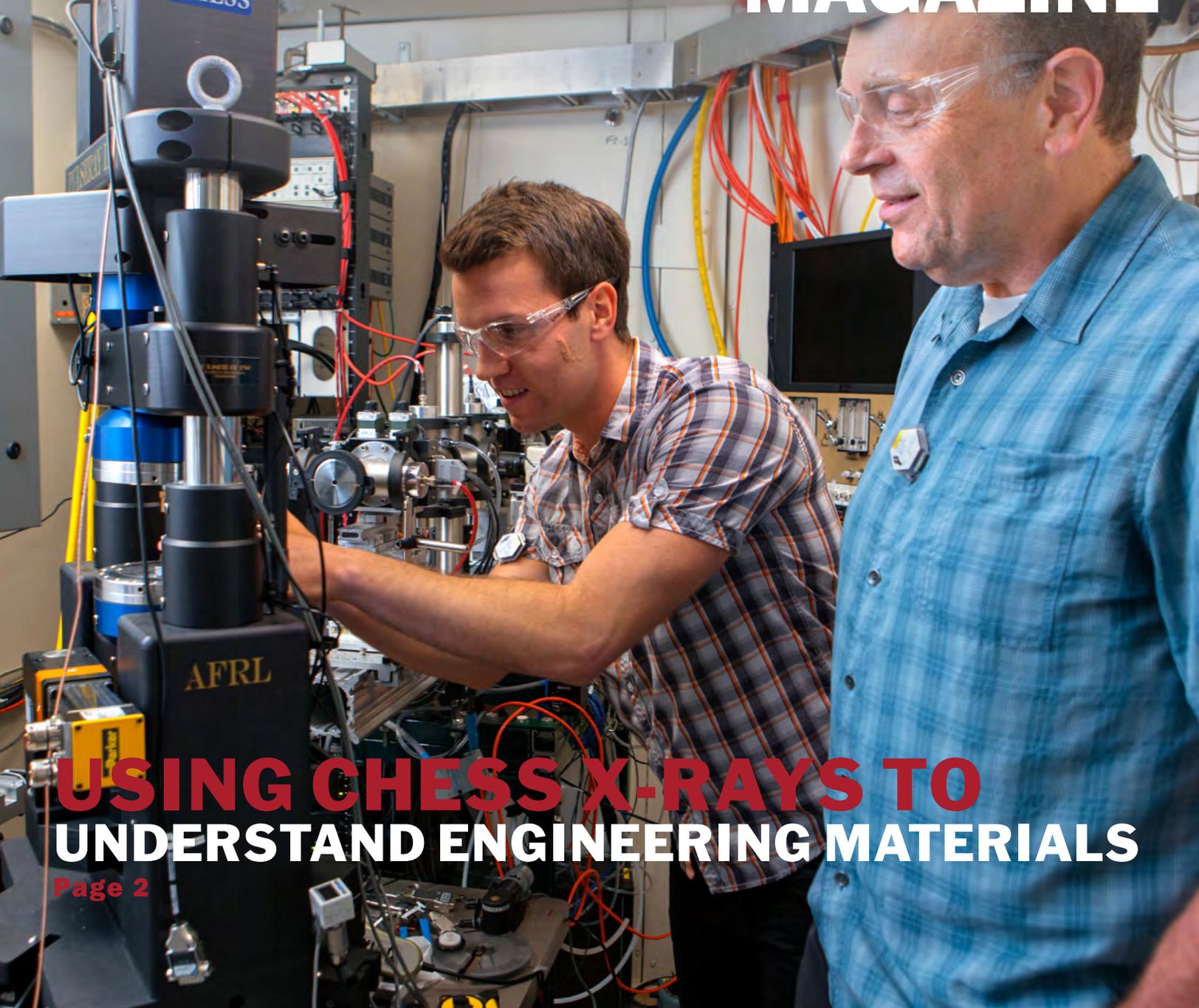




MAAE

2020

MAGAZINE



USING CHES X-RAYS TO UNDERSTAND ENGINEERING MATERIALS

DAVID ERICKSON

Hello Sibley School Friends,

Well, it's been an exciting year!

Cornell, along with nearly all higher education institutions, shifted to online education midway through the spring 2020 semester because of the COVID-19 pandemic. This was a particularly difficult challenge for a department like MAE—where our education and research is so dependent on physical projects and hands-on learning. The faculty and staff found innovative ways to complete the term, including [virtual Robotics labs](#). Our success in the transition benefited from our early investment in programs like the [active learning initiative](#) and our wonderful instructional facilities in Upson Hall.

As I'm sure you've heard, Cornell was one of the few Ivy League Universities to welcome all students back to campus this fall for a combination of socially distanced in-person and online courses. The University has employed unique tools to combat the virus including extensive diagnostic testing and a behavioral compact. As I write this letter, after completing two coronavirus tests myself this week, I'm happy to report that the plan is working better than expected. Cornell is already being recognized as a [national success story](#) in controlling infection transmission while maintaining an enriching on-campus experience.

One of the great things about Cornell is that we have access to some of the finest research infrastructure in the country like the Cornell High Energy Synchrotron Source (CHESS). In this year's magazine, we feature **Professor Matt Miller's** research and leadership as the Associate Director of CHESS and the newly established MSN-C (Materials Solution Network-CHESS). This program allows high energy X-Rays from the synchrotron to peer inside metals and other materials to understand why some parts fail. The

effort is funded by a large grant from the Air Force Research Lab and engages several industry partners.

We also introduce the newly established Veho Institute for Vehicle Automation as a joint effort between Cornell Engineering, Cornell Tech and several Italian Universities and Automakers like Ducati, Ferrari, Lamborghini and Maserati. Led and founded by **Professor Silvia Ferrari** the center aims to "transport the world of high-performance automobiles into the future, not simply with autonomous cars but also using all of the new areas of artificial intelligence, data science and the science of autonomy."

This year we are also excited to announce the formation of the inaugural **Sibley School Advisory Council**. The mission of the council "to serve as the primary source of external guidance to the Director of MAE, facilitate engagement opportunities for MAE faculty and students outside the University, and provide a channel of expertise and counsel between MAE and alumni" is even more important in these times of flux. Council members come from a diverse set of fields and all share the wish to deepen relationships between the Sibley School and their companies or industries.

In this year's issue of the magazine we're excited to profile alumni Steve J. Fujikawa MAE '77, an entrepreneur in the aerospace industry, where he has made a number of significant contributions, specifically in satellite technology. Steve also made possible the establishment of the Stephen J. Fujikawa Chair in Astronautical Engineering which was awarded to **Professor Mason Peck** on July 1, 2020. We also profile our new Assistant Professors, **Jingjie (JJ) Yeo**, **Sadaf Sobhani** and **Elaine Petro**. **Professor Tim Sands** also joined the department as our first Professor of Practice in Aerospace Engineering. Tim joins us following a 30-year career as an active duty Air Force



officer managing several space missions and serving in an executive capacity at the Naval Postgraduate School and Air Force Institute of Technology.

Finally, we are excited to welcome **Lynden Archer** as our new Dean of Engineering, the former director of Chemical and Biomolecular Engineering and a prolific researcher, member of the National Academy of Engineering, and exceptional administrator. Lynden assumes the role of Dean after 10 years of transformative leadership from Sibley School Professor Lance Collins. Lance leaves an incredible legacy to our college that includes the establishment of Cornell Tech and advancement of his vision to create one of the most diverse engineering programs in the country. The College of Engineering recently established the **Lance R. Collins Fellowship**, created to support engineering graduate students from traditionally underrepresented populations, and to honor Lance for his leadership. Lance has moved on to become the inaugural vice president and executive director of Virginia Tech's innovation campus.

