CornellEngineering
Sibley School of Mechanical and Aerospace Engineering

MAE MAGAZINE

2021

USING SYNTHETIC SOFT MATERIALS TO CREATE BIO-INSPIRED CIRCUITS

MAE DIRECTOR'S MESSAGE

DAVID ERICKSON

Hello Sibley School Friends,

Well, it's been another exciting year!

Last academic year was one of the most disruptive to higher education in a long time. As you might recall, last fall Cornell was one of the few Ivy League Universities to welcome all students back to campus for a combination of socially distanced in-person and on-line courses. I'm happy to report that this went quite well. As a university, we conducted over 1,000,000 COVID tests on campus for faculty, staff, and students (at times close to 1% of all tests in the U.S. were being done at Cornell). In the end we were able to get through the year with a lot of zoom meetings but without any major disruptions. It was a major success earning personal praise from Dr. Anthony Fauci himself!

Building on that success, this year we back to "almost" normal. Thanks largely to exceptionally high vaccination rates on campus (99% of faculty, graduate and undergraduate students are fully vaccinated) and continued masking we're back to all in-person lectures with regular density classrooms and labs! Most of the activities that had to be modified last year are back— including visitors, so be sure to drop by if you can.

In this year's magazine we feature **Professor Meredith Silberstein's** research on synthetic soft materials and how they might be used to create new types of bio-inspired electrical circuits. The very exciting work aims to understand how the inherent properties of biological materials, like the ability to self-regulate in response to changes in the environment or change shape in response to stress and adapt them to create new functionalities. This project was funded by Professor Silberstein's recent award from the Defense Advanced Research Projects Agency (DARPA).

This past year has also been an exciting year for the development of our Space Science and Technology research and education programs. We were very excited to announce in April of this year the establishment of 8-figure Fujikawa '77 Endowment for Astronautical Engineering aimed to support "future investments in graduate fellowships, professorships and laboratory enhancements, with the ultimate goal of creating an institute for space technology, innovation and entrepreneurship". We also held our first Space Technology Industry Day with speakers from across Cornell and from Planet Labs, NASA, Northrup Grumman, URSA Space Systems, Ball Aerospace, Moog, and Lux Capital. The event was supported by our KK Wang Industry Day endowment. In a joint effort with the Department of Astronomy, we also held the first Cornell SmallSat Mission Design School this summer. This year the design school cohort chose to develop a mission to probe the earliest universe before the appearance of the first stars and galaxies by monitoring distant radio signals. Also, this year we launched our Spaceflight Mechanics Cornell Certificate Program through eCornell. The 16-week program is designed to provide students with "a strong foundation in modern spacecraft orbit and attitude control system design, and an ability to recognize current problems and trends in spacecraft operations and development".

Many of our Alumni also had a very exciting year. Staying with the Space theme, this year we profiled **Swati Mohan '04** who led the guidance, navigation, and controls team for the NASA Mars 2020 mission and narrated the landing of the Perseverance rover. We also feature **Rose Lee '87** and her incredible career going from the Sibley School to President of DuPont Safety and Construction and now as CEO of Cornerstone Building Brands. Also, be sure to check out the profiles of **Kayla Keriazes '21** and **Jacob Nixon '22** and their undergraduate and M.Eng research projects.

This year, we welcome two new faculty to the department, which will enhance our stature in in two research areas of interest: Energy and the Environment and Advanced Manfuacturing and Materials. **Professor Maha Haji** joins us from MIT where she completed her post-doctoral work in the Department of Aeronautics and Astronautics. Maha has established the Symbiotic Engineering and Analysis (Sea) Lab which conducts research on sustainably extracting resources from the ocean. **Professor Mostafa Hassan**i also joins us as an Assistant Professor this year. He studies materials and deformation practices under extreme conditions and has established the Extreme Mechanics, Materials, and Manufacturing (EM3) Lab. Check out their exciting profiles in this year's magazine.

Thanks, as always for your engagement with the Sibley School! I hope you enjoy the update.

David Erickson

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Cover Design: Erin Philipson
Cover image: Meredith Silberstein taken by Robyn Wishna

SUPPORT MAE

Sibley School Discretionary Fund

The Sibley School's Discretionary Fund supports the people, programs, and places of MAE. Making an unrestricted donation is invaluable to the school's Director. These gifts may be used to update a laboratory for virtual classroom presentations, create opportunities for students to attend conferences, and further faculty research in cutting-edge areas of engineering.

Private gifts are essential and help to ensure the continued excellence, relevance, and impact of initiatives for MAE. For more information on how your support can make a difference, please call Stephen Smith at 607.255.8285, or email him at sjs422@cornell.edu.

To learn more about how your support can impact the Sibley School, visit our Giving Opportunities page.

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USING SYNTHETIC SOFT MATERIALS TO CREATE BIO-INSPIRED CIRCUITS

By Erin Philipson

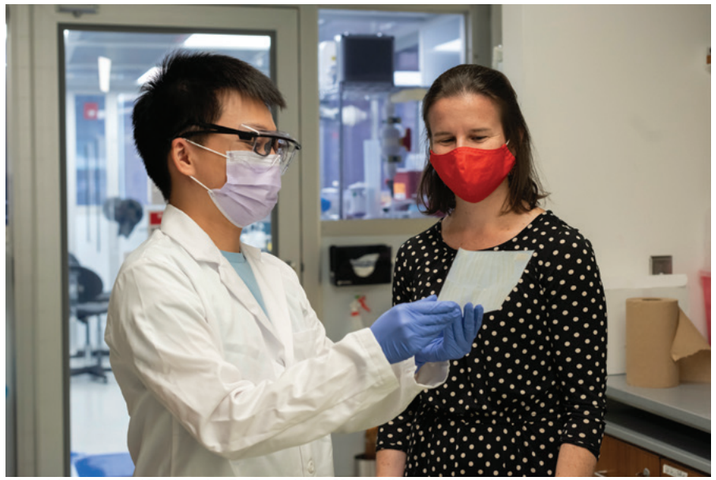
Our world relies more heavily on electronic devices today than ever before, and just about every device contains electronic circuits. For most of history, circuits have been designed using hard materials like metals and semiconductors, but Meredith Silberstein, associate professor in the Sibley School of Mechanical and Aerospace Engineering, is exploring the use of synthetic soft materials to create circuits.

