniques.

The research, published in the journal *ACS Photonics*, was led by Pernille Klarskov, a postdoctoral researcher in Mittleman's lab, with Hyewon Kim and Professor Vicki Colvin.

For their research, the team adapted for terahertz radiation a technique already used to improve the resolution of infrared microscopes. The technique uses a metal pin, tapered down to a sharpened tip only a few tens of nanometers across, that hovers just above a sample to be imaged. When the sample is illuminated, a tiny portion of the light is captured directly beneath the tip, which enables imaging resolution roughly equal to the size of the tip. By moving the tip around, it is possible to create ultra-high resolution images of an entire sample.

Klarskov was able to show that the same technique could be used to increase the resolution of terahertz emission as well. For their study, she and her colleagues were able to image an individual gold nanorod with 20-nanometer resolution using terahertz emission.

The researchers believe their new technique could be broadly useful in characterizing the electrical properties of materials in unprecedented detail.

“Terahertz emission has been used to study lots of different materials — semiconductors, superconductors, wide-band-gap insulators, integrated circuits and others,” Mittleman said. “Being able to do this down to the level of individual nanostructures is a big deal.”

One example of a research area that could benefit from the technique, Mittleman says, is the characterization of perovskite solar cells, an emerging solar technology studied extensively by Mittleman’s colleagues at Brown.

“One of the issues with perovskites is that they’re made of multi-crystalline grains, and the grain boundaries are what limits the transport of charge across a cell,” Mittleman said. “With the resolution we can achieve, we can map out each grain to see if different arrangements or orientations have an influence on charge mobility, which could help in optimizing the cells.”

That is one example of where this could be useful, Mittleman said, but it is certainly not limited to that.

“This could have fairly broad applications,” he noted.

The research was supported by the National Science Foundation, the Danish Council for Independent Research and by Honeywell Federal Manufacturing & Technologies.
Researchers Develop 3D Printed Biomaterials that Degrade On Demand

Brown University engineers have demonstrated a technique for making 3D-printed biomaterials that can degrade on demand, which can be useful in making intricately patterned microfluidic devices or in making cell cultures that can change dynamically during experiments.

“It’s a bit like Legos,” said Ian Wong, an assistant professor in Brown’s School of Engineering and co-author of the research. “We can attach polymers together to build 3D structures, and then gently detach them again under biocompatible conditions.”

The research is published in the journal Lab on a Chip.

The Brown team made their new degradable structures using a type of 3D printing called stereolithography. The technique uses an ultraviolet laser controlled by a computer-aided design system to trace patterns across the surface of a photoactive polymer solution. The light causes the polymers to link together, forming solid 3D structures from the solution. The tracing process is repeated until an entire object is built from the bottom up.

Stereolithographic printing usually uses photocurable polymers that link together with covalent bonds, which are strong but irreversible. For this new study, Wong and his colleagues wanted to try creating structures with potentially reversible ionic bonds, which had never been done before using light-based 3D printing. To do it, the researchers made precursor solutions with sodium alginate, then print a permanent structure around it using a second biomaterial, Wong said. “This way we can pattern transient structures that dissolve away when we want them to.

The researchers showed that alginate could indeed be used in stereolithography. And by using different combinations of ionic salts — magnesium, barium and calcium — they could create structures with varying stiffness, which could then be dissolved away at varying rates.

The research also showed several ways in which temporary alginate structures could be useful.

“It’s a helpful tool for fabrication,” said Thomas M. Valentin, a Ph.D. student in Wong’s lab at Brown and the study’s lead author. The researchers showed that they could use alginate as a template for making lab-on-a-chip devices with complex microfluidic channels.

“We can print the shape of the channel using alginate, then print a permanent structure around it using a second biomaterial,” Valentin said. “Then we simply dissolve away the alginate and we have a hollow channel. We don’t have to do any cutting or complex assembly.”

The researchers also showed that degradable alginate structures are useful for making dynamic environments for experiments with live cells. They performed a series of experiments with alginate barriers surrounded by human mammary cells, observing how the cells migrate when the barrier is dissolved away. These kinds of experiments can be useful in investigating wound-healing processes or the migration of cells in cancer.

The experiments showed that neither the alginate barrier nor the chelating agent used to dissolve it away had any appreciable toxicity to the cells. That suggests that degradable alginate barriers are a promising option for such experiments.

The biocompatibility of the alginate is promising for additional future applications, including in making scaffolds for artificial tissue and organs, the researchers say.

“We can start to think about using this in artificial tissues where you might want channels running through it that mimic blood vessels,” Wong said. “We could potentially template that vasculature using alginate and then dissolve it away like we did for the microfluidic channels.”

The researchers plan to continue experimenting with their alginate structures, looking for ways to fine-tune their strength and stiffness properties, as well as the pace of degradation.

In addition to Valentin and Wong, co-authors on the paper were Susan Leggett, Po-Yen Chen, Jaskiranjoet Sodhi, Lauren Stephens, Hayley McClintock and Ion Yun Sim. The research was supported by the Department of Education (P200A150037), National Institutes of Health (ST2ES007272-24), Brown’s Hibbitt Postdoctoral Fellowship and the Center for Cancer Research and Development at Rhode Island Hospital (1P30GM110759-01A1).

Ph.D. candidate Thomas Valentin uses 3D printing to pattern the Brown insignia in an ionically-crosslinked biomaterial.

“Ideas is that the attachments between polymers should come apart when the ions are removed, which we can do by adding a chelating agent that grabs all the ions,” Wong said. “This way we can pattern transient structures that dissolve away when we want them to.

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- Kevin Stacey
With a grant of up to $19 million from the Defense Advanced Research Projects Agency (DARPA), Brown University will lead a collaboration to develop a fully implantable wireless brain interface system able to record and stimulate neural activity with unprecedented detail and precision.

The international team of engineers, neuroscientists and physicians involved in the project envisions an approach to neural interfaces that is unlike any available today. They aim to create a “cortical intranet” of tens of thousands of wireless micro-devices — each about the size of a grain of table salt — that can be safely implanted onto or into the cerebral cortex, the outer layer of the brain. The implants, dubbed “neurograins,” will operate independently, interfacing with the brain at the level of a single neuron. The activity of the devices will be coordinated wirelessly by a central communications hub in the form of a thin electronic patch worn on the skin or implanted beneath it.

