

## Department of Mechanical Engineering

The Department of Mechanical Engineering (MechE) embodies MIT's motto *mens et manus*, "mind and hand," as well as "heart" by combining analysis and hands-on discovery with a commitment to making the world a better place. We train the next generation of mechanical engineers to develop creative products and solutions. By leveraging our strengths, we aspire to solve some of the biggest challenges facing our world.

During academic year 2021 (AY2021), faculty, staff, and students at MechE continued to execute our research and educational missions, while coming together to address challenges caused by the Covid-19 pandemic, renewing our resolve to be an actively anti-racist and inclusive community, and strengthening our sense of community.

### Research

MechE researchers conduct cutting-edge research at the new frontiers of mechanical engineering. Faculty often specialize in more than one discipline, ensuring a fluidity of research that promotes cross-disciplinary discovery.

Our research is organized across seven collaborative disciplines:

- Mechanics
- Design, Manufacturing, and Product Development
- Controls, Instrumentation, and Robotics
- Energy Science and Engineering
- Ocean Science and Engineering
- Bioengineering
- Micro-and-Nano Engineering

Throughout AY2021, MechE researchers continued to lead many research efforts related to Covid-19. The diversity of our faculty and researchers' expertise have led to innovations in Covid-19 research across a broad spectrum including:

- An artificial intelligence (AI) model that distinguishes cough recordings of healthy individuals from those infected with Covid-19
- A reusable N95 face mask for frontline workers
- Research on the impact lockdowns have had on air pollution and solar output
- Machine learning models measuring the efficacy of quarantine across the world
- The development and deployment of a robot that reduces health care workers' exposure to Covid-19 by remotely measuring patients' vital signs

The work MechE researchers have done to develop solutions during the Covid-19 pandemic reflects the department's strategic mission focused on four unifying MechE Grand Challenges facing our world. These include:

- Health of the Planet and Health of the People
- Global Energy Sustainability
- Robotics, Autonomy, and Intelligent Systems
- Design and Manufacturing Innovation

These challenges build upon our expertise and provide opportunities for major global impact through interdisciplinary collaborations. They also reflect MIT's mission to make a better world through research, education, and innovation.

## Education

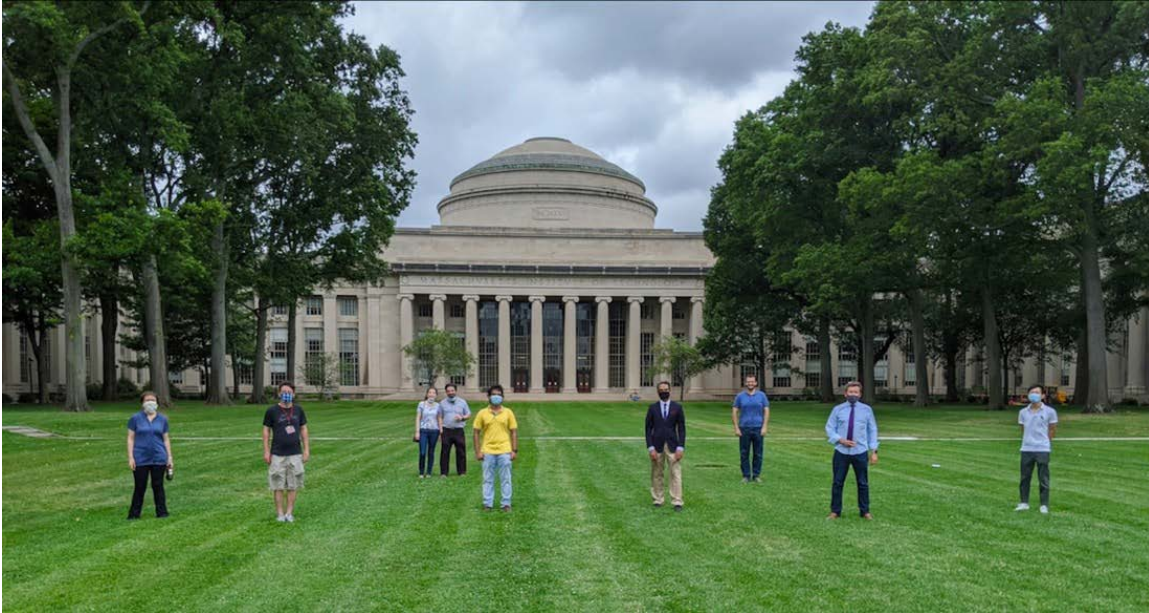


*Professors Rohit Karnik (left), associate department head for education in Mechanical Engineering, and Ken Kamrin test the setup for recording remote lectures in class 2.001 Mechanics and Materials I.*

MechE's core research disciplines and focus on grand challenges shape our world-class undergraduate and graduate-level programs. By its very nature, the education MechE provides its students is incredibly hands-on. This posed unique challenges as we grappled with the constraints of remote and hybrid learning throughout the academic year. To address these challenges, our faculty and staff introduced new innovative methods of teaching hands-on classes remotely, prioritized safety for those who were on campus, and provided students with a number of professional development opportunities in light of many canceled internships.