Basic biology has endless examples of circuits that are ionic rather than electronic, meaning they use charged molecules rather than electrons. Hard materials are inherently rigid, compared to polymers that make up soft matter, making ionic circuits far more flexible. Flexible circuits can be especially useful when trying to create devices that stretch or are biocompatible and can be used in the human body.

Ionic and electronic circuits have many fundamental differences, one of which, is that ionic circuits can respond to both charged ions and chemical gradients. This is an intriguing capability because it allows researchers to introduce chemicals that can change conductivity resulting in the ability to turn circuits on and off.

Silberstein and her group are using a two-pronged approach—conducting simulations and meticulous experiments to learn more about transport and reactions in soft materials. It is difficult to run these types of experiments and get the outcomes intended with commercial materials, so Silberstein and her group are creating their own.

"This type of work is really a mix of continuum mechanics, materials science, and electrochemistry," says Silberstein. "Material tailoring is an important piece because it enables thorough model validation and ultimately device performance customization."



Materials Science and Engineering Ph.D. candidate Hongyi Cai shows his polyelectrolyte samples that are ready for mechanical characterization.

The multiphysics simulations are an especially useful aspect of Silberstein's research because it allows for polymers to be modeled and tested virtually. This type of investigation provides an avenue for analysis that is very difficult to do with experiments.

Silberstein won the Defense Advanced Research Projects Agency (DARPA) Young Faculty Award for this bio-inspired circuit project. The award comes with $500 thousand for the first two years of research and an option for another $500 thousand in year three.

Silberstein is also working to discover how synthetic polymer membranes can be self-regulating and self-healing under electric fields, which will result in better performance and durability—a project funded by the U.S. Department of Energy (DOE). Polymer membranes are a critical part of low temperature electrochemical energy storage and conversion technologies. These membranes must be mechanically robust to prevent device failure and must transport ions efficiently to avoid wasting energy.

Safety, efficiency, and lifetime are major concerns for polymer membrane design. These could be greatly enhanced by having membranes whose properties adapt under different electric field intensities. For instance, electrical gradients that form as membrane damage develops locally could drive self-healing at that location.

While there are real-world applications of this work, the project is fundamental science based. Silberstein and her group are taking ideas prominent in biological systems, such as self-healing, and making a synthetic polymer version.

"Biological materials have much more sophisticated ability than synthetic materials to self-regulate in response to their environment," says Silberstein. "We aim to discover mechanisms for such self-regulation within synthetic polymers that operate outside the typical biological environment."

CONTINUED LEADERSHIP IN SPACE EDUCATION AND RESEARCH

By Syl Kacapyr

Entrepreneur Steve Fujikawa '77 has committed an eight-figure gift to aerospace engineering at Cornell, an investment that will strengthen the university's status as a leader in space education and research.

The Stephen J. Fujikawa '77 Endowment for Astronautical Engineering will be used for future investments in graduate fellowships, professorships and laboratory enhancements, with the ultimate goal of creating an institute for space technology, innovation and entrepreneurship.

"Steve's vision for space science and engineering at Cornell looks to the future—space entrepreneurship, game-changing technologies and innovative student experiences," Peck said. "This level of support, coming from one of our most successful technological innovators, communicates that Cornell's space technology research and education address cutting-edge needs for the nation."

The endowment will help grow Cornell's roster of faculty with aerospace industry experience, creating new opportunities for technology translation and business partnerships. The endowment will also support the development of a space technology design lab and a spacecraft demonstration lab, adding to existing opportunities for students to engineer and test technologies such as satellites and sensors.

"The impact of this gift will reverberate across Cornell, benefiting the interdisciplinary astronomers, materials scientists, roboticists, physicists and computer scientists who collaborate with our aerospace engineers," said President Martha E. Pollack. "I'm so grateful to Steve for enabling us to advance a shared vision for the future of space sciences and technology at Cornell."

Lynden Archer, the Joseph Silbert Dean of Engineering, said Fujikawa's gift is an investment not just in Cornell, but in expanding humanity's reach across the solar system.

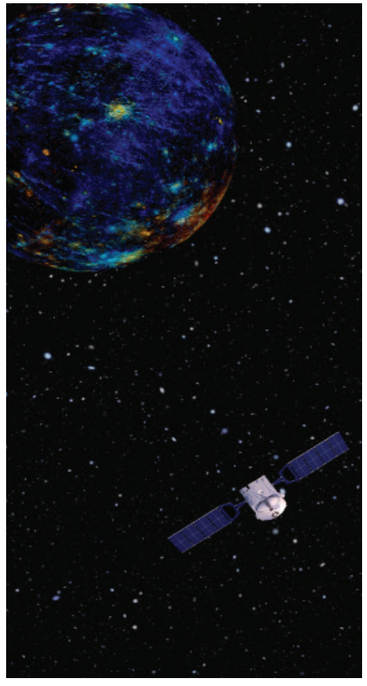
"The advent of commercial space exploration has enabled successful entrepreneurs, including Steve, to advance rocketry and spacecraft technologies, making access to space easier and more affordable," Archer said. "Steve's forward-thinking gift will help prepare our students for this transformational change as they enter industry or begin their own startups."