The system will be designed to have both “read-out” and “write-in” capabilities. It will be able to record neural activity, helping to deepen scientists’ understanding of how the brain processes stimuli from the outside world. It will also have the capability to stimulate neural activity through tiny electrical pulses, a function researchers hope to eventually use in human clinical research aimed at restoring brain function lost to disease.

“What we’re developing is essentially a micro-scale wireless network in the brain enabling us to communicate directly with neurons on a scale that hasn’t previously been possible,” said Arto Nurmikko.

At Brown, the work will build on decades of research in neuroengineering and brain-computer interfaces, computational neuro-science and clinical therapeutics through the Brown Institute for Brain Science, the University’s Warren Alpert Medical School and its School of Engineering.

“Brown has a tradition of innovative multi-disciplinary research in brain science, especially with projects that have the potential to transform lives through technology-assisted repair of neurological injuries,” said Jill Pipher, vice president for research at Brown.

“This new grant enables a group of outstanding Brown researchers to develop leading-edge technology and solve new computational problems in a quest to understand human brain functionality at a totally new scale,” said Arto Nurmikko.

The project aims to develop a wireless neural prosthetic system made up of thousands of implantable microdevices that could deepen understanding of the brain and lead to new medical therapies.

Brown to Receive Up to $19M to Engineer Next-Generation Brain-Computer Interface

The project will involve many daunting technical challenges, Nurmikko said, which include completing development of the tiny neurograin sensors and coordinating their activity.

“We need to make the neurograins small enough to be minimally invasive but with extraordinary technical sophistication, which will require state-of-the-art microscale semiconductor technology,” Nurmikko said. “Additionally, we have the challenge of developing the wireless external hub that can process the signals generated by large populations of spatially distributed neurograins at the same time. This is probably the hardest endeavor in my career.”

Then there is the challenge of dealing with all of the data the system produces. Current state-of-the-art brain-computer interfaces sample the activity of 100 or so neurons. For this project, the team wants to start at 1,000 neurons and build from there up to 100,000.

“When you increase the number of neurons tenfold, you increase the amount of data you need to manage by much more than that because the brain operates through nested and interconnected circuits,” Nurmikko said. “This becomes an enormous big data problem for which we’ll need to develop new computational neuroscience tools.”

The team will first apply new technologies to the sensory and auditory function in mammals. The level of detail expected from the neurograin system, the researchers say, should yield an entirely new level of understanding of sensory processes in the brain.

“We aim to be able to read out from the brain how it processes, for example, the difference between touching a smooth, soft surface and a rough, hard one and then apply microscale electrical stimulation directly to the brain to create proxies of such sensation,” Nurmikko said. “Similarly, we aim to advance our understanding of how the brain processes and makes sense of the many complex sounds we listen to every day, which guide our vocal communication in a conversation and stimulate the brain to directly experience such sounds.”

The Brown-led team is one of six research teams to be awarded grants from DARPA under the NESP program, which was launched last year. Other awarded projects will be led by researchers at Columbia University, the Foundation for Vision and Understanding, John B. Pierce Laboratory, Paradromics and the University of California, Berkeley.
Brown University School of Engineering Professors Kenny Breuer and Sharon Swartz have received a National Science Foundation – Major Research Instrumentation program award to be used for a new million-dollar animal flight and aerodynamics wind tunnel for use at Brown and beyond for the continued study of biological flight. Both Breuer and Swartz have dual appointments in both the School of Engineering and Department of Ecology and Evolutionary Biology.

Scientists at Brown have pioneered many experiments in the field of animal flight, and in particular bat flight. Animal flight research has become an area of intense research among both biologists and bio-inspired roboticists. These groups use advanced diagnostic tools to better understand the kinematics, mechanics and dynamics of biological flight, power requirements for flight, physiological and muscular processes during flight and sensing and control processes associated with flight and life on the wing.

“The School of Engineering at Brown University is already home to one of the few close-loop low-turbulence animal flight wind tunnels in the United States,” Breuer said. “However, the current facility is dated and in need of new investment. The new facility will be larger, capable of operating at higher speeds and will be equipped with the most advanced equipment for making aerodynamic and biological measurements.”

The new wind tunnel will permit animal flight scientists at Brown University and throughout the U.S. and the world to expand their research, working with a more diverse selection of animals and employing more sophisticated experimental techniques in the study of biomechanics, animal flight and bio-inspired robotics. It will enable advanced measurement of kinematics and dynamics of animal flight, muscle function, echolocation, sensing and control during flight. In addition to biological testing, the wind tunnel will be used by a diverse community of researchers in traditional aerodynamics and fluid mechanics research, allowing for transformative experiments at larger scale and higher wind speeds (contributing to higher Reynolds numbers) on critical projects related to Vortex Dynamics, the use of Cyber-Physical systems for fluid-structure interactions and the development of unsteady aerodynamics for renewable energy harvesting.

Because the facility is so unique, external researchers from diverse communities including major research universities, undergraduate teaching colleges, private and public institutions are expected to participate in research programs using the new wind tunnel and its associated instrumentation. There will be trainings in advanced measurement techniques, and workshops and symposia on biological aerodynamics and control.

Leigh Hochberg Receives Merit Award from VA

Center for Neurorestoration and Neurotechnology (CNN) Director and Professor of Engineering Leigh Hochberg, M.D., Ph.D., FAAN, FANA has received a Department of Veterans Affairs Rehabilitation Research & Development (VA RR&D) Merit Award. Hochberg is the principal investigator for "BrainGate: Robust Neural Decoding for Veterans with ALS," a study that aims to provide Veterans with ALS a means to maintain or restore communication through neurally driven "point and click" control over a computer.

The four-year, $2,038,942 project began on August 1. The study team includes CNN researchers and Brown Engineering Assistant Professor (Research) John Simeral, Senior Engineering Research Associate David Rosler, Stephen Mernoff, M.D., and Margy Bowker, R.N., as well as other research partners at the Brown School of Engineering, the Brown Institute for Brain Science, and Massachusetts General Hospital.

Huajian Gao Awarded von Karman Medal

Huajian Gao, Walter H. Annenberg Professor of Engineering at Brown University, was awarded the 2017 Theodore von Karman Medal from the Engineering Mechanics Institute of the American Society of Civil Engineers (ASCE), at its annual conference.