While there was a great deal of focus on revising our classes in light of the restrictions put in place due to the pandemic this past year, we continued to make changes to our class offerings in reaction to various mechanical engineering research and career trends. This included continuing to incorporate more computing options into our class offerings and determining how to best intersect with the Schwarzman College of Computing.

## Community



*Professor Gareth McKinley and the team at the Hatsopoulos Microfluids Laboratory held a socially distant group gathering on Killian Court in August 2020 to celebrate the Zoom-based PhD defense of Anoop Rajappan.*

The department continued to make fostering a sense of community a top priority during AY2021. With the vast majority of faculty, staff, and students remote throughout the year, we employed new methods and channels to foster a greater sense of community. This included the launch of a Community Events Committee, the hiring of a community and communications coordinator, and a new weekly community newsletter.

This year, we placed greater emphasis on our commitment to being a more diverse, equitable, and inclusive department. Under the leadership of the MechE Diversity, Equity, and Inclusion (DEI) Task Force, Asegun Henry—Robert N. Noyce Career Development Professor, associate professor of MechE, and diversity faculty chair—and Bryan Nance—our new community and equity officer—we are close to finalizing a multi-year strategic plan for our department. After conducting hundreds of hours of interviews and surveys with key stakeholders, the MechE DEI Task Force published a departmental diversity, equity, and inclusion vision statement, as well as set of community values.

In this year's report, we provide an overview of departmental news throughout AY2021. The report includes a short synopsis of this year's goals, objectives, and priorities; accomplishments; administrative initiatives; updates on faculty news—new hires, promotions, changes in departmental leadership, and retirements; select research highlights across the department; education highlights; awards and recognitions to provide a small sampling of the diversity, breadth, and depth of achievements across the

entire MechE community; a summary of various communication activities; and finally an overview of space renovations completed on campus.

### **Current Goals, Objectives, Priorities**

A number of our objectives and priorities were focused on the impact of the Covid-19 pandemic on our educational and research missions as well as our commitment to equity. This year, we also placed a growing emphasis on computing in engineering.

This past year's departmental goals, objectives, and priorities include the following:

- Facilitate intradepartmental research collaborations that focus on Grand Challenges
- Support Health of the Planet Research through seed funding provided by MathWorks
- Pioneer new pedagogy and innovations in teaching in reaction to the Covid-19 pandemic; assess the efficacy of these changes and implement successful changes to our education beyond the pandemic
- Successfully execute our educational mission in the face of challenges associated with remote and hybrid learning
- Utilize the breadth and depth of expertise across the department to develop research solutions for the challenges the world faces in light of the Covid-19 pandemic
- Emphasize the growing role of computing in mechanical engineering through the Committee on the Strategic Integration of Data Science into Mechanical Engineering and enhance collaboration with the Schwarzman College of Computing
- Increase outreach to first-year students and prospective students in an effort to better inform students about the department and encourage undergraduate enrollment
- Improve the graduate student experience through understanding the challenges of the qualifying exams, developing new teach assistant (TA) process, piloting training on building inclusive laboratory cultures, and graduate student group coaching program
- Increase outreach to female and underrepresented minority (URM) groups in an effort to encourage a more diverse cohort of incoming graduate students
- Facilitate and support the launch of Mechanical Engineering Graduate Association (MEGA) of Women's "Find Your Next Adventure" chat series, spotlighting female alumnae
- Support our students' career and professional development with the MechE Alliance program
- Foster a deeper sense of community, particularly in light of remote work and learning
- Create and promote a more diverse, equitable, and inclusive department and community and reject racism and prejudice in any form
- Enhance space for education, research, operations, and community

## Accomplishments

### Focus on Grand Challenge Research

This past year, the department continued its efforts to increase discussions and opportunities for intradepartmental research collaborations in the four Grand Challenge areas previously identified in the strategic plan. These efforts included the following:

#### ***MathWorks Seed Fund Program to Address MechE Grand Challenges***

As part of the MathWorks Seed Fund Program, the department announced a second call for collaborative seed-funding proposals to support new audacious cooperative research projects between two or more faculty members in our department. This follows a first round of seed funding to support collaborative research projects related to the Health of the Planet. For this second MathWorks seed-call, any of the Grand Challenges can be the focus area. Each proposal must have at least two joint lead principal investigators (PIs) from within our department. The selection of the seed funding projects is ongoing and will be reported in next year's report.