Fujikawa received his bachelor's degree from the Sibley School of Mechanical and Aerospace Engineering before founding satellite manufacturer Maryland Aerospace in 2002. Following a series of mergers and acquisitions, the company became part of Redwire, which provides space solutions to NASA, the U.S. Department of Defense, and commercial and academic entities.

"It is an honor and a privilege to provide this endowment for Cornell," Fujikawa said. "I wanted to be able to give back to the university and the space community for affording me the opportunity to contribute over the course of my career."

The Sibley School has long been considered one of the premier institutes for the study of space technology. Among its standout laboratories is the Space Systems Design Studio, directed by Mason Peck, the Stephen J. Fujikawa '77 Professor of Astronautical Engineering.

"Steve's vision for space science and engineering at Cornell looks to the future—space entrepreneurship, game-changing technologies and innovative student experiences," Peck said. "This level of support, coming from one of our most successful technological innovators, communicates that Cornell's space technology research and education address cutting-edge needs for the nation."



ROSE LEE ‘87
PATH TO CEO

By Erin Philipson

The importance of innovation and technology have woven through the various roles held by Rose Lee ‘87 over the course of her career. After completing her bachelor’s degree in the Sibley School of Mechanical and Aerospace Engineering at Cornell University, Lee went on to pursue an impressive career with a hand in all aspects of manufacturing and will soon become the chief executive officer (CEO) of Cornerstone Building Brands.

Lee had always been interested in math and science as a child, so engineering was a natural fit when it came time to decide on a career path. After graduating valedictorian of Westmoor High School in Daly City, California, Lee applied to the College of Engineering at Cornell University. She committed to Cornell without having visited and when she arrived at the beautiful Cornell campus, she was not disappointed. Her years at Cornell were formative—instilling the work ethic that she has applied throughout her career. The combination of the high-quality faculty and students and the new challenges each semester was a major driver for Lee.

“Cornell is an institution that challenges you and helps you recalibrate, and even when you receive difficult feedback, that just makes you that much more aware about your gaps and what you need to work on,” says Lee.

As a first-generation Korean immigrant, Lee found a community at Cornell of fellow Korean American students, becoming involved in a range of extracurricular activities with the student group. Outside of the student groups in which Lee was involved, she found Ithaca to be an inclusive and

community-focused place.

After completing her undergraduate degree, Lee entered the aerospace industry by joining Pratt & Whitney as a design engineer. Lee obtained her master’s in aerospace engineering from Rensselaer Polytechnic Institute (RPI) during her time at Pratt & Whitney, applying her thesis to her work—creating a synergistic experience.

It was at Pratt & Whitney that Lee became interested in the leadership and management side of the business, deciding to pursue her MBA from the Sloan School of Management at the Massachusetts Institute of Technology (MIT).

Lee worked in consulting at Booz & Company, then held several leadership roles at Saint-Gobain and DuPont, most recently as the President of DuPont Water and Protection where she leads a diverse business creating water, shelter, and safety solutions to create a more sustainable future.

In the water business, DuPont is creating solutions to the global water crisis, an issue that leaves 785 million people without access to clean water. Her engineering background has been instrumental in understanding the underlying technology then working to expand these solutions globally.

“The power of innovation is really important,” said Lee. “My grounding in technology, and my appreciation for innovation has been a critical part of what I find motivating, interesting and just amazing at times.”

At DuPont, Lee is changing the narrative surrounding failure, which has become feared in the business world. Her view on failure came from her background in engineering, where researchers are constantly generating hypotheses, testing, and retesting—learning from failures and moving the needle towards technological advancements.

“The big picture theme is to figure out how to fail fast and embrace failure so that you become more of a learning organization for yourself as an individual and as an institution,” said Lee. “If you figure out how to do that, I think that that’s one of the key attributes of a winning organization.”

On September 6, 2021, Lee transitioned to president and CEO of Cornerstone Building Brands, the largest manufacturer of exterior building products in North America.

SWATI MOHAN ‘04
LANDED MARS ROVER

By Erin Philipson

On Feb. 18, Swati Mohan ‘04, a graduate of the Sibley School of Mechanical and Aerospace Engineering, narrated the historic landing of the NASA Perseverance rover on Mars.

“Touchdown confirmed,” Mohan said, speaking from mission control at NASA’s Jet Propulsion Laboratory (JPL). “Perseverance is safely on the surface of Mars, ready to begin seeking the signs of past life.”

Mohan was the mission’s guidance, navigation and controls operations lead, essentially the eyes and ears of the spacecraft on its seven-month, 300 million-mile cruise to Earth’s neighboring planet.

She chose to attend Cornell because of its many connections to space research, such as the Arecibo Observatory, the recently decommissioned radio telescope in Puerto Rico that was conceived by Cornell faculty, built with federal funding and then managed by Cornell for its first five decades.

As an undergraduate, Mohan conducted research with Mark Campbell, the John A. Mellowes ‘60 Professor in Mechanical Engineering, on the CubeSat satellite project. Campbell assigned Mohan to the attitude controls system, the same sub system she works on to this day.

“That one assignment helped me find my niche that I’ve continued in throughout my career so far,” Mohan said.

Campbell was an influential mentor for Mohan, not just in the lab but also in the satellite design class he taught. After graduating a semester early and working at JPL for a year, Mohan joined the Massachusetts Institute of Technology Space Systems lab for her graduate degree—the same lab in which Campbell completed his doctorate.