Gao has been honored by several professional societies for his work. He was elected to the National Academy of Engineering (NAE) in 2012 for contributions to micromechanics of thin films and hierarchically structured materials. In 2015, he was elected as a Foreign Member of the Chinese Academy of Sciences (CAS) for his scientific achievements and contributions made to promoting and developing science and technology in China. In 2017, he was elected to the German National Academy of Sciences Leopoldina in recognition of his scientific achievements. He received the William Prager Medal from the Society of Engineering Science (SES) in 2015 in recognition of his outstanding research contributions in theoretical solid mechanics.

Sharon Swartz named AAAS fellow

Members of the American Association for the Advancement of Science (AAAS), the world’s largest general scientific society, has elected Brown University professor Sharon Swartz as fellow, an honor she shares with Brown biology professor Stephen Helfand, among others, and which she will formally receive at the AAAS Annual Meeting in Austin, Texas, in February 2018.

Swartz, a professor of engineering and biology, won election “for distinguished contributions to the field of biomechanics, particularly for deepening integrative engineering and biology to study the aeromechanics of flight in bats,” according to AAAS.

In her research, Swartz and collaborators have discovered many of the specialized motions and anatomical features that endow bats with their amazing aerial abilities. In the last few years, she has co-authored several papers describing, for example, how tiny muscles in bats control their stiffness and shape, and that bats fold in their wings on the upstroke to save energy.

Swartz said Brown has been a conducive setting for building a team around biology and engineering.

“Brown’s institutional culture of collaboration, particularly across disciplinary boundaries, has been instrumental to our lab’s successes,” she said. “Moving across biological and physical sciences has been easy, and valued, at Brown in a way that isn’t common in the academic world. I couldn’t have created the lab we have today at most institutions.”

Swartz also praised AAAS’s mission of science outreach and promotion.

“I feel very honored to be elected a fellow of AAAS, a unique scientific society, whose role has never been more critical,” she said. “AAAS supports science, scientists and humanity in many ways — increasing public interest and engagement with science, helping scientists communicate more effectively with journalists and the public, promoting responsible use of science in public policy, contributing to the strength and diversity of the STEM workforce, and advancing international scientific cooperation.”
New Grant Supports Comprehensive Research on Traumatic Brain Injury

With a new $4.75 million grant from the Office of Naval Research, a team of scientists aims to develop new insights into how traumatic injuries form in the brain and develop new helmets and protective equipment to help prevent them.

“The helmets used today on the battlefield and on playing fields are tested against a standard developed in late seventies to prevent skull fractures,” said Christian Franck, the grant’s principal investigator and an associate professor in Brown’s School of Engineering. “We want to update that standard to assess how well a helmet protects the soft tissue inside the skull - the brain - and ultimately develop a prototype helmet that meets our new standards.”

Achieving that will require a comprehensive, multi-level understanding of how forces are transmitted from a helmet to the skull, from the skull through the brain and ultimately to the individual neural cells that are damaged during traumatic brain injury (TBI). Franck will work with Brown colleagues Diane Hoffman-Kim and Hanesh Kesari, as well as researchers from Drexel University, Sandia National Laboratory and Team Wendy, a manufacturer of helmets and helmet liners.

Franck’s lab at Brown has developed a novel technique for measuring the effects of traumatic forces on individual neurons. Most previous research on TBI at the cellular level has been done on two-dimensional petri dishes, but Franck uses a custom-built device that can apply compressive forces to neurons inside three-dimensional cell cultures, while using a powerful microscope to track the effects of traumatic forces on individual neurons.

“The mini-brains offer a more complex cell culture than those used by other researchers,” Franck said. “We want to know how much force inside the brain is too much for individual neurons to operate.”

The information gleaned from the cell culture will be combined with results of studies designed to better understand the forces on a helmeted head generated by typical blunt impacts and blast waves. To do that, the research team will work with Team Wendy to develop a sensor system that can be fitted to existing helmets used in combat and athletics. In 2013, Franck and Team Wendy developed a simple but fully functional impact acceleration measuring combat helmet system, which served as a proof of principle for the current grant.

The team will build upon that initial sensor design, then they will use facilities at Drexel and Team Wendy to test the response of helmets to a wide variety of forces, and how those forces are transmitted to the skull. To complete the picture of how forces transmitted by a helmet are distributed through the brain to individual cells, Franck will work with researchers at Sandia National Laboratory. The Sandia team has developed models of the head and neck based on thousands of CT scans. Those models are able to provide insights into how forces are transmitted through soft tissue.

“We want put all these pieces together from the macrosopic level of helmets to the microscopic level of cells to get a complete picture of how these injuries occur,” Franck said. “Once we have that, we can start to think about new methods of diagnosis and prevention.”

Based on the injury model developed during this project, the researchers aim to deploy a version of their sensor system in combat theaters and playing fields. “The idea is that when some- one experiences a blow to the head, the helmet transmits the force data to a computer,” Franck said. “A first responder could then look at that data and determine if TBI is likely and how severe it might be.”

Ultimately, the team hopes the data generated by the research can be used to devise a new testing standard for helmets and a new helmet prototype. In developing the prototype, Franck will work closely with Team Wendy and his colleague in the School of Engineering, Hanesh Kesari, who studies the mechanical properties of solid materials.

“What’s exciting to me about this is that it spans the macro- to micrometer scale,” Franck said. “We’re not aware of any other project that has taken such a comprehensive and tightly integrated approach to understanding how to better prevent these kinds of injuries.”

- Kevin Stacy

Hurt Earns 2017 Graphene Award from IAM at Annual International Conference

Brown Engineering Professor Robert Hurt was named the 2017 Graphene Award of the Year at the European Advanced Materials Congress, the principal annual international conference in the field organized by the International Association of Advanced Materials (IAAM). Hurt also delivered an award lecture at the plenary session entitled, “Graphene-based Breathable Barriers for Multifunctional Fabrics.”

The Graphene Award is given by the IAM for notable and outstanding research in the field of graphene science and technology. The purpose of the award is to recognize outstanding international research work in graphene and 2D materials. Across the world, any researcher engaged in research in the field of graphene and 2D materials and technology is eligible for this award. The prize is awarded based on contributions made through work done during the five years prior to the announcement of the award.