#### ***MechE Faculty Retreat: Big/Audacious Research Ideas***

On January 27, MechE hosted a Faculty Retreat focused on big/audacious research ideas. The goal of the retreat was to hear from program managers from different agencies and to brainstorm research ideas among all faculty. Agencies and speakers at the retreat included the following:

- National Science Foundation (NSF): Dawn Tilbury, assistant director, Engineering
- Advanced Research Projects Agency-Energy (ARPA-E): Jennifer Gerbi, deputy director of technology, ARPA-E
- Air Force Office of Scientific Research (AFOSR): Frederica Darema, former director of AFOSR and former senior science and technology advisor at NSF (retired)
- AFOSR: Erik Blasch '92, program officer, AFOSR
- Defense Advanced Research Projects Agency (DARPA): Aaron Kofford, program manager, Strategic Technology Office
- NASA: Mike Seablom, senior strategist for NASA's Earth Science Technology Office at NASA headquarters

### Remote Educational Innovations

In light of the challenges posed by the Covid-19 pandemic, our faculty and teaching staff developed a number of game-changing innovations to ensure we could still execute our educational mission. Many of these innovations can be utilized in a post-pandemic world. Highlights include:

## MechE Summer X

The summer 2020 launch of the MechE Summer X, or Knowledge Exchange provided students, recent graduates, faculty, and staff an opportunity to share and learn skills by offering and participating in short-term remote activities. Activities included an introduction to metamaterials, a course on Fusion 360, and a Chinese dumpling making course.

## Remote Kit Shipping Team



*Senior Lecturer Barbara Hughey (right) and PhD candidate Lauren Chai prepare kits to ship to students in 2.671 Measurement and Instrumentation.*

A small team of teaching staff and faculty instructors designed processes, coordinated and executed an enormous procurement, assembly, and shipping operation that enabled tens of thousands of parts to be shipped in more than 1,000 boxes to effectively bring the signature hands-on experience of learning in a MechE laboratory session to hundreds of students dispersed around the world.

## 2.S009 Explorations in Product Design

Under the leadership of Professor David Wallace, the department successfully carried out an in-person version of our hallmark senior capstone class 2.S009 Explorations in Product Design during the fall 2020 semester. The class retained as many elements of the typical 2.009 semester as possible, including presentations shot on a sound stage and live streamed to audiences at home.

### 2.001 Mechanics and Materials I: “Discovery Labs” Kits

The teaching staff in class 2.001 Mechanics and Materials I, sent students a kit of materials so students could conduct “Discovery Labs” in their own homes during synchronous small group meetings.

### 2.008 Design and Manufacturing II: Flipped Classroom

Faculty and staff in class 2.008 Design and Manufacturing II, utilized a flipped classroom model to maximize laboratory time for students on campus. They also developed a virtual/augmented reality app that allows students to choose an object—such as an Amazon Fire tablet—manipulate it, disassemble it, and experience what it might be like to “tear down” the product in their own hands.

### 2.007 Design and Manufacturing I: Remote Robot Competition



*MIT student Julianna Rodriguez built a robot from her kitchen in West Roxbury, Massachusetts. In spring 2021, each student in course 2.007 Design and Manufacturing I was shipped a special game board for their robot to compete on.*

Under the leadership of Amos Winter, Tata Career Development Professor and associate professor of MechE, and Sangbae Kim, professor of MechE, the team running 2.007 Design and Manufacturing I completely reimagined the course. Students were sent a 130 pound kit of materials and a game board so they could design and build robots at home. The course concluded with the first known live head-to-head remote robot competition, streamed from homes, apartments, and dorms across the country.

### 2.00B Toy Product Design: PLAYsentations on Killian Court

First-year students in 2.00B Toy Product Design, were able to present their toy products in the typical PLAYsentation skit format from a stage on Killian Court. The event was streamed live to audiences at home.