I hope you enjoy the update.


David Erickson

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About the Cover

Cover Design: Erin Philipson

Cover image: Matt Miller and Ph.D. student Mark Obstalecki inserting a titanium test sample into a loading machine for an in situ x-ray diffraction experiment at CHESS.



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.

**Imagine
What's
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**Accelerate
Discovery.**

**Make
Impactful
and Lasting
Change.**

USING CHESS X-RAYS TO UNDERSTAND ENGINEERING MATERIALS

By Erin Philipson

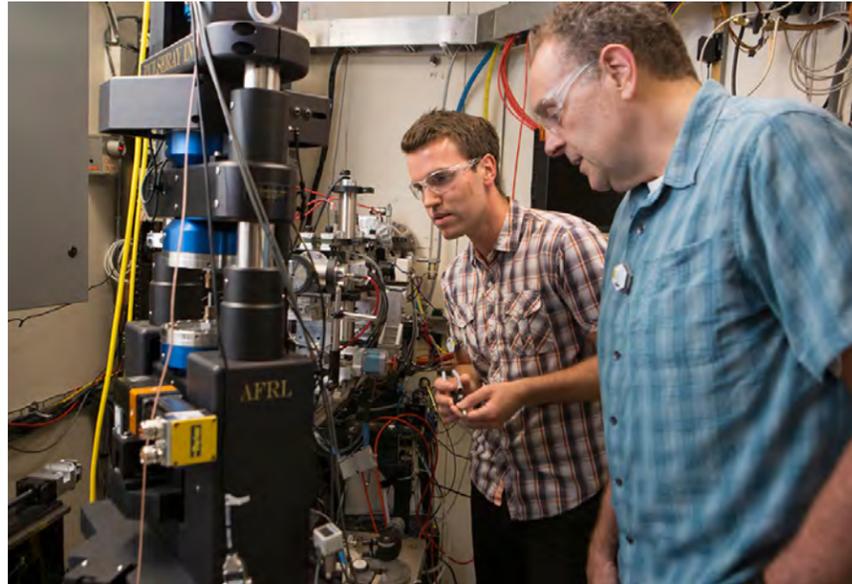
It has long been common practice for mechanical engineers to conduct loading tests on metals like steel and titanium, then to create models for the behavior of those metals based on the results of these tests. Matt Miller, professor in the Sibley School of Mechanical and Aerospace Engineering (MAE) and Principal Investigator for MSN-C in the Cornell High Energy Synchrotron Source (CHESS), did the same when he first started at Cornell.

Miller's research lies at the intersection of mechanical engineering and materials science—exploring how the internal structure of metals supports the loads applied to the things engineers design, like aircraft, cars, and heavy machinery. “The performance of a winning mechanical design over the next best very often boils down to the material that is used,” says Miller. “That’s one of a designer’s most important degrees of freedom.”

As Miller was starting at Cornell in 1994, mechanics of materials modeling were becoming multiscale. Modelers were starting to use microstructure (millions of tiny crystals in the case of metals) to predict properties and performance of an engineering component. However, there were no microscale mechanical testing data—no one knew what the stresses on each tiny crystal were.

“The dream is, if we can model every crystal in a metallic part, by understanding deformation processes at that scale, maybe we can design the material at that scale.”

Metallic crystals are anisotropic, or directionally dependent, meaning they



Matt Miller and Ph.D. student Mark Obstalecki inserting a titanium test sample into a loading machine for an in situ x-ray diffraction experiment at CHESS.

have different properties in different directional alignments. Anisotropy means some crystals have much larger stresses because of their orientation. Understanding stress at the crystal scale is especially important when looking at structural failure, such as fatigue or fracture of metals.

“The places where these cracks start are often places where this anisotropy, at that really small scale, rears its head,” says Miller. “The dream is, if we can model every crystal in a metallic part, by understanding deformation processes at that scale, maybe we can design the material at that scale.”

During Miller's sabbatical in 2000, he became interested in the idea of using X-rays to study the microstructure and the microscale deformation of metals and alloys. X-rays are uniquely suited to penetrate materials and non-destructively probe the structure of matter. Miller's idea came to fruition through CHESS, a

high-intensity X-ray source, one of only five in the world and located right on the Cornell campus. CHESS, established in 1978, was originally funded by the National Science Foundation (NSF) and provides a high-intensity X-ray source in the form of beamlines. These beamlines provide researchers with state-of-the-art synchrotron radiation facilities.

Emerging X-ray diffraction techniques that Miller and his research group helped develop allowed them to measure and then to simulate how each individual crystal in a sample is loaded and evolves over time—for example, during the loads experienced by a titanium compressor blade in a jet engine.

Miller's group has been part of the transition at CHESS from science-based X-ray experiments to repeatable engineering measurements to better understand engineering-relevant questions like crystal scale stress and strain.

Government institutions and industry

saw the possibilities in this type of research—recognizing the opportunity to test metals and parts for aircraft, vehicles, and equipment.

To help streamline what could sometimes be a slow process, in 2019 the Air Force Research Laboratory (AFRL) funded two new beamlines at CHESS, providing dedicated access to experimental “beam time” to conduct Department of Defense funded experiments for unrestricted amounts of time—a project that totals about \$7M per year.

Miller is the principal investigator (PI) of this AFRL grant, which established the Materials Solutions Network at Chess (MSN-C) and provides state-of-the-art X-ray tools developed from Miller's research program to understand processes like crack initiation and to improve processes like additive manufacturing so that manufacturers can directly address questions like: why do parts fail? The two MSN-C experimental stations are the Structural Materials Beamline (SMB), optimized for high performance metals and the Functional Materials Beamline (FMB), optimized for polymer-based materials, such as carbon-fiber composites.

The first year at MSN-C proved very productive—Department of Defense users from all three service branches successfully completed experiments on the SMB or FMB. In August 2020, MSN-C received a renewal of funding from the Air Force Research Lab for their second year.

During experiments, the beamlines provide such an enormous amount of data, it takes a massive amount of processing to convert the raw X-ray data into the crystal scale stresses and strains that can be used together with models to predict behavior.

“We have recently done a great job of developing new hardware; CHESS recently went through a very large upgrade and now the amount of data from a typical experiment has increased by at least an order of magnitude. We are focused now

on ways of digesting and understanding these data. As we move forward, utilizing all of the data collected at the beamline is a great opportunity for data science methods such as machine learning,” says Miller. “Can the raw data that is taken directly from the pixels on the x-ray detector be used to say something definitively about what’s going on in the material?”

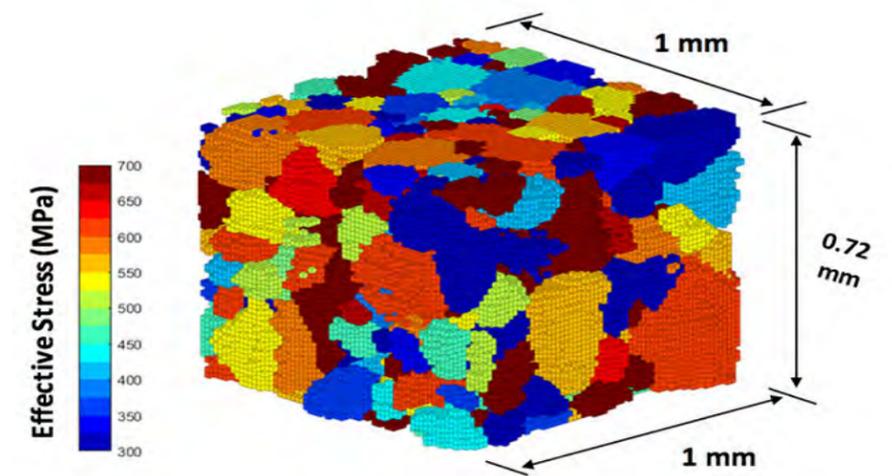
Creating enhanced remote user access to datasets and data reduction workflows are the motivation for a Research Advanced and Interdisciplinary Science and Engineering (RAISE) grant from NSF recently awarded to Miller and CHESS for a project called “A Materials Science Gateway for X-ray Imaging and Modeling of Microstructures.”