Hurt received his Ph.D. from MIT in 1987 and before joining Brown held positions in the Central Research and Development Division of Bayer AG in Leverkusen, Germany, and at Sandia National Laboratories in Livermore, Calif. He currently serves as Editor-in-Chief of the materials science and nanotechnology journal CARBON. He served as Technical Program Chair for the international conference, Carbon2004, and in the same year received the Grafit Lecture Award of the American Carbon Society. Hurt also received the Silver Medal of the Combustion Institute in Naples, Italy in 1996 and an NSF CAREER Award in the same year. He currently serves as Director of Brown’s NIH-supported Superfund Research Program Center on environmental health and Principal Investigator on the GAANN training grant “Interdisciplinary Training in the Applications and Implications of Nanotechnology.”

Hurt’s research focuses on nanomaterials and their applications and implications for human health and the environment. Current research thrusts include the biological response to graphene-family nanomaterials, mechanisms of carbon nanotube uptake and toxicity, nano- silver and nano-copper transformations in the natural environment, safe material design, and the assembly and folding of graphene to make three-dimensional architectures for barrier and encapsulation technologies, and as electrodes and catalyst supports.

The 2017 European Advanced Materials Congress took place in Stockholm, Sweden in August. The goal of the annual congress is to provide a global platform for researchers and engineers coming from academia and industry to present their research results and activities in the field of fundamental and interdisciplinary research of materials science and technology. It brings together professors, researchers, scientists, business giants, and technicians to offer an international platform for the dissemination of original research results, new ideas and practical development and discover advances in the field of advanced materials and related interdisciplinary topics.

PADTAPPOINTED EDITOR OF ACTAMATERIALIA

Professor Nitin P. Padture has been appointed Editor of Acta Materialia — the premier journal in the field of Materials Science and Engineering. Padture is the Oris E. Randall University Professor in the School of Engineering, and Director of Brown’s Institute for Molecular and Nanoscale Innovation (MINI). He continues to serve as Editor of Scripta Materialia (since 2013), the companion ‘letters’ journal of Acta Materialia.

Padture came to Brown University in 2012 from the Ohio State University, where he was College of Engineering Distinguished Professor and founding Director of the NSF-funded Materials Research Science and Engineering Center. His research interests are in the broad area of advanced ceramics and nanomaterials for applications ranging from electronics to solid-state systems. Padture has published over 190 papers, which have been cited about 13,000 times, and presented over 200 invited/keynote/plenary talks. He is a fellow of the American Association for the Advancement of Science.
Passionate about visualizing the intrinsic beauty of scientific phenomena, Assistant Professor Daniel M. Harris melds the realms of art and science to aid in understanding fluid mechanics.

Capturing a liquid droplet mid-bounce across the surface of a vibrating bath makes for strikingly beautiful art. It also became the basis for an award-winning photograph for one of Brown Engineering’s newest faculty members.

The artwork, although secondary to his research, serves a valid purpose in his research. “Often, it’s a great start in the conversation,” he said. “Technical terms are not always the best way to begin.” Harris’ scientific and technical expertise is in fluid mechanics, interfacial phenomena, microfluidics, and nonlinear systems.

The photographs he takes, like that droplet bouncing indefinitely on the surface of a vibrating fluid bath, and the localized field of waves excited by the droplet, illustrate and serve as an introduction to the work he does in his lab. A self-described amateur photographer, he is a regular contributor to the American Physical Society’s Gallery of Fluid Motion, a visual record of the aesthetic and science of contemporary fluid mechanics.

A native of North Carolina, Harris joined the School of Engineering faculty in the fall of 2017 as an assistant professor. For now, he is borrowing a small section of Professor Kenny Breuer’s lab, while he actively recruits both undergraduate and graduate students as partners in research for several ongoing projects. Later this spring, he will move into the new Engineering Research Center into his own space with all the utilities he needs. “It is very exciting to design the layout of a brand new lab,” he said. “I got the experience of helping design my advisor’s new lab workspace at MIT, but then I graduated and never actually got to work in it.

“While I was at Chapel Hill, I happened upon the chance to collaborate with biomedical engineers,” he said. “A group there was working to improve a cell-sorting device, but needed help with the mathematical model to explain their observations. I have an engineering and an applied math background. I helped them with one small scale part, but working together was truly enlightening for all of us. I took the piece that made sense to me, and it helped bring them context.”

“Crossing boundaries is fruitful, people just don’t do enough of it in general, and it is one of the things I really liked about the space at Brown. For grad students to share is healthy. Not to mention, it’s an aesthetically beautiful building!”

Harris earned his mechanical engineering degree from Cornell in 2010, focusing on thermo-fluids engineering, and his Ph.D. in physical applied mathematics from MIT in 2015. His undergraduate experiences at Cornell, and particularly with the Formula Society of Automotive Engineers, helped shape much of his outlook on what undergraduate research and learning should be. He is excited to work with Brown’s FSAE car team as co-advisor with Chris Bull, Director of the Brown Design Workshop.

Meanwhile, in his lab, pictures of his research taken with off-the-shelf cameras and tripods set up throughout his lab will continue to augment his technical explanations.

“My family is rather artistic,” he said, as he pulled down 6 x 6 tiles, covered in a fabric print inspired by his own research. “My sister designed and made these to decorate my office. I also have a tie in the same pattern, sewn by my mom.” The pattern is an artistic take on a counter-rotating vortex pair in ground effect, part of an award-winning entry in the Gallery of Fluid Motion from 2009.

“I’m sure this is how the photographs have figured so prominently into my work. Moving forward, I hope to be able to do more outreach to the community, using that medium to engage the public on complex scientific discoveries through these images.”

- Beth James
Biomedical Engineering's Ileana Pirozzi '18 Embraces Translational Approach to Medicine

From the time she first stepped foot onto College Hill, there was little doubt Ileana Pirozzi '18 was right where she belonged. Without delay, she delved into chemistry research, designing and developing an experiment to provide hands-on learning of quantum mechanics. Investigating wave mechanics by synthesizing silver nanoparticles, it took her just two semesters and a summer Undergraduate Research and Teaching Award to assist in implementing a new under-graduate experiment that is now used in introductory organic chemistry labs.

"Professor (Anubhav) Tripathi told me to start research early," she said matter-of-factly, referring to her freshman advisor, who continues to serve as mentor and instructor to the senior from Italy. "I attended a UWC (United World College), an international high school, where I received a very liberal education, which shaped how I view education, valuing every aspect of holistic learning - creativity, invention and expression."