“Swati always had this amazing passion for space,” Campbell said. “When you combine that passion with her excellent technical, collaborative and leadership abilities, it is not hard to see how Swati has become the impactful engineer and leader she is today.”

While at JPL, Mohan worked on NASA’s Cassini just as the sophisticated robotic spacecraft took its first images of Saturn. The mission studied Saturn and its complex system of rings and moons.

“Here was a project that had been formulated the year I was born, in 1982, and had launched in 1997, when I was still in high school,” Mohan said, “and the timing just worked out that I got to be there working on it when it reached Saturn and took its first images, which was really cool.”

The days leading up to the landing were filled with nerves, causing the JPL team to check and recheck everything, according to Mohan. But the mission proved successful, beginning a multi-year, multi-mission campaign to bring samples from Mars back to Earth.

Information from the Mars Reconnaissance Orbiter showed that the rover landed within 5 meters of the point they had chosen, well within JPL’s goal of landing at least 60 meters from the targeted location.

“As you’re coming down, it’s basically like saying, ‘which is the best house for me to go to,’ finding that house and then landing in the bedroom,” said Mohan. “To go all the way from Earth to Mars and land within 5 meters of where we picked is just phenomenal.”

“It was just a really cool experience of being able to have this platform where you can take something all the way through,” said Mohan. “I could conceive of an algorithm, code it, test it on the ground, link it into space, test it in space, and then get the data back. Then with the data I got back, I could improve for the next round.”

Swati Mohan ‘04 at NASA’s Jet Propulsion Laboratory mission control on Feb. 18, prior to the Perseverance landing.

JACOB NIXON ‘22

By Erin Philipson

THE GUT MICROBIOME AND BONE STRENGTH

Jacob Nixon ‘22 has been interested in biomechanics since he was in middle school – namely the coordinated motion and physical interaction of different parts of the body, such as muscles and bones. Now, as a junior mechanical engineering major in the Sibley School of Mechanical and Aerospace Engineering, he is working with Professor Christopher Hernandez to characterize a relationship between the gut microbiome and bone strength in mice.

Prior to Nixon conducting undergraduate research with the Hernandez Group, the group had discovered that younger mice that were dosed with antibiotics and thus had the population of bacteria in their guts altered also had bones with a lower tissue strength. The study was published in the Journal of Bone and Mineral Research in early 2017.

Nixon has worked to expand these findings by attempting to identify potential mechanisms by which bone is affected by the gut microbiome—striving to characterize which bacteria or groups of bacteria are responsible for changes to bone properties.

By analyzing the bacteria present in test animals’ microbiome, Nixon and the Hernandez Group are able to identify differentially abundant features in the bacteria—which may lead them to discover which bacteria are affecting the bones of the test animals. However, it is difficult to narrow down just a single species or genus that is causing this effect on bone because many features can be differentially abundant.

In addition to working with microbial data, Nixon also tests bones to find their behavior under mechanical loading. Together with x-ray imaging and image filtering, material properties of the bone, such as strength, can then be identified.

Hernandez has made a great impact on Nixon’s undergraduate experience—providing mentorship in all aspects of his research. Hernandez has guided Nixon throughout the entire research process, from experimental planning to methodology to data analysis and finally communicating the results.

Nixon has experienced collaboration in almost every aspect of his undergraduate career, from working in the lab with graduate students, to working with classmates on group projects.

“In current times, the department has placed an emphasis on collaborative efforts during lectures (using Zoom breakout rooms) that has offered a new avenue to both learn from other students and to improve my understanding of course content by helping other students,” says Nixon.

Nixon has also benefited greatly from his experience as a TA—gaining the opportunity to disseminate knowledge to others while also reinforcing his own knowledge of the topics. “Seeing the moment when a concept ‘clicks’ for a student is highly refreshing, and I have found that developing a method to evoke such a response can, in itself, be a learning experience for an instructor,” says Nixon.

After graduation, Nixon plans to pursue his Ph.D. in the area of tissue engineering and mechanics. His advice for students is to make connections in the department. “There are opportunities to learn almost any aspect of mechanical engineering you may be interested in, it’s just a matter of making the right connection. I highly recommend getting to know your professors, and upperclassmen, who are happy to give advice and point you in the right direction!”

KAYLA KERIAZES ‘21

By Erin Philipson

ANALYZING VIABILITY OF ELECTRIC BUSES

Kayla Keriazes in front of a Proterra electric bus.

After first arriving at Cornell as a freshman, Kayla Keriazes ‘21 wasn’t sure whether she wanted to major in mechanical or electrical engineering. But after being mesmerized by the mechanically based teams at Project Team Fest, she decided to major in mechanical engineering and never looked back.

After completing her bachelor’s in 2020, Keriazes is now pursuing her M.Eng. degree in the Sibley School of Mechanical and Aerospace Engineering to gain more experience in the field before entering the workforce. The M.Eng. program has given Keriazes the opportunity to conduct research with Max Zhang, professor in the Sibley School, and take high-level courses that provide the experience and knowledge employers are looking for in recent graduates.

Keriazes is working with Zhang and the Energy and the Environment Research Laboratory to analyze the performance of electric buses in the cold climate and rugged terrain of Ithaca, NY. The Tompkins Consolidated Area Transit, Inc. (TCAT) has recently acquired electric buses, manufactured by Proterra, which will be circulating around Cornell University and the surrounding areas.

Keriazes will be collecting data such as vehicle speed, miles traveled per charge, and energy used per route for various environmental constraints such as air temperature and the grade of the terrain. With this data, the team hopes to determine if these conditions have a significant impact on the performance of electric buses - which are manufactured and primarily used in areas with warmer climates and more mild terrain. The team also plans to use this data for route optimization in the future.