The collaboration converges structural materials data collected from the SMB and other beamlines at CHESS with new cyberinfrastructure technologies being developed by partners at the University of Minnesota and the San Diego Supercomputing Center at NSF High Performance Computing sites. The gateway will integrate multiscale X-ray data with accelerated image processing and data reconstruction tools. In addition to CHESS, the University of Minnesota

and the San Diego Supercomputing Center, the award is shared by Carnegie Mellon University.

Before starting his career as an academic, Miller played football at the University of Colorado and for the NFL's Cleveland Browns. Miller credits his mindset as an offensive lineman as some of the driving influence in his academic career. “It's something where you're directly responsible for any successes the team makes but you're never directly touching the ball,” says Miller. “As a teacher, the mindset of an offensive lineman is a good thing. You're always wanting to get people to the next level.”

One of Miller's overarching goals since starting to work at CHESS nearly 20 years ago is to lower the bar for new users to the beamlines at CHESS, enabling faculty that aren't extremely familiar with X-rays to still benefit from the technology. Miller has made a significant effort to involve junior faculty in MAE with his program. Faculty in the area of Advanced Materials and Manufacturing including Meredith Silberstein, Robert Shepherd, and Atieh Moridi have and continue to experiment at CHESS.



Crystal stresses in the titanium sample after two experiments; one that provides the crystal outline and one that measures the stress value on each crystal.

STEVE J. FUJIKAWA MAE '77

By Erin Philipson



Steve Fujikawa '77 has always been interested in aerospace and spacecraft—even as a child he built model airplanes to occupy his time. This interest is what drew Fujikawa to the Cornell Sibley School of Mechanical and Aerospace Engineering and what later led to his career in the aerospace industry.

While at Cornell, Fujikawa especially enjoyed his courses in dynamics, system dynamics and control systems which led him to pursue a Masters in Dynamics and Control at Stanford University.

Fujikawa was eager to enter the aerospace industry after leaving Stanford and worked at a number of companies designing rockets and spacecraft before eventually founding his own.

In 1997, Fujikawa's entrepreneurial spirit led him to start a company with two friends, which eventually

became Maryland Aerospace. His company aimed to provide attitude determination and control systems for satellites.

Maryland was the ideal location for an aerospace startup because of its close proximity to government agencies like the NASA Goddard Space Flight Center, the Naval Research Laboratory and the Defense Advanced Research Projects Agency (DARPA), and large aerospace contractors in the satellite business.

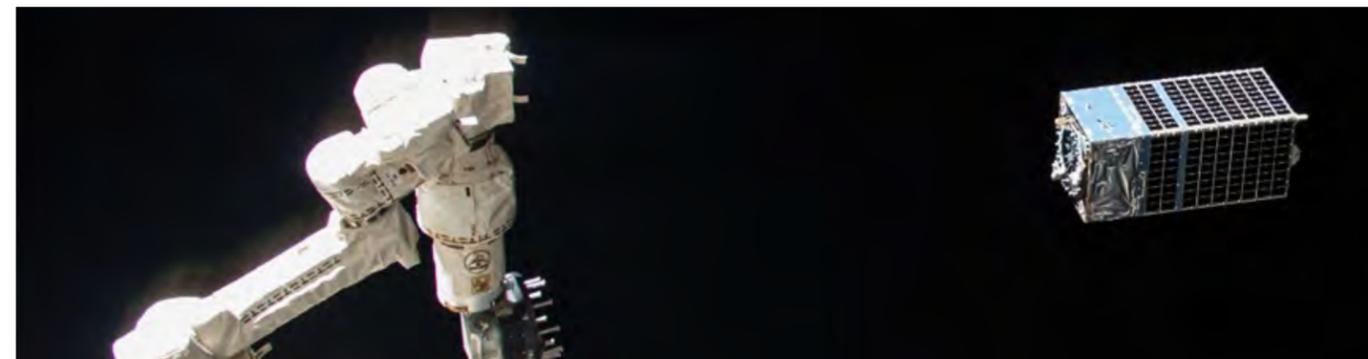
One of their first big contracts was with the Naval Research Laboratory, supporting the initial construction of the International Space Station—designing the orbit and attitude control system. "This was really instrumental in helping us start the company," says Fujikawa. "It kept us going for probably two or three years while we looked for more business and hired other people."

As a visionary, Fujikawa endeavored to position the company to take advantage of the coming New Space revolution. A shift from the traditional paradigm of big, expensive space to smaller, faster, cheaper satellites.

One of Maryland Aerospace's first products was the IMI-100, an attitude control system for very small satellites called CubeSats. Development of the IMI-100 was funded by DARPA. The IMI-100 was intended to capitalize on the growing government and industry interest in the potential applications of CubeSats because they were quick to develop, a fraction of the cost of previous satellites, and took a much smaller team of people to build.

"Some of the original CubeSats just tumbled, so they had limited functionality," says Fujikawa. "When we brought this product to market it kind of revolutionized the industry because it allowed CubeSats to do what some of the larger satellites did by precisely pointing to targets on the Earth or in space."

Previous applications of CubeSats were limited because these small satellites could not remain pointed in one direction—they had no attitude control. "Some of the original CubeSats just tumbled, so they had limited functionality," says Fujikawa. "When we brought this product to market it kind of revolutionized the industry because it allowed CubeSats to do what some of the larger satellites did



Kestrel Eye deployment from the International Space Station on October 24, 2017.

by precisely pointing to targets on the Earth or in space."

One of the first uses of the IMI-100 was in CUSat. A satellite built at Cornell University by Mason Peck, the Stephen J. Fujikawa '77 Professor of Astronautical Engineering. Fujikawa recently established Peck's professorship in the Sibley School of Mechanical and Aerospace Engineering.

Maryland Aerospace then secured funding from DARPA to develop another product called Kestrel Eye—a miniature surveillance satellite that had a telescope and was able to image targets on the battlefield for soldiers on the ground.

Previous battlefield reconnaissance was done with multi-hundred-million-dollar satellites that only made one or two passes over a given location each day. "The concept with Kestrel Eye was to make them smaller and cheaper and then launch hundreds of them," says Fujikawa. "Then there's always one coming over the horizon."

The U.S. Army was excited about the opportunity to build a constellation of spy satellites that could provide real-time surveillance for battlefields, which led the U.S. Army Space and Missile Defense Command to sponsor the Kestrel Eye program, and deploy it from the ISS. Kestrel Eye operated successfully for the duration of its

planned mission in 2017 – 2018.

"WITH THE MERGER, ADCOLE BROUGHT PROCESS TO OUR BUSINESS AND WE BROUGHT INNOVATION TO THEIRS," SAYS FUJIKAWA.

This program fueled the growth of the company—allowing them to expand their sales to U.S. Federal Government Agencies, domestic commercial markets and global markets.