"Only a few certain universities then, made sense for me to attend. Brown has helped me in that it has been exactly what it advertises to be. So from the beginning, it was a natural transition for me."

Transitions appear easy for the likeable 20-year-old, who, in her sophomore year, made the move back to biomedical engineer- ing, joining the Tripathi Lab and focusing on medical diagnostics, and a translational approach to medicine. As a sophomore and junior, she joined the lab's work on cancer cell detection, working with an oil and water interface on a microfluidic device to isolate rare cancer cells from whole blood via immunomagnetic capture. She worked inde- pendently and persistently to improve upon the device, illustrating her versatile skills in the laboratory.

"Ileana came to my lab driven to contribute in a meaningful way," Tripathi said. "She continually shows the desire to take on chal- lenging problems and work with complicated instruments that others have avoided."

"For me, the beauty of it all is really in the way it comes together," Pirozzi said. "As a biomedical engineer, you have to understand the governing physics and mathematical principles, but also be an expert in biology. It is so interesting, yet challenging, to com- bine these equally fascinating aspects of my degree. To understand pressure and velocity profiles in microfluidic flows as well as criti- cal frequency of rotation, while keeping in mind the effects of shear rates on live cells. These are the reasons I love BM&E," she mused.

Before the end of her junior year, Pirozzi’s research had led to an original manuscript, along with an invitation to present at the Biomedical Engineering Society’s annual meeting in Phoenix in October. The device her research centers around demonstrates high purity and high selectivity, making it a competitive option for diagnostics, while its compact size makes it a potentially portable, point-of-care diagnostic device. This is an impor- tant part of what attracts Tripathi to the lab every day - the idea that diagnostics exempli- fies how engineering helps human lives.

By spring of her junior year, she had also seen enough convergence of physics, math and bi- ology to propose her own new device idea for cancer cell separation, isolation and subse- quent on-chip assays, by exploiting centrifugal and Coriolis forces to compartmentalize cells. She proposed the idea to Tripathi, and a Vincent and Ruby DiMase fellowship over the summer helped finance the opportunity to explore this newest "lab-on-a-chip" idea.

She spent the summer conceptualizing the project, developing the computational model and design optimizations to get to a prototype.

"Most importantly, this fellowship enabled me to appreciate, from start to end, the dedica- tion, frustration and satisfaction of seeing your own project grow from a con- ceived idea to a working prototype," Pirozzi said. "The roadblocks forced me to trouble- shoot and think creatively, and increased my commitment to the project."

"Thanks to the DiMase, I was able to balance living expenses and project budgeting, which is a truly educational experience for a developing scientist."

Graduate Student Kyle Gion ’17, Sc.M. ’18 Named Slavin Fellow

Kyle Gion ’17, Sc.M. ’18 (CBE) was recently announced as one of five new Slavin Fellowship awardees, joining an elite group of student entrepreneurs chosen for their talent, drive, and desire to create positive change in the world.

Since the Slavin Fellowship program began in October 2015, it has awarded Fellowships to 14 entrepreneurs, including Brown students or alumni at each of this year’s three award dates in February, Matthew DiMarcantonio ’18 and Aaron Mayer ’18, in June, Brown alumnus and Schwarzman Scholar Max Song ’14; and most recently, Gion.

The Slavin Fellowship is the brainchild of entrepreneur Nick Slavin. In 2004 as a 18-year-old senior at Yale, he founded his first company, later sold following his time at Harvard Law School. Since moving to Los Angeles, Slavin has founded his own startups in addition to advising and investing in industrialists in medicine, virtual reality, augmented reality, energy, education, and space exploration.

“Sometimes even the most brilliant of stu- dents need a helping hand as they navigate a path in the real world, and I feel compelled to help because I know how much is at stake,” Slavin said. His Fellowships receive support and mentorship from the Slavin Family Foundation’s broader network of entrepre- neurs, investors, academics, and other lead- ers, as well as a place among what has become a tight-knit group of Slavin Fellows. Fellows receive a $2,500 scholarship.

For Gion, entrepreneurship was not on his radar until this year. “My internship last summer was at a pharmaceutical company that develops drugs for treating the underlying cause of cystic fibrosis. Seeing firsthand how research can drastically improve the lives of patients instilled in me a desire to pursue something that positively impacts the world,” Gion said.

As a graduate student doing research on nanomaterials in Professor Robert Hurt’s lab, Gion enrolled in Professor Danny Warshay’s ENGN1010 course, ‘The Entrepreneurial Process’, on a whim. From an announcement Warshay made during class one day, Gion learned Slavin was com- ing to campus to speak about his work on a chemistry venture founded on research from a Nobel Laureate lab, his involvement in a foundation that is sending knowledge into space, and his seed-staged venture capital fund.

“Seeing firsthand how research can drastically improve the lives of patients instilled in me a desire to pursue something that positively impacts the world.”

Gion had a brief conversation with Slavin after the talk but did not have the opportu- nity to speak one-on-one with him. “I sent him an email after we met saying I wanted to know more about his Fellowship and was thinking of applying,” Gion said.

A few days after Gion met up with Slavin, he received confirmation from the serial entre- preneur that he had been accepted into the Fellowship. Slavin said that he saw in Gion an "unstoppability and determination that you see in the best founders." Gion also holds two U.S. National records in free diving, evidence he is able to set a goal and see things through.

“It’s funny how small choices can magnify. I grew up in Hawaii and one of my greatest passions is free diving, a form of underwater diving where individuals compete for the longest breath hold, deepest dive, or farthest distance swam on a single breath hold. It all began when I accepted a friend’s offer to go spearfishing and here I am eight years later having spent countless hours training and
Engineers Win Brown Hult Prize, Take Second in Global Business Plan Competition

Cloud Agronomics, a team composed of Jack Roswell ’20 (mechanical engineering), Alex Zhik ’20 (mechanical engineering), and Julian Vallelyesse ’20 (chemical engineering) won the Brown Hult Prize Pitch Competition in December, capping off a fall semester of awards for the startup group. Cloud Agronomics has developed a solar-powered unmanned aerial vehicle (UAV) drone that uses remote sensors to provide farmers better data about their crops.

Ten ventures pitched ideas focused on harnessing the power of energy to change the lives of 10 million people at Brown’s Hult competition. With that victory, Cloud Agronomics will advance to compete at the Hult Ivy competition in April held at the University of Pennsylvania, followed by the regional Hult competition in Boston in March. The winner of these competitions spends the summer in the Hult Castle in the Hult Accelerator program polishing their idea to pitch at the United Nations.