It became clear to Zhang from their very first discussion of the project that Kayla’s passion on electrified transportation is contagious. “Kayla’s determination to make a difference in the EV world and solid background in automotive engineering have made her a perfect student to take on the project,” says Zhang. “She drives the project, no pun intended!”

Community partnership is also key to the project. “We are very fortunate to collaborate with great community partners at TCAT who are equally passionate about sustainability,” say Zhang.

One of the most valuable aspects of her M.Eng. experience has been conducting research in her field of interest combined with the opportunity to gain experience in industry. This summer, Keriazes will be interning at Proterra—where she will gain a more in-depth experience having already started studying the electric buses.

Keriazes has greatly enjoyed working with Zhang, especially his ability to balance a “hands-off” approach to mentorship while also providing useful guidance when needed.

“With his style of mentorship, I feel like I have a level of independence and the opportunity to figure things out for myself,” says Keriazes. “But, at the same time, if I am ever stuck on something, Professor Zhang always makes time to meet with me and help me through the problem.”

As an undergraduate, Keriazes was very involved with the Cornell FSAE Racing project team—gaining real-world experience through collaboration and problem-solving.

“Not only did I gain an abundance of technical skills and knowledge, but I also learned what it means to be a good teammate and a good leader,” says Keriazes. “The teamwork aspect was my favorite part of this experience and I have made life-long friends on the team.”

FACULTYAWARDS

HADAS RITZ
WON ASEE 2021 NATIONAL OUTSTANDING TEACHING AWARD

Hadas Ritz, senior lecturer in the Sibley School, won the 2021 American Society of Engineering Education (ASEE) National Outstanding Teaching Award. Earlier in the year, she won the Outstanding Teaching Award for the St. Lawrence Section.

Ritz is known widely across the College of Engineering for her exceptional teaching abilities and dedication to her students, according to David Erickson, the S.C. Thomas Sze Director of the Sibley School.

"Her dedication to both her students and their educational success is reflected year after year in student testimonials." Erickson said.

David Erickson, S.C. Thomas Sze Director of the Sibley School, was inducted to the Canadian Academy of Engineering (CAE).

Meredith Silberstein, won the Knauss Young Investigator Award, awarded by the Society for Experimental Mechanics (SEM).

Atieh Moridi, Assistant Professor, was selected for the NSF CAREER Award and the 2021 Swartz Research Fund.

Patti Wojcik, was promoted to Assistant to the Director in the Sibley School.

Lance Collins, professor emeritus, was elected to the National Academy of Engineering.

Max Zhang, Professor, was named the Kathy Dwyer Marble and Curt Marble Faculty Director at the Cornell Atkinson Center for Sustainability

Guy Hoffman, Associate Professor, won the Andrew P. Sage Best Transactions Paper Award from the Institute of Electrical and Electronics Engineers (IEEE).

Dmitry Savransky, was promoted to Associate Professor and was appointed the Director of Graduate Studies for Theoretical and Applied Mechanics.

Silvia Ferrari, John Brancaccio Professor of Mechanical and Aerospace Engineering, was selected for an Outstanding Research Award from the College of Engineering and published a new book titled "Information-Driven Planning and Control (Cyber Physical Systems Series.

Hadas Kress-Gazit, was elected the Geoffrey S.M. Hedrick Senior Endowed Professor, was elected a fellow of the Institute of Electrical and Electronics Engineers (IEEE) won the Outstanding Research Award from the College of Engineering.

Olivier Desjardins, was promoted to Full Professor.

Lawrence Bonassar, the Daljit S. and Elaine Sarkaria Professor, was elected a fellow of the Orthopaedic Research Society for his notable contributions to orthopaedic research over the course of his career.

Robert Shepherd, Associate Professor, received an Amazon Science Research Award and ORL, co-founded by Shepherd, won 1st place in the NFL 1st and Future Competition.

Brian Kirby, the Meinig Family Professor of Engineering, was named Associate Director of Undergraduate Affairs.

Patrick Wick, teaching support specialist in the Sibley School of Mechanical and Aerospace Engineering, won the 2021 Academic Achievement Award from the Cornell Engineering Alumni Association.

Kae-Lynn Buchanan Wilson, was promoted to Assistant Director for Undergraduate Studies in the Sibley School.

STUDENTAWARDS

DEPARTMENT AWARDS

Walter Werring Prize:
Recognizing talented and dedicated graduating seniors who have enhanced the Cornell community, excelling in a manner befitting the reputation of the Sibley School.

Award Recipient: Grace Ding '21

Thomas J. and Joan T. Kelly Prize:
Awarded to Seniors and M.Eng. Students in MAE displaying excellence in aerospace engineering, as demonstrated through coursework or an innovative design project. The awardee must show tangible evidence of being a well-rounded person with an outstanding non-engineering contribution to Cornell and/or the greater community.

Award Recipient: Matt Schnieder '21

Outstanding Senior:
Awarded to one M.E. Undergraduate Student who has exemplified leadership and made significant contributions to the Mechanical Engineering undergraduate community. This award is made possible by Matthew O'Connor '81, M.Eng. '82, ASME Chapter President, '80-'81.

Award Recipient: Julia Radzio '21

2021 Sibley Prize:
The Sibley Prize was established in 1884 for the Senior with the highest scholastic average.

Award Recipient: Michael Zakowortny '21

Frank O. Ellenwood Prize:
Awarded to graduating Seniors with the highest GPA in heat and power courses.

Award Recipient: Brooke Zara Aamer '21

McManus Design Award:
Awarded for the best technical paper of single or joint authorship presenting an original solution to a design problem or project.