Fujikawa says that as entrepreneurs, "We attempted to start a new product line every 2 years with the same personnel and skill set that we already had." Their next large development was a star tracker, a device that calculates spacecraft attitude with respect to fixed stars. In 2015, Maryland Aerospace was approached with a merger offer by Adcole, a company that specialized in sun sensors, a device that does the same thing using measurements to the sun. The

company was interested in Maryland Aerospace's star tracker to complement their sun sensor business.

"With the merger, Adcole brought process to our business and we brought innovation to theirs," says Fujikawa.

In 2020, Adcole Maryland Aerospace was sold to AE Industrial Partners, a private equity firm that specializes in Aerospace, Defense and Government Services, Power Generation and Specialty Industrial markets.

As a serial entrepreneur, Fujikawa is currently investigating prospects for starting another aerospace business. He is also assisting Professor Peck with preparing his students for their careers in the space industry.



IMI-101 Attitude Control Units Flown on Cornell's CUSat in 2013.

VEHO INSTITUTE ESTABLISHES CENTER AT CORNELL TECH By Erin Philipson



Members of the Veho Institute celebrate the opening of the Italian Academic Center at Cornell Tech, November 25, 2019 on Roosevelt Island in NYC.

Cornell Engineering has launched the Veho Institute for vehicle intelligence, formally partnering Cornell with Italian universities and luxury automakers as well as establishing a new academic center at Cornell Tech. The launch celebration was held Nov. 25 at Cornell Tech in New York City.

Partners include Cornell Engineering, Cornell Tech and the Motorvehicle University of Emilia-Romagna (MUNER) from the University of Bologna, Italy.

Engineering professors Silvia Ferrari, left, and MAE chair David Erickson are shown at the opening of the Italian Academic Center, November 25, 2019.

The institute's central goal is advancing automotive engineering and data science, with an emphasis on societal impacts, through collaboration between students, faculty and auto industry partners. Subject areas include advanced automotive engineering; virtual reality and computer graphics; autonomous driving; assisted mobility; and transportation and civil infrastructures.

The institute is co-led by Silvia Ferrari, the John Brancaccio Professor of Mechanical and Aerospace

Engineering in the Sibley School; Francesco Ubertini, chancellor of the University of Bologna; and Enrico Sangiorgi, vice chancellor for teaching and education at the University of Bologna.

"My hope is that this new institute will help us transport the world of high-performance automobiles into the future, not simply with autonomous cars but also using all of the new areas of artificial intelligence, data science and the science of autonomy," said Ferrari, whose research includes the development of an autonomous driving model for Ferrari vehicles.

The gathering also celebrated the opening of the Italian Academic Center, in the Tata Innovation Center at Cornell Tech. The new center will give the Veho Institute and Cornell's Italian partners a presence on the Cornell Tech campus, and will provide Cornell students and faculty with opportunities for joint research projects and exchange programs with companies including Ducati, Ferrari, Lamborghini and Maserati.

"Bringing in industry partners is really important to ensure the work we do has intellectual robustness and to ensure that the outcomes of our work can be translated to the world

at scale," said David Erickson, the S.C. Thomas Sze Director of the Sibley School of Mechanical and Aerospace Engineering.

The Veho Institute's first initiatives will include projects conducted by master's and Ph.D. students, as well as internships and exploratory projects for Cornell students who are interested in partnering with automakers. The institute plans to use its website as a forum for companies to post project opportunities for financial support, for which faculty at Cornell and Cornell Tech can compete. Faculty will also have the opportunity to teach courses at MUNER.

The institute was announced in 2018 with a memorandum of agreement. With the formal launch, each partner university made an initial investment of \$1 million to begin programming.

The Veho Institute has already begun joint entrepreneurship activities, including workshops, startup days and incubator programs, with the goal of eventually developing spin-off companies. Rosa Grimaldi, professor and special delegate for entrepreneurship at the University of Bologna, is heading these initiatives.

SIBLEY SCHOOL ANNOUNCES FORMATION OF ADVISORY COUNCIL By Chris Dawson

David Erickson, Sibley College Professor and the SC Thomas Sze Director of Cornell's Sibley School of Mechanical and Aerospace Engineering (MAE), announced the formation of the Sibley School Advisory Council after a more-than-twenty year absence.

"This is an idea that has been percolating for a long time," says Erickson. "A key part of our mission as New York's land grant institution is to contribute meaningfully to the common good. Ensuring that we are truly impacting the common good requires us to engage beyond the academy. Most of our graduates go on to work in industry—and industry is where scientific discovery is put into practice at a scale that can truly make an impact."

The inaugural members include four high-level academic researchers, (from Georgia Tech, UCLA, Case Western Reserve, and Yale), and eleven industry representatives from a diverse array of fields.

Erickson explains that the formation of an Advisory Council is part of a larger plan to increase industrial engagement at the Sibley School. "We see opportunities to increase the

number of collaborations and research partnerships we have with industry," says Erickson, "while at the same time providing our students the 'real world' experience they clamor for."

Council member Mark Schuster '92, who earned a B.S. in Mechanical Engineering, sees the formation of the Advisory Council as a win for Cornell Engineering and an excellent way for the ASML Corporation to engage with the Sibley School. Schuster is a Director of Engineering—Mechatronics at ASML's Fairfield, Connecticut operation.

"As a Cornell Mechanical Engineering grad, I'm honored to be invited to serve on the MAE Advisory Council," says Schuster. "My company makes some of the most advanced machines on the planet, requiring the brightest students from the top engineering programs. I'm proud to say that we hire more mechanical engineers from Cornell than from any other school. Any feedback I can provide to further optimize the program will benefit the school, the students, and hopefully my own future staff."

Another Sibley School alumnus and Advisory Council member,

Richard Aubrecht '66, M.S. '67, Ph.D. '69, says that joining the council gives him another way to contribute to his alma mater. "I have been a member of the Engineering College Council for 35 years, a member of the previous MAE Advisory Board for 6 years, and a Cornell Trustee Emeritus since 1992," says Aubrecht. "Over that time Moog Inc. has contributed in many ways to support MAE's facilities, research, and Project Teams. Through these affiliations, I have acquired knowledge of Cornell's innovations, Strategic Plans, governance, processes, etc. This background will enable me to contribute to the plans for evolving MAE. With my experience in strategic planning, I can help facilitate the updating of the MAE Strategic Plan."

Aubrecht worked at Moog as a Vice President for Strategy and Technology and as Vice Chairman of the Board of Directors.

"Our members come from a diverse set of fields and all share the wish to deepen relationships between the Sibley School and their companies or industries," says Erickson. "This can only make us stronger as a school and as a college."

INAUGURAL MEMBERS

Richard A. Aubrecht, Former Vice President, Strategy and Technology, Moog, Inc

Ken Christy, Portfolio Manager, Navy Enterprise and Sea Systems (NESS), the MITRE Corporation

Timothy Fisher, John P. and Claudia H. Schauerman Endowed Chair in Engineering and Director of Mechanical and Aerospace Engineering, UCLA Samueli School of Engineering

Andres Garcia, Executive Director, Parker H. Petit Institute for Bioengineering and Bioscience; Petit Director's Chair in Bioengineering and Bioscience, Regents' Professor, George W. Woodruff School of Mechanical Engineering Regents Professor

Robert F. Funari, Executive Chairman, Patient Care America, Chairman of the Board NxStage Medical

David Heller, CEO, Heller Industries

Mekala Krishnan, Leader, McKinsey Global Institute's research on gender economics, inclusive growth, and economic development

Hilary Lashley Rension, Senior Business Development Manager, GE

Matthew Edward Monaghan, Chairman/President/CEO Invacare Corp

Tara Murphy, CEO, Vermont Smoke & Cure

Clare Rinnac, Distinguished University Professor, Wilbert J. Austin Professor of Engineering, Case Western Reserve University

Holly Rushmeier, John C. Malone Professor of Computer Science, Yale University

Mark Schuster, Director of Engineering, ASML

Dan Vaughn, Manager of External Technology Collaborations and Intellectual Assets—Corning Incorporated

Brett G. Wood, President and CEO, Toyota Material Handling North America, Senior Executive Officer at Toyota Industries Corporation

MAE AWARDS AND HONORS

FACULTY



Nelly Andarawis-Puri, Associate Professor, was appointed Associate Director for Graduate Programs in the Sibley School & DGS for Mechanical Engineering.