The group also tied as first runner up in the Startup Storm global competition held in October. StartupWind, Inc. is a social networking and equity crowdfunding platform, and invited budding entrepreneurs from premier schools to create a business plan and a funding ready pitch, showcasing their plans in front of a global network of 6,000 investors, mentors and entrepreneurs. The second place cash prize was $2,500 and continued mentoring by Startup Storm, who has connected the group to a venture capitalist.

“Having a platform that enables aspiring student entrepreneurs to get access to funding, advice from professionals, and the opportunity to meet other like-minded students has been a truly phenomenal experience,” said Vallelyesse. “StartupWind has given us a mouthpiece to articulate our ideas and receive constructive feedback in an unparalleled way,” said Vallelyesse.

Honor Society Inducts Newest Members

Tau Beta Pi, the engineering honor society, inducted 32 new members into the Rhode Island Alpha chapter at Brown University on Friday, December 8. Eighteen juniors were inducted along with 14 seniors.


Mohak Patel Places Second in Paper Competition

Brown School of Engineering Ph.D. candidate Mohak Patel took second place in the Society of Experimental Mechanics (SEM) Student Paper Competition held in Indianapolis. The Student Paper Competition was established to encourage excellence in technical communication in the experimental mechanics field. The title of his paper was “Beyond DIC: Displacement Mapping via Position-based Single Particle Tracking.”

“It’s still in stealth mode,” Gion said slyly. “Nick and I are having a startup related to the application of communication systems in healthcare. It’s still in stealth mode,” Gion said slyly. “Nick and I are having a startup related to the application of communication systems in healthcare.

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Weekend Exclusive: Pirozzi ’18 Embraces Translational Approach to Medicine

Pirozzi’s contributions include working on self-healing materials for the mission and bioBactery, a biological replacement to a chemical treatment. Pirozzi’s contributions include working on self-healing materials for the mission and bioBactery, a biological replacement to a chemical treatment.

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Increasing prosthesis accessibility was the goal of RiseUP: Universal Prosthetic Socket (below left) and Project Ascend: An Adjustable Pylon for Pediatric Lower Limb Devices (below right). BME concentrators and brothers Alexander ’18 and Matthew Lo ’18 teamed with mechanical engineering concentrator John Figus ’18 to produce a universal socket for the residual limb. Biomedical engineers Luke Morales ’18, Justin Lee ’18, and Claire Sise ’18 worked on the adjustable pylon for pediatric patients, and both groups were advised by Professor Braden Fleming and Michael Nunnery, owner of Nunnery Orthotic and Prosthetic Technologies. Senior Lecturer Chris Bull also advised on Project Ascend.

BME concentrators Anne Beer ’19, Mark Hays ’18, and Keenan Line ’18 joined with Rhode Island School of Design senior Emily Holtzman to design an Innovative Room Divider to Transform Parental Experience and Reduce Stress in the Neonatal/Intensive Care Unit by allowing parents to destress, sleep, and interact in a private, disturbance-free section of their single-family NICU room. The group was advised by Dr. Ravi D’Cruz.

An Audiovisual Interface to Facilitate Parental Bonding in the Neonatal Intensive Care Unit was presented by Bonnie Marcus ’18, Ameka Khoo ’18, and Elizabeth Bixler ’18, all BME concentrators. More than 3.5 million laparoscopic surgeries are performed every year in the U.S. Hand-assisted laparoscopic surgery (HALS) necessitates use of tools with one hand. Many current laparoscopic stapler designs on the market are exclusive of surgeons with smaller hands, causing a negative bias toward women or people with small hands. The group sought to create a laparoscopic stapler for use by surgeons with an adapter to support ease for all surgeons. The clinical advisor was Dr. Adena Dsiband.

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Interactive Social Robot for Calming Agitated Senior Patients in the Emergency Room was presented by Joshua Daniel ’18, Anthony Minnahn ’16, and Abdi Abdil ’18 (not pictured), all BME concentrators. Hospital-induced delirium affects seven million hospitalized Americans each year. Treatment is difficult when patients are agitated and violent. Sedation is an often preferred cheap and easy go-to option with side effects. Current robotic animals are prohibitively expensive or have basic interactivity. The group sought to design a robotic pet suitable for use in a clinical setting, and was advised by Assistant Professor Dr. Alison Hayward.

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Easy Removal in Deep Brain Simulation Polymeric Electrode Catheter Design for Pocketed Filter for Embolic Protection in Aortic Cannulation Cardiothoracic Surgeries was presented by biomedicalengineering’s Lilbeth Martinez ’18, Zahra Ahmed ’18, Rhode island School of Design senior Lucy Yip, and Amber Buhagiar ’18. Because the current practices fall short of desirable criteria, the group intended to design an inexpensive malaria diagnostic tool that rapidly detects low levels of infected red blood cells in blood in 30 minutes or less, is simple to operate, and can be deployable to low-resource settings. Associate Professor Dr. Ian Michlow served as clinical advisor to the project.

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Musical Blocks Integrate Blind, Sighted Children at Play

A multidisciplinary team of Brown and Rhode Island School of Design students is developing a sensory play toy utilizing prototyping tools in the Brown Design Workshop.

Equipped with background research concerning the visually impaired community and a desire to create change, industrial design major Rosa Park from the Rhode Island School of Design signed on with Design for America looking for a team. Her topic “Increasing Literacy Rates in Blind Children” was one of several January 2017 projects accepted in the Brown/RISD program that uses design to approach complex community challenges. The then-sophomore knew she wanted to create something with societal impact, but she lacked specificity. Meanwhile, four Brown University students, with backgrounds in electrical engineering, biomedical engineering, cognitive science and classics signed on for the project, based on the pitch and project description provided by Park. No one in the group knew any of the other members.

Fast forward a full year. The group of five became six, has capitalized on their complimentary skill sets, and are on the verge of creating a product that has the ability not only to integrate sensory play between sighted and blind children, but with technology that could be of interest to the music industry.

“Our initial intent was to increase literacy rates for braille,” said Anya Brown ’19 (classics). “Braille is declining at a very fast rate. It is one generation from being removed. We knew early on that we needed to find ways to incorporate the visually impaired into the community, if for no other reason than to give them independence.”