## **Departmental Retreat—MechE Education in the 21st Century**

The retreat held in June 2021 focused on learnings from the pandemic, and on pedagogy and education in the coming years. Faculty and teaching staff discussed what knowledge or skills are likely to be of increasing importance to future MechE engineers, and why, and how the department should adapt its curricula, degree programs, and pedagogy to prepare mechanical engineers of the future.

### **Focus on Engineering Decision Making**

The Education Strategy Committee, a standing committee constituted last year, deliberated upon the approach that the department's education should take in the long run. The committee converged on "engineering decision-making" as a core competency to develop in our students, and recommended that the department consider including it in a deliberate manner into the degree programs. A preliminary template that could act as a pedagogical tool was developed.

### **Covid-19 Research**

In addition to conducting research on a variety of grand challenges our world faces, throughout AY2021, many of our faculty, research staff, and students focused heavily on developing solutions for the Covid-19 pandemic.

### **Focus on Computing**

#### **Strategic Integration of Data Science into Mechanical Engineering**

MechE launched a new Committee on the Strategic Integration of Data Science into Mechanical Engineering. Under Professor George Barbastathis' leadership, the committee developed a strategic vision to integrate machine learning and data science into research, entrepreneurship and education unique to our department.

#### **Launch of Common Grounds Class**

Barbastathis taught our first Common Grounds class with the Schwarzman College of Computing, 2.C161/2.C169 Physical Systems Modeling and Design Using Machine Learning.

### **Focus on Undergraduate Enrollment**

Under the leadership of Mary Beth Gallagher, communications manager, a comprehensive enrollment strategy was developed and implemented with the goal of attracting more undergraduate students in light of decreasing undergraduate enrollment numbers. The following strategic actions were implemented during AY2021:

- Increased focus on careers, including the launch of a Careers Page on the MechE website
- Email campaigns highlighting course offerings to first-year students
- Focus on MIT News articles written by Mary Beth Gallagher highlighting top undergraduate students
- Inaugural "MechE Faculty Lunch Series" in which faculty hosted small groups of first-year students to discuss MechE



- Hosted Pizza Party for current first-year students and current juniors and seniors studying mechanical engineering
- Inaugural laboratory tours during Campus Preview Weekend to attract and engage prospective students
- Revised Open House content, including new Prezi brochure, during Campus Preview Weekend
- Increased utilization of the Office of the First-Year's weekly newsletter to highlight events
- Continued offering of 2,000 Explorations in Mechanical Engineering

### Diversity, Equity, and Inclusion Initiatives



*The MechE Diversity, Equity, and Inclusion (DEI) Task Force is composed of faculty, staff, and students from across the department.*

### Diversity, Equity, and Inclusion Task Force

The MechE Diversity, Equity, and Inclusion Task Force is composed of faculty, staff, and students who were asked to define our community values and develop a 5-year Action Plan to hold us accountable and ensure we are making progress. Formed in summer 2020, the DEI Task Force includes the following members:

- Asegun Henry, faculty
- Bryan Nance, community and equity officer
- Katey Stewart, staff
- Jonathan Tagoe, undergraduate student
- Yadira Rivera, staff

- Fiona Grant, graduate student
- Vishnu Jayaprakash, graduate student
- Dawn Wendell, teaching staff
- Cullen Buie, faculty
- Daniel Oropeza, graduate student

### **MechE Vision Statement and Community Values**

The MechE DEI Task Force finalized the [MIT MechE DEI Statement](#) and [Community Values](#) in spring 2021. These documents were developed with extensive feedback from the MechE community including students, staff, faculty, and alumni. The task force has clearly outlined our department's vision, where we are now, and where we hope to be with regards to issues of diversity, equity and inclusion. They have also published a MIT MechE Code of Conduct as well as a set of community values and personal competencies to hold us all accountable.

### **Diversity, Equity, and Inclusion Accomplishments and Initiatives**

Under the leadership of the MechE DEI Task Force, our department has taken some important steps toward increasing diversity and prioritizing inclusivity. This has resulted in the following:

- Starting with the March 2021 Visiting Committee meeting, diversity, equity, and inclusion will be a standing agenda item for all MechE Visiting Committees moving forward.
- The number of individuals who identify as URM applying to MIT MechE for graduate school in 2021 doubled after implementation of a new outreach and recruiting effort.
- Launched the first ever “Futures in MechE” series to encourage women and URMs to pursue an advanced degree in mechanical engineering. The series included a two day workshop for undergraduate women, an afternoon workshop for URM students, and an afternoon workshop specifically for Black students.
- The number of Black students matriculating to our graduate program increased by 150% between 2020 and 2021.
- The department has piloted MechE ENGAGE to help new graduate students who identify as female and/or URMs build a quality network of support and skills for graduate school through structured peer and faculty mentoring in a small group format. ENGAGE will help students navigate the unknowns of the graduate student experience with greater confidence, particularly if they have fewer contacts with graduate school experience in their personal network.
- The department is in the process of hiring three female faculty members, including the department's first tenure-track Black female faculty member.