Perrine Pepiot, Associate Professor, was appointed Director of Graduate Studies for Aerospace Engineering and won the Dennis G. Shepherd Award.



Mason Peck, Professor, was elected the inaugural Stephen J. Fujikawa '77 Professor of Astronautical Engineering.



Christopher Hernandez, was promoted to Professor.



Zhiting Tian, was elected a fellow of the American Society of Mechanical Engineers (ASME) and promoted to Associate Professor with tenure.



Guy Hoffman, was promoted to Associate Professor with tenure.



Alan Zehnder, Professor, was appointed the Associate Dean for Undergraduate Studies in the College of Engineering.



Mark Campbell, John A. Mellowes '60 Professor, received the U.S. Air Force Chief of Staff Award for Exceptional Public Service—the highest-level award granted by the U.S. Air Force and was named a fellow of the American Institute of Aeronautics and Astronautics (AIAA).



Silvia Ferrari, John Brancaccio Professor of Mechanical and Aerospace Engineering, was elected a fellow of the American Society of Mechanical Engineers (ASME) and the American Institute of Aeronautics and Astronautics (AIAA).



Hadas Ritz, Senior Lecturer, received the American Society of Engineering (ASEE) Outstanding Teaching Award and the Michael Tien '72 Teaching Award.



Jane Wang, Professor, was awarded a Simons Fellowship in Theoretical Physics and Mathematics.



Meredith Silberstein, Associate Professor, was selected for the 2020 Defense Advanced Research Projects Agency (DARPA) Young Faculty Award.



Liran Gazit, Teaching Support Specialist, was awarded the Academic Achievement Award from the Engineering Alumni Association.



Robert Shepherd, Associate Professor, and his company Organic Robotics Corp engineered one of the ten breakthrough apparel innovations at the Consumer Technology Association Conference 2020.



Olivier Desjardins, Associate Professor, received the Research Excellence Award from Cornell Engineering.



Matt Ulinski, Senior Lecturer, won the Sonny Yau '72 Award from Cornell Engineering and was an honored educator through the Merrill Presidential Scholars Program.



Lawrence Bonassar, Professor, won the Fiona Ip Li '78 and Donald Li '75 Award.



Keith Green, Professor, was named a Cornell Engaged Faculty Fellow.



C. Thomas Avedisian, Professor, received the ASME Classic Paper Award.



Hadas Kress-Gazit, was promoted to full Professor and was named one of the "30 women in robotics you need to know about."

STUDENTS

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: Madeline Dubelier '20

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: Stewart Aslan, M.Eng. '20 for "Pathfinder for Autonomous Navigation: A Low-Cost Architecture for Autonomous CubeSat Rendezvous and Docking."

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: Carl DiFranco '20

2019 Sibley Prize: The Sibley Prize was established in 1884 for the Senior with the highest scholastic average.

Award Recipient: Colin Hegarty '20

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

Award Recipient: Brooke Jin, M.Eng. '20

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 Recipients: Francesco DiMare '20 for the project "Cornell Baja Suspension Geometry" and Wei-Ling Sun '20 for the project "Cornell Baja OD16 Four-Wheel Steering."

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

Award Recipient: William Nuñez '20 for his proposal titled "Design and Manufacture of an FSAE Car Pedal Bay."

EXTERNAL AND UNIVERSITY AWARDS

Keith LeGrand, Ph.D. student working with Professor Silvia Ferrari, received the FUSION Best Student Paper Award for his paper on exploiting bounded sensor field-of-view geometry in tracking and sensor planning problems.

Jennifer Bustillos, Ph.D. student working with Assistant Professor Atieh Moridi, was selected for the Knight@KIC Fellowship, funded by the Kavali Institute at Cornell for Nanos.

Akane Wakai, Ph.D. student working with Assistant Professor Atieh Moridi, won a NASA Space Technology Graduate Research Grant.

Xiangkun (Elvis) Cao, Ph.D. student working with Professor David Erickson, received the MKS Instruments Research Excellence Award at Photonics West 2020 and was named "BP Advancing Energy Scholar" at the One Young World Summit.

Bart Conta Prize in Energy and Environment:

Awarded for best work on a research or design project dealing with energy and environment.

Award Recipients: Kaitlyn Dantuono '20; Emma Renner '20 for their project "Extreme Wind and Waves in the Northeast," and Jilly Cai '20 and Andrew Siler '20 for their project "Quantifying the Energy and Environmental Performances of a Real-World Electric Heat Pump Conversion Project in New York City."

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: Sarah Morris, M.E. Ph.D. degree candidate and Pushan Sharma, M.E. Ph.D. degree candidate.

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: Aditya Bhaskar, T.A.M. Ph.D. degree candidate.

Xu Liu, Ph.D. student working with Associate Professor Robert Shepherd, was named "BP Advancing Energy Scholar" at a One Young World Summit.

Colin Hagarty '20, was selected as a Merrill Presidential Scholar, an honor that recognizes outstanding seniors in the top 1% of their class.

Madeline Dubelier '20, was selected as a Merrill Presidential Scholar, an honor that recognizes outstanding seniors in the top 1% of their class.

JINGJIE YEO



Jingjie (JJ) Yeo has joined the faculty of Cornell's Sibley School of Mechanical and Aerospace Engineering (MAE) as an assistant professor. Yeo's research focuses on interdisciplinary studies of material and biological phenomena by advancing multiscale, multi-physics computational methods and simulations. He aims to characterize and predict the mechanical, chemical, optical, and electrical structure-function relationships of polymers, biopolymers, and bio-inspired materials of various morphologies.

Using additional techniques from machine learning and computational biology, Yeo investigates phenomena related to the human microbiome as a living material for engineering purposes.

Before coming to Cornell, Yeo was a research scientist at Singapore's Institute of High Performance Computing, where he developed silk-based cosmeceuticals and collaborated with Procter & Gamble on molecular dynamics (MD) modeling of keratins and pigment cells. He also had post-doctoral positions at Tufts University and the Massachusetts Institute of Technology (MIT).

Long before any of these positions, Yeo was a young boy in Singapore who liked solving puzzles, building models, and playing with Gundam robots. At the age of twelve Yeo was streamed into the

math/physics track at school and found that he excelled and very much enjoyed the subject matter. "I am a first-generation college graduate," says Yeo. "Neither of my parents graduated from high school. They were both very supportive of me and let me choose the path I wanted to take."

That path led Yeo to a bachelor's degree in aerospace engineering and a Ph.D. in computational materials science and engineering. Both degrees were conferred by Nanyang Technological University (NTU) in Singapore. As Yeo was searching for an undergraduate institution, Nanyang established the first aerospace engineering program in Singapore. "That made my decision easy," says Yeo. "During my undergraduate studies I met Professor Teng Yong Ng, who taught several of the materials-related courses at NTU. The clarity of his teaching inspired me."