The spring semester was spent enhancing Park’s initial research, with an overarching thought toward design. Surveys, interviews with educators, site visits to public schools that serve visually impaired children, and developing a connection with the Perkins School for the Blind in Watertown, Massachusetts were key research factors for the group. “I think one of the biggest things we began to understand was that the visually impaired learn part-to-whole, whereas we learn whole-to-part,” Park said. She used a water bottle as an example. A seeing person sees the whole bottle, and then considers the lid, the label, the shape. A visually impaired person must first tactilely investigate the lid, the label, and how the pieces fit the shape to understand it is a bottle.

“What we learned by being at Perkins was that these students feel very isolated,” said Matthew Lo ’18 (biomedical engineering). Park added, “Cognitive abilities of visually impaired students tend to be at different levels. We decided to concentrate on the student-student connection. This topic of integrated play seemed to be a good fit.”

“When you begin to do research, you quickly realize that technology can be used to integrate the visually impaired student with their non-disabled peers,” said Monica Alves ’20 (electrical engineering). With the spring semester winding down, and a direction taking shape, the group was ready to begin prototyping in the fall. “We knew we wanted a simple design where complexity was determined by the user,” said Michelle Basta ’18 (cognitive science), referring to the preliminary forms of the building blocks that play notes when connected.

The group found themselves carving out space in the Brown Design Workshop, but decided they could use another engineering team member. Enter Iyad Owen-Ellia ’17.5 (mechanical engineering), who was returning to campus to complete his degree, and had previous experience with Design for America.

“We sat down to build, and realized we needed a lot of materials,” Owen-Ellia said. “So we applied for and received several grants.” Among those grants were a Brown Design Workshop Maker Grant, as well as funds from other places in the university, including the Swartz Center.

“We had to get more specific about components, what would be feasible in a semester of prototyping. There were choices to make about what exactly could go into the block. The BDW really became our meeting place,” he said. “We probably spent more time there – on the electronics equipment – than any other group during the semester. Even though Matt was a BDW mentor, I think the rest of us were mistaken for mentors multiple times.” Owen-Ellia joked.

The prototype results are Melos, auditory building blocks designed for a collaborative play opportunity for blind and sighted children to compose music together. The name comes from the Latin noun melos, meaning song, tune, strain, a melody or hymn.

“This could be appealing to aspiring music producers,” Owen-Ellia said. “The core technology covers a wide range of music creation, and a new way of building a song. We designed Melos to inspire either casual social play or individual composition sessions.”

The Melos will continue to grow next semester. “There is still testing to be done, in the field, to see what kind of interactions we get with the blocks,” Park said. “We’re hopeful this will open more possibilities, and more iterations of the Melos. I love that I’ve learned so much from working with this group. It’s never easy to get involved in a project at this depth with a group that comes from different schools, with different majors, but everyone has both contributed to the whole, and taken away knowledge they didn’t have before. It’s rare to find a project that is so interdisciplinary, with a group of people who are so passionate about it.”

“The main thing our organization is trying to do is to prove the cost-effectiveness and accessibility of space,” he said. “So if we can get this off-the-shelf 360-degree camera to the edge of space and make it perform well with simple modifications, that fits our core values.”

The second major test was the transmission and receiving equipment needed to broadcast live images to the web. The transmitter absorbed the balloon sent a signal to a mobile home, which transmitted the images to the students droved under the balloon’s flight path.

“Half the team spent a great deal of time trying to figure out how to send the images back down to Earth so we could watch them in real-time,” Belcaster said. These are potential systems that could be used on future satellites the club designs. The team has been working on their current satellite since 2011, and received approval for a NASA launch in 2014. Belcaster is hoping that the testing done on these balloon flights might speed up production of future student satellites.

“We’re trying to cut down on the time it’s going to take to get EQUiSat into space,” he said. “We’d like to bring that down to maybe two years or so for the next one.”

The full balloon launch recap is available at http://brownspaces.org/Ewen.

From Left: Celina Chen ’21, Shreya Bagharia (RISD), Tacker Wray ’21, Anisha Medicherla ’20, Madhu Adumu ’21, Noah Thorson (RISD), Alex Ng ’20, David Schulman ’20, Henry Belcaster ’19, David Lu ’20, Nishan Khawale ’20, Esmirada Montes ’21, Austin Stewart ’20

- Kevin Stacey
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Glicksman taught at Brown for 25 years, ultimately becoming University professor emeritus and professor emeritus of engineering and physics. He joined the faculty in 1969 after working at the Radio Corporation of America (RCA) Laboratories in Princeton, N.J. and directing the RCA Laboratories in Tokyo. RCA’s semiconductor division was a focal point of Glicksman’s research.

“Through his research, Maurice Glicksman became one of the pioneers in advancing fundamental semiconductor science. In the 1960s and ’70s when the challenge was to understand the electrical conductance of semiconductors such as silicon and germanium at high-electron density,” said Arto Nurmiokko, Glicksman’s colleague and a professor of engineering and physics at Brown. “Unraveling the interactions at microscopic level of such many-body systems then led, in turn, to the astonishing acceleration in the pace of development of transistor technology toward modern microelectronics.”

Glicksman’s arrival at Brown heralded an “expansion in condensed matter physics and engineering,” at the University, Nurmiokko said. Rodney Clifton, a professor emeritus of engineering, added that Glicksman, along with two colleagues, “really boosted Brown in solid-state physics and engineering.”

In addition to his scholarship and teaching, Glicksman served as chairman of the Faculty Policy Group, was appointed dean of the Graduate School in 1975 and acting dean of the faculty and academic affairs in 1975. He served in both capacities until he was named provost and dean of the faculty in 1978, posts he held until 1990.

Glicksman’s career also included leadership positions with groundbreaking research laboratories. In the 1980s he chaired the board of overseers of the Fermi National Accelerator Laboratory (Fermilab), the leading particle physics and accelerator laboratory in the U.S. With this role he came full circle, having earned his Ph.D. at the University of Chicago, where he studied with Enrico Fermi, a leader on the team of physicists on the Manhattan Project for the development of nuclear energy and the atomic bomb.

Despite having a unique perspective on 20th-century scientific developments, however, Glicksman was known among his colleagues as a man who talked little about himself and expressed great interest in the work of others.