## **Faculty Bias Training**

To ensure an inclusive environment for all and to work on the sometimes problematic power dynamics at play in academia, all MechE faculty were required to attend bias training. The training was a scenario-based training focused on qualifying exams.

## **Updates to Qualifying Exams**

The MechE PhD Qualifying Exams were conducted remotely for the first time in January 2021. A small team developed a new workflow for the exam and worked through logistics and contingency plans. The planning involved consideration of aspects such as creating virtual reading rooms, proctoring versus honor codes, hardware and software to be used, guidance for students and examiners, advance testing and familiarization of the format for students and examiners, among other factors. Nearly all of the administrative support staff prepared for more than a month and were involved in running the exam, which helped to develop a better sense of community and also provided an opportunity for the support staff to learn new skills.

In addition to remote exams, the department also took steps to address the concern raised by some students regarding the Qualifying Exams, namely that the passing rates of female students were lower than male students. Students also expressed concerns that the expectations of the exam were unclear. Although the department did not find evidence of bias (although pass rates were different), several steps were taken to address potential biases that could exist. A bias training was arranged before the exam, and all faculty were required to take the training. Student concerns were conveyed to faculty by bringing them up in faculty lunch meetings with the goal of making faculty more aware of the student perspectives. Based on discussions in faculty meetings, objectives of the Qualifying Exam, description of how the results are determined, and what factors are taken into consideration, were drafted and included in the exam guide and graduate guide. Finally, the department worked with Institutional Research to design a study (which started in July 2021) to holistically assess the spectrum of experiences of the graduate students to provide insights that will guide future improvements to the graduate program and making sure that all graduate students have the opportunity to flourish in a welcoming and supportive environment.

## **MechE Alliance Program**

During the past year, the MechE Alliance, under the leadership of Theresa Werth, program manager, and Brian Anthony, faculty lead, the MechE Alliance has leveraged our alumni and industry relationships to maintain connections between students, alumni, faculty, and industry during an uncertain year. New and continuing initiatives continue supporting students in achieving their career goals.

## **Mentorship**

The MechE Alliance has facilitated over 300 one-to-one mentoring conversations and alumni portfolio reviews between alumni and students in addition to organizing group mentoring through alumni panels.

## Industry Engagement

Knowledge exchange and relationship building with industry has remained strong during the pandemic through educational programming and seminars. These relationships are now being leveraged to create new data and computing focused projects through the Master of Engineering in Advanced Manufacturing and Design program.

## Education

The MechE Alliance was able to leverage relationship building over the past years and the Institute's Summer 2020 Experiential Learning Opportunity (ELO) program to conduct the MechE Alliance Industry Connected ELO program. In this program, a cohort of students worked individually or in small groups on a current challenge in industry. Several student teams were co-mentored by company representatives and learned valuable lessons about working in industry. Students were also brought together for trainings and lectures on common skills needed by the projects and to build a sense of community among the cohort. At least one student gained full time employment with their partner company and the MechE Alliance received a donation from one company to host another of these educational projects based on their positive experience.

The MechE Alliance works also with department courses and programs to arrange alumni volunteers and presenters to improve our educational offerings. This spring, two alumni panels were arranged for 2.000 Explorations in Mechanical Engineering to highlight career paths in MechE.

## MechE Alliance Seminars

From June 2020 to July 2021, the MechE Alliance hosted 29 virtual seminars featuring MIT MechE students, postdoctoral researchers, faculty, alumni, and external partners. Through these seminars, we support the free-flow of ideas throughout the networks of researchers that make up the global MechE community.

## Building Your Career Portfolio for MechEs

During summer 2021, the MechE Alliance held our second annual summer career development workshop series that walks students through the most important career development steps to take in preparation for their job search. Self-introductions, LinkedIn, and portfolio development are particularly emphasized with specific tips and examples for MechEs. Through a mix of self-paced learning and workshops, students are supported in developing their career portfolio culminating in a feedback session with departmental alumni in relevant fields. Over 80 students participated.