In his fourth year as an undergraduate, Yeo had an internship with the Singapore Institute of Manufacturing Technology (SIMTech), where he worked on a method to perform non-destructive testing of the skin of an airplane. "It was the first chance I had to see industry-oriented research and I liked it a lot," says Yeo. Yeo then applied to SIMTech's parent organization, Singapore's Agency for Science, Technology, and Research (A*STAR), hoping to win funding for his doctoral studies.

"IT IS SUPPORTIVE AND COLLABORATIVE AND LESS COMPETITIVE BETWEEN FACULTY MEMBERS. PEOPLE IN THE DEPARTMENT REALLY WANT TO HELP EACH OTHER SUCCEED," SAYS YEO.

His application was successful and he continued to work with Professor Teng Yong Ng, together with his co-supervisor from A*STAR, Professor Zishun Liu. Yeo's doctoral work focused on computer simulation of graphene and silica aerogels. Together, Yeo, Liu, and Ng created a standardized method to create

structural models and characterize thermal properties of silica aerogels. "Professor Ng was very good to work with," says Yeo. "He would give me general directions and guidance, but he also gave me a lot of freedom to develop my own ideas."

As noted above, upon graduating with his Ph.D., Yeo spent a total of three years at the Institute of High Performance Computing in Singapore and two-and-a-half years in post-doctoral positions at MIT and Tufts. While at MIT, Yeo was a Kaufman Teaching Fellow. "It was such a good experience for me," says Yeo. "I learned so much about teaching. I realized that teaching is something that can be learned and practiced—that a person can get better at teaching by working at it." Yeo put into practice what he was learning in his role as a Co-Instructor at Station1, a non-profit organization with a scalable model of higher education based on inclusion and equity, learning through project-based inquiry, and integration of STEM content with societal perspective and impact.

With these many and varied experiences under his belt, Yeo is eager to apply it all at Cornell. "Cornell is quite unlike many of the universities I have seen," says Yeo. "It is more supportive and collaborative and less competitive between faculty members. People in the department really want to help each other succeed. And it is also just so beautiful here."

At Cornell, Yeo's lab will focus on improving the prevention and treatment of diseases associated with aging and noncommunicable diseases, especially by developing soft, adaptive, and responsive biomaterials at a low cost for drugs or drug delivery vehicles with specific targeting mechanisms, environmentally sensitive implants for tissue engineering, or for dynamic health monitoring. "Through our research," says Yeo, "we will propel the development of dynamically-responsive, living materials and design synthetic biological platforms for engineering and medical applications."

By Chris Dawson

SADAF SOBHANI



Sadaf Sobhani has joined the faculty of Cornell's Sibley School of Mechanical and Aerospace Engineering as an assistant professor. Sobhani's research is focused generally on thermal management and energy conversion, with the goal of impacting innovations in high-efficiency, low-emission, robust energy systems. Before coming to Cornell, Sobhani was a postdoctoral researcher at the Lawrence Livermore National Laboratory and a visiting assistant professor in the Sibley School.

Sobhani was born in Iran and her family moved first to Austria when she was ten years old and then, a year later, to the San Francisco Bay area of California. Sobhani's father was an engineer, but he was unable to complete his studies in Iran due to educational restrictions placed on certain religious groups. Sobhani recognizes that part of the impetus for her to earn engineering degrees is rooted in wanting to complete her father's path.

"In high school," says Sobhani, "math and science came naturally and I loved learning about the natural world. I also loved creating things—I was always in my room, drawing and painting. And reading! I never thought that I would ever know enough to be satisfied. I had this insatiable

urge to know more." Two events in high school helped Sobhani narrow down her options a bit. The first was an internship as a nursing assistant in a nursing home. "I had been thinking that I would go to medical school and save the world that way," says Sobhani with a laugh. "But I did not like the experience at all."

The second was a chance to do some biology-focused research. "That was formative for me," says Sobhani. "It made me see that, through research, you can discover new information and take it out into the light." Sobhani took this insatiable desire to learn more and moved to Stanford, where she earned a B.S., M.S., and Ph.D., all in mechanical engineering.

"CORNELL IS THE PERFECT PLACE FOR ME TO DO THIS SORT OF WORK," SAYS SOBHANI. THERE ARE ALSO SOME INCREDIBLE SHARED FACILITIES HERE FOR ADDITIVE MANUFACTURING, CHARACTERIZATION, AND COMPUTATION. I CAN REALLY DIG INTO THESE QUESTIONS ABOUT HOW WE CAN DESIGN THERMAL SYSTEMS THAT HAVE BOTH A FLUID AND A SOLID STRUCTURE."

Sobhani carried out her doctoral work in the Center for Turbulence Research with her advisor, Professor Matthias Ihme. "My work focused on combustion," says Sobhani. "I wanted to use lab work and computation to describe how flames behave when they are restrained in a porous structure. There is not a lot of research yet on this

question, so in a way we are helping to push the field into some new territory."

Sobhani will continue this work at Cornell, with a dedicated lab space recently built in Grumman Hall. "Cornell is the perfect place for me to do this sort of work," says Sobhani. "I am very excited to have this experimental space. And the students that come to Cornell are so strong. There are also some incredible shared facilities here for additive manufacturing, characterization, and computation. I can really dig into these questions about how we can design thermal systems that have both a fluid and a solid structure."

"In conventional fluid dynamics," says Sobhani, "we think of boundary conditions as determining system possibilities. Embedding these solid structures changes everything." Sobhani uses experimental and computational techniques to investigate flow, heat transfer, and chemical reactions in porous media. Using what she learns about the connections between micro-scale features and macro-scale transport properties, Sobhani researches ways to apply topology optimization techniques, additive manufacturing, and non-intrusive diagnostics to design, fabricate, and analyze tailored porous structures in combustion, electrochemistry, and other complex flow systems.

By Chris Dawson



Sadaf Sobhani speaking at the Global Ethanol Summit, 2019.

ELAINE PETRO



Elaine Petro has joined the faculty of Cornell's Sibley School of Mechanical and Aerospace Engineering (MAE) as an assistant professor. Petro, who started in July 2020, is thrilled to be at Cornell. "Cornell has all the pieces already in place for me to build the research program I want to build," says Petro. "I wanted to be at a place that is already strong in engineering, space science, and plasma science and Cornell is one of very few schools that fits that description."

Petro's says her research "straddles propulsion engineering and planetary exploration." She will explore in situ resources (those found on other bodies in the solar system) that can be used for propellants and novel architectures that can take advantage of these resources for planetary exploration.

Before coming to Cornell, Petro had a position as a post-doctoral research associate at MIT's Space Propulsion Laboratory, studying ion propulsion for small satellites. Petro earned her Ph.D. in aerospace, aeronautical, and astronautical engineering at the University of Maryland College Park, where she worked with Professor Ray Sedwick, studying water-based spacecraft propulsion. Before starting her doctoral studies, Petro worked at NASA's Goddard Space Flight Center

in Maryland supporting the James Webb Space Telescope and the Mars Atmosphere and Volatile Evolution missions.

Working at Goddard after earning her B.S. in aerospace engineering from the University of Maryland was, in an odd way, a bit of a homecoming for Petro. "When I was growing up, my mom worked at Goddard sewing protective thermal blankets for use on spacecraft," says Petro, "and my dad also worked there, applying thermal coatings to spacecraft. I even got to see two shuttle launches because of their work. Because my parents exposed me to what NASA does, I was always really interested in space and the planets. I was also always good at—and enjoyed—math and science, so it wasn't hard to choose aerospace engineering as my field."