Award Recipient: Matthew Sherman '21

R.N. Janeway Automotive Engineering Award:
This award is meant to recognize the best proposal for improvement in automotive vehicles.

Award Recipient: Connor Li '21

Bart Conta Prize in Energy and Environment:
Awarded for best work on a research or design project dealing with energy and environment.

Award Recipients: Emily Carr '21

Sibley Prize for Excellence in Graduate Teaching Assistant:
Awarded to Ph.D. Students and M.S. candidates, recognizing their dedication and excellence as teaching assistants for Sibley School courses.

Award Recipients: Khaled Hashad

H.D. Block Graduate Teaching Prize:
Awarded to Ph.D. and M.S. Candidates in the TAM Field, recognizing their dedication and excellence as a teaching assistant in Engineering Mathematics and Engineering Mechanics.

Award Recipients: Michael Buche and Arnaldo Rodriguez-Gonzalez

EXTERNAL AND UNIVERSITY AWARDS

Giancarlo D'Orazio, doctoral student working with Assistant Professor Sadaf Sobhani, received the Cornell NanoScale and Technology Facility (CNF) Fellowship.

Keith LeGrand, doctoral student working with Professor Silvia Ferrari,was selected for the NDSEG Fellowship, sponsored by the DoD.

Gustavo Alvarez Escalante, doctoral student, working with Associate Professor Zhiting Tian, received an NSF Graduate Research Fellowship.

Xiangkun (Elvis) Cao, doctoral student working with Professor David Erickson, was selected for the 2021 German Chancellor Fellowship.

Houston Claure, doctoral student working with Assistant Professor Malte Jung, was inducted into the Cornell chapter of the Edward Alexander Bouchet Graduate Honor Society.

Andre Paradise, doctoral student working with Professor Silvia Ferrari, was awarded the Coleman Fellowship by Diversity in Engineering and was recognized as a Sloan Scholar by the Alfred P. Sloan Foundation's Minority Ph.D. Program (MPHD).

Jennifer Bustillos, doctoral student working with Assistant Professor Atieh Moridi, won the TMS Henry DeWitt Award from the Minerals, Metals, & Materials Society.

Shreyasvi Gowda '22, was selected as a Brooke Owens Fellow and was named one of Aviation Week's 20 Twenties, a worldwide competition for top aerospace-bound students.

Jordan Sandell '23, received an Engineering Learning Initiatives Summer Research Award.

Danielle Weisenfeld '23, received an Engineering Learning Initiatives Summer Research Award.

Claire Chen '22, received a Serve in Place Fund to develop and produce community-engaged learning activities focused on STEM.

MAHA HAJI

By Chris Dawson

If Maha Haji has her way, Ithaca might join Woods Hole and Scripps as hotbeds of applied ocean science research. Haji, who joined the faculty of Cornell Engineering's Sibley School of Mechanical and Aerospace Engineering in the summer of 2021, wants to develop new designs for offshore systems that can sustainably extract power, fresh water, food, and mineral resources from the ocean.

"The world's population is getting bigger. We have to meet growing energy needs, food needs, and the need for mineral resources that are key to the production of clean energy. To do this we are going to have to go deeper into the oceans," Haji said. However, systems built to work in the ocean cannot be built in the same way as systems designed for use on land. They must be reliable, robust, and long-lived. They should be able to function well without daily maintenance.

"To keep costs down while at the same time meeting the needs of the growing population, we are going to have do things drastically differently," Haji said. "We are going to have to utilize systems that can accomplish multiple tasks at once and that are optimized for the ocean setting. That's the work we are going to do in my lab at Cornell."

If you had told the 16-year-old Maha Haji that this would be her future, she might have laughed out loud. In high school, Haji wanted to become a documentary filmmaker, and she was seriously exploring summer programs for photojournalism. To apply to these programs she needed written recommendations from some of her teachers. When she asked her physics teacher, he agreed on the condition that Haji also apply to a summer program designed to expose young women to engineering.

As it turned out, the only program Haji was accepted to that summer was the Women's Technology Program in Mechanical Engineering at MIT. So she left Florida for Massachusetts that summer, and it changed her life. "That program was what got me into engineering. And then a couple years later I got the chance to be an instructor for them. It was so valuable for me to get that exposure in high school," Haji said.

Haji earned her undergraduate degrees from UC Berkeley in both mechanical engineering and applied mathematics. As an undergraduate, she had several opportunities to engage in hands-on research and took full advantage. For example, one project with Professor Alice Agogino focused on retrofitting gym equipment to harvest some of the energy people expend while working out in order to charge their smartphones and tablets while they exercise.

One summer, as a National Oceanographic and Atmospheric Administration (NOAA) Hollings Scholar she took part in a research internship with NOAA and Oregon State University. Haji worked on wave energy converters, examining how these machines affect the environment as well as how the environment affects these machines. She returned to MIT through the MIT Summer Research Program where she explored how to minimize drag around submersibles.

All these experiences made it clear to Haji that she wanted to learn more about ocean engineering. She continued in school and earned her doctorate at MIT, working with Professor Alexander Slocum. Her thesis was titled "Extraction of Uranium from Seawater: Design and Testing of a Symbiotic System." From MIT, Haji went to work for ATA Engineering in Huntsville, Alabama, and Austin, Texas, where she was a project engineer and helped clients use analysis to drive their design projects. Her work with ATA helped her better understand the demands of clients building real projects in the world.

"In a Ph.D. you spend a lot of time finding all of the possible answers to a problem or a challenge, but I saw that in the real world you often only need to find something that meets the requirements of the client and is safe," Haji said.