Gang Xiao, chair of the physics department and professor of physics and engineering, said that Glicksman’s interest and encouragement meant a great deal to him while Xiao was a young physicist. So did his impact on my life both during school and after I left Brown. His was the number of students he mentored. One comment: “He has had a lasting impact on my life both during school and after school and I will miss him.” Another held a remembrance in San Francisco. To all he was a model of commitment to learning, to being a friend, to seizing opportunities.

Maurice Glicksman P’78

GP’13, an accomplished engineer, physicist and long-time Brown University faculty member who served as provost from 1978 to 1990, died on May 26 at age 88.
The School of Engineering is grateful for the support of all of its donors during the 2017 fiscal year (July 1, 2016 – June 30, 2017). The listing of individuals, organizations and support makes the continued commitment to excellence in teaching and research at the Brown School of Engineering possible. While every effort has been made to ensure accuracy, please notify us immediately if there are any errors or omissions.

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BRUCE CHICK ’50
SCM’53, P’77, P’80, GP’17, GP’17

Belonging: Multiple generations of one family have called Brown “home”

A planned gift helps Bruce and Caroline Chick make an impact on the School of Engineering and financial aid.

How did it all start?
When Franklin Augustus Chick moved from Limerick, Maine by hay wagon to the more populous Westbrook so that his children could receive better schooling? Or when his son Alton Charles Chick graduated with both a bachelor’s (1919) and a master’s (1926) from Brown prior to teaching at the University?

Whatever the beginning, by the time Alton’s son Bruce was of age, his love of family and a quality education was strong. And Brown University figured highly in both.

“I always wanted to be an engineer; my father was an engineer,” says Bruce. A Providence native, he enlisted in the Navy right out of high school due to World War II. There, he trained as an electronics technician prior to a tour in the Pacific. His dream ultimately prevailed: following his discharge in July, 1946, he enrolled as a Brown engineering student in September.

From student to staff on College Hill
Some campus experiences remain sharply focused. His blind date with Caroline Decatur, who later became his wife, is one of them. Both remember it taking place at a May Day Dance on the Pembroke campus during their sophomore year. Caroline, who is five-foot-two-and-a-half, she says, had to look “way up” at the six-foot-tall Bruce whom she was meeting at the behest of a mutual friend. Smiles and laughter accompany the telling.

Even with a master’s degree, Bruce found that jobs for electronics engineers were, in 1953, hard to come by. “I always wanted to be an engineer; my father was an engineer,” says Bruce. A Providence native, he enlisted in the Navy right out of high school due to World War II. There, he trained as an electronics technician prior to a tour in the Pacific. His dream ultimately prevailed: following his discharge in July, 1946, he enrolled as a Brown engineering student in September.

Continuing the legacy of giving back
His connection with the University changed over the years, too. The core group of four graduates—Caroline and Bruce Chick, his late dad and late brother (Alton, Jr. ’45)—has, with the addition of the couple’s daughters (Deborah Chick Burke ’77 and Nancy Chick Hyde ’80 P’17), expanded to eight. So it was an easy choice, when it came to estate planning, to include Brown. Bruce’s dad, many years earlier, had established a scholarship via a planned gift. “When you reach a certain point in life, you start to wonder where you want to make a contribution,” says Caroline. “Brown University is very dear to us. We wanted to do something similar to what my husband’s father had done.”

The couple set up a Charitable Gift Annuity, with half of the residual allocated to the construction and maintenance of the building(s) housing the School of Engineering and the other half to The Bruce and Caroline Chick Financial Aid Fund.

“It’s either in your heart to give or it’s not,” says Bruce. “We’re hoping that our daughters or their families might add to our funds—the same way we added to my dad’s scholarship—when we are gone. Our small gift will make little impact on the School of Engineering. But if enough people give small gifts, it will make a huge impact.”

- Catharine Beattie

Giving Opportunities

New Engineering Facilities

School of Engineering Building Fund
New and renovated space on College Hill for education, collaboration and research including classrooms, research labs, conference rooms, etc.

Brown Design Workshop in Prince Lab
The focus of collaborative making and experiential learning for the campus

Faculty Support

Endowed Professorships
Providing faculty support plus start-up funds for research and infrastructure needs

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Endowed Graduate Fellowships in Engineering Support for transformative research

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Endowed First-Year Seminar Fund Provides funding for one first-year seminar each year

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Endowed Technology Investment Fund
Support for enhanced classroom technology and new and upgraded state-of-the-art instructional equipment for labs

Dean’s Fund for Engineering Excellence
Support investment in novel research and curriculum innovations, and the creation of new educational ventures

“I HAVE GOTTEN TO KNOW DEAN LARRY LARSON OVER THE PAST FEW YEARS AS A MEMBER OF THE ENGINEERING ADVISORY COUNCIL AND HAVE SEEN THAT HE HAS A STRONG VISION FOR ENGINEERING AT BROWN, AND HAS PROVIDED GREAT LEADERSHIP AT AN IMPORTANT TIME. THERE IS IMPORTANT WORK TO BE DONE TO SUPPORT THE DEMAND FOR ENGINEERING EDUCATION AND RESEARCH, INCLUDING GROWING OUR GRADUATE PROGRAMS, RECRUITING NEW FACULTY, AND COMPLETING THE NEW RESEARCH BUILDING. PLEASE JOIN MY WIFE BLAIR AND ME IN SUPPORT OF THE SCHOOL OF ENGINEERING. TOGETHER WE CAN ENSURE THAT THE NEXT GENERATION OF BROWN STUDENTS HAS THE RESOURCES THEY NEED TO PREPARE THEMSELVES TO ADDRESS THE GRAND CHALLENGES FACING 21ST CENTURY ENGINEERS.”

- M. Fazle Husain ’87, Engineering Development Committee

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$137.6 M as of December 31, 2017

Campaign goal

$160 M

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All amounts
In recognition of your collective investment, the names of all School of Engineering donors who contribute $10,000 or more in gifts before December 31, 2017 will be displayed publicly in the new Engineering Research Center.

All donors to the School of Engineering campaign will be invited to join us to celebrate the public building dedication on May 24, 2018.

Please consider this opportunity as we establish the new Engineering Research Center and strengthen the School’s ongoing efforts to educate future leaders in the fundamentals of engineering in a world-class research environment.

Contact: Rick Marshall, Director of Development for the School of Engineering, Richard_Marshall@brown.edu Tel: +1 (401)863-9877.

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Thursday, May 24, 2018
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