"I WANTED TO BE AT A PLACE THAT IS ALREADY STRONG IN ENGINEERING, SPACE SCIENCE, AND PLASMA SCIENCE AND CORNELL IS ONE OF VERY FEW SCHOOLS THAT FITS THAT DESCRIPTION," SAID PETRO.

Petro enjoyed her three years working at Goddard before starting her doctoral studies. "You get a different perspective working on 'real' projects that aren't simply isolated thought experiments," says Petro. "The things we made at Goddard had to exist and succeed in the real world, with all of its budgetary and political and logistical constraints." As an academic, Petro feels this awareness of the non-technical constraints on space technology adds a useful dimension to her work.

A draw away from Goddard and back to

academia for Petro is the opportunity to try things that are a little more experimental in nature. "The projects NASA sends into space are so high stakes and require such reliability and confidence," says Petro, "that there is not really any room for risky engineering or untried technologies. If you want to come up with new designs or try new things, the university is the place to do that."

Petro's work at Cornell will continue to focus on propulsion engineering for planetary exploration. Her specialty is ion propulsion, which allows you to apply a small, steady force over long periods of time to achieve very high velocities. The basis for the systems Petro works with is water—a resource which is proving to be abundant throughout the solar system. Water molecules can be ionized and then the ionized molecules can be accelerated using electric fields. When these accelerated molecules are focused and directed out of a spacecraft, the craft is propelled forward. Ion propulsion may sound like the stuff of science fiction, but Petro points out that Robert Goddard studied the technology in the very early 1900s.

Petro is excited to be at Cornell and is currently recruiting graduate students to join her lab. In the fall semester of 2020 she is teaching a class on the physics and engineering behind space propulsion.

By Chris Dawson



Elaine Petro teaching a Satellite Design School at the Universalized Panamericana

CORNELL SOLAR DISTRICT CUP TEAM PLACES THIRD IN NATIONAL COMPETITION

By Erin Philipson

The Cornell Solar District Cup Team placed third at the U.S. Department of Energy's Solar District Cup, a design competition aimed at modeling optimized, distributed solar energy systems.

Competing teams worked to design integrated solar and storage systems for real-world mixed-use districts. Winning designs provided the highest annual energy offset and the greatest financial savings.

The Cornell team, managed by the Energy Systems Club, led by Hannah Contreras '21, and advised by Matt Ulinski, Director of the M.Eng. Program in the Sibley School of Mechanical and Aerospace Engineering, was tasked with designing a solar plus storage system for Crystal Parks, a section of the Crystal City neighborhood in Arlington, Virginia—a growing hub that houses the new Amazon headquarters.

Shivanie Rambaran '20, led the design subteam where she planned the central logistics around the PV rooftop arrays and ground installations which included determining sizing, necessary equipment, and optimization strategies.

"We realized early on that there was no way to tackle problems without taking a "Systems Thinking" approach. Each decision we had to make as a design subteam relied heavily on input from all the rest; the finance, electrical, and development subteams," said Rambaran. "We would sit in on each other's meetings and be in constant communication about updates because each small change would have a ripple effect on everyone else. That was great practice for how engineering teams and

systems engineering work in the real world."

Together, the various subteams modeled all aspects of the proposed system, from the interconnection of the buildings and grid, to the power purchase agreement and battery dispatch cycles, as well as permitting and legal issues of the project.

The team saw the expansion of Arlington into a growing hub as an opportunity to make community engagement a selling point with their design. "Besides the five large buildings with an abundance of rooftop space to house solar PV arrays, we incorporated ground installations as well such as solar carports over parking for shade and solar-powered kiosks that provide information about the local renewable generation," says Rambaran.

The solar conference was scheduled to take place in Georgia, but due to COVID-19, was held

virtually on April 26th, 2020. The team delivered their presentation to industry professionals during a live video conference event. The competition started with 61 teams and ended with first, second and third place winners for each of the three use case districts.

"It was invaluable to see how other people approached the same problem we had been working on for months," says Rambaran. "The feedback for each team was definitely a wakeup call for how industry operates in comparison to some theoretical approaches in our designs. It made us really reflect on what we did well or could have done better."

The Cornell Solar District Cup Team is part of the Cornell Energy Systems Club. "Solar District Cup was an incredible experience professionally, socially and academically," says Rambaran. "The lessons extend far beyond renewable generation."



Cornell Solar District Cup Team on a Zoom Call



Sibley Alum Leading a Team Making Next-Gen Respirators for Health Care Workers

Dan Cohen '05, MS '07, Ph.D. '10 is CEO & co-founder of 3DBio Therapeutics, a Cornell spinout company that creates

living tissue implants for therapeutic applications. When the COVID-19 pandemic hit, 3DBio was focused on developing reconstructive tissue for children with microtia. As the virus escalated, 3DBio reconfigured a portion of its engineering operations to design and manufacture powered air purifying respirators (PAPRs), top-of-the-line protective devices for workers in the most infectious environments.



Bone breakthrough may lead to more durable airplane wings:

Professor Christopher Hernandez and his team made a breakthrough discovery about how the internal structure of bone can be strengthened to withstand repeated wear and tear. His findings could help treat osteoporosis patients and lead to the creation of more durable, lightweight materials for the aerospace industry.



Three Sibley School Ph.D. students will explore market potential for their research:

The students became Commercialization Fellows which allows them to explore the market potential for their research with entrepreneurship experts in the industry and academia



Cornell Atkinson Center awards grant for project led by Professor Max Zhang:

The project will develop, monitor and model mitigation strategies for medical facilities to protect health care workers from COVID-19 in NYC. Collaborators include Weill Cornell Medicine, The Baker Institute and the School of Civil and Environmental Engineering.



Space Applications used for Agriculture:

Former Lecturer in, Hunter Adams, pivoted the use of autonomous chip satellites from space applications to agriculture.



Microbiome research at Cornell:

Professors Christopher Hernandez, and researchers are collaborating to understand the human microbiome.



Earthworm-shaped robots could help breed new drought-resistant crops:

Associate Professor Robert Shepherd partnered with horticulture to develop robots that can burrow into the soil with minimal disturbance to better understand roots.



Halo Labs raised \$12M in Series B Financing:

The company was co-founded by S.C. Thomas Sze Director, David Erickson, and former Ph.D. student, Bernardo Cordovez who worked in Erickson's lab. Halo Labs analyzes particles to allow their customers to better their biopharmaceutical products.

Chemists create faster-degrading plastic for marine uses:

A collaboration between Sibley School Professor, Meredith Silberstein, Cornell University Chemistry & Chemical Biology, and the College of Wooster produced a new plastic that can degrade on a realistic time scale if lost in an aquatic environment.



Cornell Online Classes Gain Popularity with Alumni and General Public:

Rajesh Bhaskaran, Swanson Director of Engineering Simulation in the Sibley School, has seen increased enrollment in his free EdX online course called "A Hands-On Introduction to Engineering Simulations" since the COVID-19 pandemic.



Active Learning Initiative Makes Big Impact on Transition to Online Instruction:

The project, called Active Learning Initiative (ALI), is funded by Cornell's Office of the Vice Provost for Academic Innovation and the Center for Teaching Innovation through grants, with the overall goal to facilitate the redesign of courses to implement research-based active learning strategies. The program greatly aided the transition to virtual instruction in the spring.