She is thrilled to be back in the academic world at Cornell, where she does not have to stop her explorations once she finds an answer that simply "meets the requirements." At the same time, she values what she learned in her time at ATA. "I can dive deeper into questions I have and take my curiosity further, but I now also have a little more insight into what is actually needed by the people and companies that implement some of these technologies," Haji said.

Haji was motivated to join the faculty at Cornell Engineering for compelling reasons. "The research I do is inherently interdisciplinary," Haji said. "And Cornell already has strong research happening in the areas of aquaculture, chemistry, biology, and materials science. Because Cornell is so great in so many areas, it is the perfect place to carry out this kind of interdisciplinary work that I want to do."

When Haji is not thinking about ocean engineering solutions to hunger, energy, and resource challenges, she likes to read, watch movies, hike, and play with the puppy that helped get her through the many months of pandemic office and lab closures.

MOSTAFA HASSANI

By Chris Dawson

Mostafa Hassani knows the technologies of the future cannot rely on the structural materials of the past. Melting metals and then mixing and shaping them into useful configurations was fine for thousands of years, but engineers and designers are asking more of structural materials than the old processes and materials can deliver.

Hassani sees himself as a bridge between mechanical engineers and materials scientists, since he has a foot firmly planted in each of those worlds. Hassani, who joined the faculty of Cornell's Sibley School of Mechanical and Aerospace Engineering in 2019 as a senior research scientist and is now an assistant professor, believes that this academic bilingualism makes Cornell Engineering the perfect place for him.

"The Sibley School has got such a great reputation for mechanical engineering. And when you combine that with the groundbreaking materials research that happens at the Department of Materials Science and Engineering and the fabulous facilities like CHESS and CNF, why would I go anywhere else?" Hassani said, referring to Cornell's synchrotron and nanoscale science facilities.

Hassani's Extreme Mechanics, Materials, and Manufacturing (EM3) Lab has several interwoven areas of focus. One is structural materials processing and design where Hassani exploits the great promise of advanced and additive manufacturing techniques to create stronger, lighter, and more sustainable structural materials. Hassani wants to advance researchers' understanding of the relationships between the processing, the microstructure, and the resulting properties of structural materials. One special area of attention is structural materials that do not rely on molten metals as part of their creation process.

A second area of focus is elucidating the processes of deformation and mechanical failure of structural materials. No material lasts forever so it is essential that researchers understand what happens to crystalline and amorphous metals and alloys, ceramics, and composites as they deform, fracture, and fatigue. This is where some of the specialized facilities at Cornell are essential. Electron microscopes can show what is happening at the surface of materials, but they can't show what is happening inside.

The Cornell High Energy Synchrotron Source (CHESS) gives researchers a way to see inside. Hassani uses high-intensity X-ray beams available at CHESS to unravel the underlying deformation and failure mechanisms experimentally.

A third area of focus is on micro-projectile impact testing of structural materials. "Our small-scale impact experiments open ways to high-throughput characterizations of materials performance and energy absorption mechanisms under extreme conditions. This in turn can significantly accelerate material discovery and design for dynamic loading applications," said Hassani, who added that Cornell is uniquely positioned for research into micro-projectiles. "Measurements and characterizations of materials that are currently conducted post-mortem – after impact – can be done in-situ, during impact deformation using high-intensity X-rays. This enables a significant advance toward a more comprehensive understanding of materials under extreme loading conditions."

Hassani earned his bachelor's degree in mechanical engineering at Iran's University of Tabriz. He then moved to Tehran for his master's studies in mechanical engineering at the Sharif University of Technology. At that point he knew exactly what he wanted to focus on during his doctoral studies and joined the group of Professor Mario Guagliano at the Politecnico di Milano in Italy to earn his Ph.D. degree with a focus on improving fatigue performance of structural materials.

To give a materials science perspective to his research endeavors, Hassani completed a postdoctoral appointment in the Department of Materials Science and Engineering at MIT working with Professor Christopher Schuh before coming to Cornell.

Hassani says he never seriously considered going into industry at any point in his academic progression. "I have always loved teaching. In that way I am like my mother who is the most dedicated teacher I have ever seen. She and I both get so much enjoyment and fulfillment from answering questions and helping other people understand things," Hassani said.

When Hassani is able to take his mind off of structural materials and questions of how to make them better, he enjoys playing soccer, cooking, and listening to podcasts that tell real people's stories.

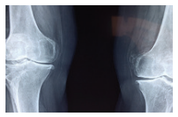
Engage public, explore methods to secure NYS green energy

Solar-power developers need to explore using lower-quality agricultural land for solar energy, boost incentives for dual-use (combined agriculture and solar) options, avoid concentrated solar development and engage communities early to achieve New York's green energy goals, according to Professor Max Zhang. "As farmland is generally flat and cleared, agricultural land will be the prime target for future solar energy development," said Zhang. Keeping solar farms from becoming too concentrated in regions will likely help mitigate negative economic activity.

Study highlights promise of 3D printing for electrochemical reactors: According to a new study co-authored by Assistant Professor Sadaf Sobhani, using additive manufacturing to rapidly prototype electrochemical reactors, designs could be optimized for improved conversion rates—leading to reduced greenhouse gas emissions.

Varda Space aims to build factories in orbit: Varda Space Industries, founded by SSDS alum, Will Bruey, is building space factories for earth-bound products. The company just raised over $50M in funding!

Thermal analysis guides future design of 2D hybrid materials: A first-of-its-kind study, led by Associate Professor Zhiting Tian, which examines the thermal transport properties of a novel material is helping steer the future of hybrid perovskites

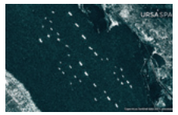


Researchers look to gut microbiome to improve bone health: A collaboration, led by Professor Christopher Hernandez, has been awarded a five-year, $3.6 million grant from the National Institutes of Health to explore the ways that the gut microbiome impacts bone quality.