Five Sibley School students have been selected as 2020 Kessler Fellows:

The Kessler Fellows program is designed to help cultivate entrepreneurial readiness—preparing students to spend their summer with a startup.



The Missing Link: Cornell Professor finds Hidden Connections

Between Energy and the Environment: With the introduction of congressional bills like the Green New Deal, climate change and the environment have been at the forefront of the nation's mind. However, for Professor K. Max Zhang, mechanical and aerospace engineering, it was a class at Cornell that inspired his current research on High Energy Demand Days—days during the year when energy demand is particularly high.



Two-step method patches herniated discs:

A collaboration led by Lawrence Bonassar developed a two-step technique to repair herniated discs so they maintain mechanical function and won't collapse or deteriorate.



Sibley Ph.D. and Group won Novelty Prize at Digital Ag Hackathon:

Houston Claire, doctoral student, MAE; Apratim Jash, doctoral student, food engineering; Adam Kendrick, MBA '20; Patrick Schulz, M.S. '21, food engineering won the novelty prize at the digital ag hackathon for their project "Using waste byproducts from tequila production for a healthy probiotic drink."



Researchers create 3D-printed, sweating robot muscle:

To address the challenge of managing soft robots' internal temperature, Associate Professor Rob Shepherd and his team took inspiration from our own natural cooling system: sweating.



Professor Mason Peck on Cosmos:

Mason Peck, Stephen J. Fujikawa '77 Professor of

Astronautical Engineering, along with 4 other Cornell Faculty were science advisors on COSMOS. All five faculty are members of the interdisciplinary Carl Sagan Institute:



Telescope upgrade, move will aid in search for exoplanets:

Dmitry Savransky, assistant professor of mechanical and aerospace engineering, is a co-investigator on a \$2.6 million NSF grant aiming to improve the search for exoplanets by upgrading the Gemini Planet Imager (GPI).



Engineering Co-op Program continues relationship with GE Aviation,

providing invaluable student experiences: Cornell Engineering has a long history with GE Aviation, most recently Sophia Norwood '21 completed her Co-op at their facility outside of Boston, MA.



Astronaut conducts Cornell experiment on space station:

Orbiting 250 miles above the Earth on the International Space Station, astronaut and station commander Luca Parmitano conducted an experiment designed by Professor Michel Louge that will help validate numerical models used for a number of industrial and geophysical applications.



Iterate Labs pivots to track workplace social distancing:

Iterate Labs, founded by Apoorva Kiran, Ph.D. '17 and Jason Guss, Ph.D. '18 has expanded the features of their technology to enable companies to bring employees back to work safely amid COVID-19.



NSF funding to help erase upstate NY's digital divide:

NSF has awarded \$1.5 million to Professor Max Zhang and collaborators to help bridge New York's digital divide by designing the nation's first statewide Internet of Things public infrastructure.



Mobile phone-based saliva test wins NIH prize

A team of researchers including David Erickson, S.C. Thomas Sze Director of the Sibley School, designed a mobile phone-based system to detect infectious diseases, inflammation and nutritional deficiencies which was awarded a \$100,000 NIH Tech Accelerator Challenge prize. For the saliva-based test, a small 3D-printed adapter is clipped to a mobile phone and synced with a mobile app. The app uses the phone's camera to image test strips to detect malaria, iron deficiency and inflammation, with results in under 15 minutes. The proposal builds on the FeverPhone and NutriPhone platforms developed by the team at Cornell's Institute for Nutritional Sciences, Global Health and Technology (INSIGHT).

CornellEngineering

Sibley School of Mechanical and Aerospace Engineering

Published by the Sibley School of Mechanical and Aerospace Engineering

Editors: Erin Philipson, David Erickson, and the Engineering Marketing and Communications Team

Writers: Erin Philipson and Chris Dawson

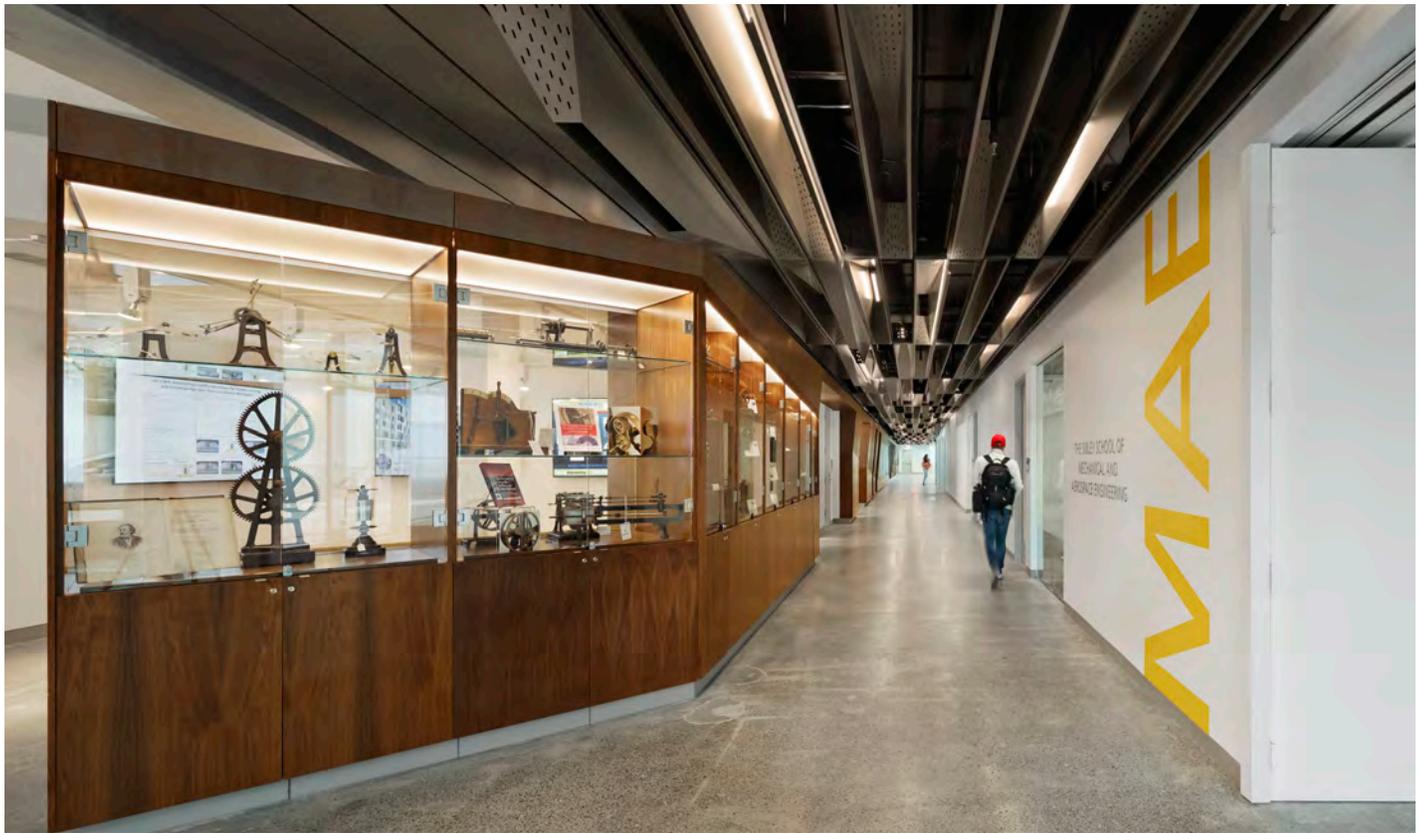
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