Cornell launches online fluid dynamics simulation certificate: Cornell University is partnering with software company Ansys to create a new certificate program that allows engineers from across the world to master simulation of fluid dynamics—developed by Rajesh Bhaskaran, the Swanson Director of Engineering Simulation in the Sibley School.

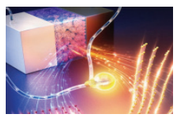
Propelling future space exploration: "We are getting to the point where it is possible to build an entire propulsion module on a silicon chip," says Assistant Professor Elaine Petro in a recent feature from Cornell Research.

No bones about it: Marysol Luna '20 was featured in the March/April issue of Diversity in Action that focuses on women in STEM.



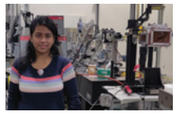
Cosmos unveils space-tech business, science opportunities: More than a dozen space industry leaders, capital investors, startup entrepreneurs, a Jet Propulsions Lab manager and Cornell professors gathered virtually for Cornell's first Space Tech Industry Day/K.K. Wang Day symposium on April 23—featuring this year's event theme, "New Opportunities in Space Technology."

Enhancing winter storm response in rural communities: Professor Max Zhang was interviewed on WBNG 12 News about his leadership role in the community-based research on how to improve winter storm and natural disaster response. The research is funded by the National Science Foundation (NSF).



Nanoscale defects could boost energy storage materials: Assistant Professor Nikolaos Bouklas collaborated with Assistant Professor Andrej Singer from Cornell MSE to use X-ray nanoimaging to gain a new view into solid-state electrolytes—which may now be leveraged to create superior energy storage materials.

How Cornell is leveraging Carbon DLS™ 3D Printing for Robotics Applications: Associate Professor Robert Shepherd explains how Cornell is using Carbon Digital Light Synthesis™ 3D printing process for robotics research. "Materials science is a doorway to better robots," says Shepherd.



Students win NASA challenge with 3D-printer smart sensor: A team of Cornell students has won a grant through NASA's University Student Research Challenge for a proposed sensor that can help 3D printers build better, more reliable products. The team, led by doctoral student Adrita Dass and advised by assistant professor Atieh Moridi, is the first to be selected by NASA this year.

Cornell women overcome isolation, stereotypes in male-dominated STEM fields: Dr. Swati Mohan '04 speaks about what it's like to work in a male-dominated field. Mohan said her experiences as a Cornell undergraduate were essential to navigating these roadblocks and achieving success in STEM.

Engineer to model sunshine deflection for cooling planet: Professor Douglas MacMartin will lead a team from the Cornell Climate Engineering group to model the effects of introducing reflective aerosols into the stratosphere, which could reduce Earth's temperature and limit the impact of climate change. The research is funded by the SilverLining Safe Climate Research Initiative and was matched by an anonymous donor for a $1M total grant.

Stretchable sensor gives robots and VR a human touch: A new fiber-optic sensor results in a stretchable "skin" that could give soft robotic systems the ability to feel the same sensations that mammals depend on to navigate the world. The sensor was developed by Associate Professor Rob Shepherd and his team.

Developing a cost-effective air-quality system for Chinese cities: Max Zhang, professor in the Sibley School, is leading a Cornell China Center-funded project team to develop a cost-effective air-quality system for Chinese cities.

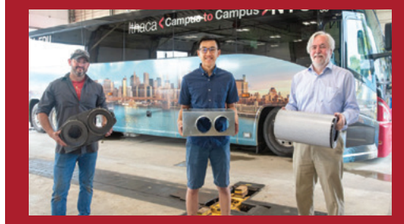
Helmet design protects dentists, doctors from COVID-19: A team led by Assistant Professor Mahdi Esmaily developed a transparent helmet that prevents 99.6% of virus-containing droplets exhaled by patients from reaching the environment during open-face procedures.

Dimensional Energy emerges as $20M Carbon X Prize finalist: Dimensional Energy, co-founded by David Erickson, director of the Sibley School, is one of two finalists in the $20 million Carbon X Prize competition. The company developed technology that captures industrial carbon dioxide and converts it to an environmentally friendly product like aviation fuel.

Soft robots use camera and shadows to sense human touch: Associate Professor Guy Hoffman and his team have created a low-cost method for soft, deformable robots to detect a range of physical interactions without relying on touch at all.

Global 'wind atlas' propels sustainable energy: Cornell wind energy scientists, including Rebecca Barthelmie, have released a new global wind atlas to help engineers select the turbines in any given region and accelerate the development of sustainable energy.

3D-printed biomedical parts with supersonic speed: A collaboration led by Assistant Professor Atieh Moridi has developed a 3D printing technique that creates cellular metallic materials by smashing together powder particles at supersonic speed that results in mechanically robust, porous structures that are 40% stronger than similar materials made with conventional manufacturing processes.



A breath of fresh air for C2C filtration project

The Cornell Campus-to-Campus (C2C) buses have resumed service thanks to a new air filtration system that was designed, built and installed by a team of faculty and staff, and at the center of the collaboration, a Christopher Kartawira '21, a student in the Master of Engineering Program in the Sibley School of Mechanical and Aerospace Engineering. "It seemed like an interesting problem," said Kartawira. "And it became very hands-on, which gave me insight into how, in the real world, it might be nice to really get the nitty-gritty details of what the airflow looks like, what the viral concentration in the bus looks like. But at the end of the day, they needed something done, and they needed something that works."

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