Workshops sessions run from June–August and will be offered annually each summer to MIT MechE graduate and undergraduate students and postdoctoral researchers.

## Enhancing Space for Education and Research

In collaboration with the Office of the Provost and Department of Facilities, we have started the construction for the Newman Laboratory renovation. We completely redesigned the space, maximizing both the available space and its usability, with

the mezzanine level now running the length of the laboratory. The revised plan allows existing research groups to continue and extend their full programs, while accommodating Sangbae Kim's biomimetic robotics research group and a flexible laboratory space for one of our flagship courses—2.12 Introduction to Robotics, taught by H. Harry Asada, Ford Foundation Professor of Engineering, and Kamal Youcef-Toumi, professor of MechE. We also added new capabilities for research in robotics, instrumentation, chemistry, and biology, including a conference space, as well as a new metal 3D printer in the renovated machine space. We moved all of the existing research towards temporary space in Buildings 35 and 41, and completed the associated renovations in Building 35, so as to provide future usable spaces for MechE.

The MathWorks capital renewal funds are being used to create a collaborative space for computing and interdisciplinary design in the Department of Mechanical Engineering. The renovated space will act as a hub for research at the intersection of computing and hardware systems and will be located at and near the Ziggurat (pyramid shape tower) at the end of the fourth floor of Building 3. It will offer a combination of spaces that enable collaborative research projects, meetings, and functions. If feasible, a new outdoor space will also be created for collaborative laboratory research, outdoor celebrations, and research reflections on the top floor of Building 1, adjacent to and accessible from the Ziggurat. The renovations will change the outdated look of the Ziggurat and increase our usable space into a modern, state-of-the-art space for collaborative engineering research and educational activities. Over the last year, we have worked with MIT's Office of Campus Planning, Facilities Engineering, Office of the Provost, and the Dean of the School of Architecture and Planning. We have also selected Ann Beha Architects to create the concept design, organizing many workshops since spring 2021 to refine our ideas, as well as to discuss sustainability, energy usage, building codes, and other modalities. The concept design should be completed by September 2021.

## **Administrative Initiatives**

### **Focus on Diversity, Equity, and Inclusion**

MechE administrative and support staff have made significant contributions to DEI initiatives in the department through the work of the DEI Task Force. Of note are the Staff Grievance and Staff Retention and Development Working Groups, which are being led by staff as part of the development of the DEI Action Plan.

### **Development of Web-based Systems**

This year a number of individuals across the department, including the Webmaster and MechE Space Team, were actively involved in the development of web-based systems on tools such as QuickBase and Drupal. These tools were critical for the new dynamic management of space, research, and education in the Covid-19 phases. This expertise is now utilized in many other projects that improve our management, services, and safety. This includes software for our General Institute Budget (GIB) and for our new space management system as well as the distributions of new research opportunities.

## Supporting Remote Work

The department ensured that all staff had appropriate “home office” equipment, access to tools and resources to support their work while remote due to the Covid-19 pandemic. We’ve provided support and regular updates to staff through monthly staff meetings, weekly office hours, frequent updates to the MechE Covid-19 Resources Page, and by arranging dedicated support sessions for staff from the Clinical Director at MyLife Services, in response to the unforeseen levels of grief seen in the community during this time.

## Staffing

We continue to work to ensure we are adequately and appropriately staffed to best support the evolving needs of the department and ensure that staff are not overwhelmed and there is redundancy so that staff can take vacations. Additions to headcount include a department community and equity officer, an additional human resources (HR) administrator, and a communications and community coordinator. We’ve also restructured the MechE research administration team, adding an additional financial assistant and creating the manager of Research Administration role.

## Staff Community Events Committee

In February 2021, the department established the Staff Community Events Committee. Led by the Communications and Community Coordinator, Kimberly Tecce, the committee meets regularly to brainstorm, plan, and execute key departmental events throughout the year, with particular emphasis on events that bring the community together.

## Staff Retreat

On June 24, 2021, the department hosted the inaugural MechE Staff Retreat for administrative and support staff. The retreat was led by Melissa Scheid Frantz, an empowerment coach and consultant with 25 years of experience working in higher education. Our goal with this retreat was to strengthen the sense of community within MechE staff, help individuals develop advocacy skills and strategies to activate empowerment both for themselves and for their colleagues, and to recognize our individual and collective strengths and achievements.

## Faculty Promotions

### Alberto Rodriguez

Alberto Rodriguez has been promoted to associate professor with tenure. Rodriguez is a leader in the field of Robotic Manipulation, a fundamental function of robots interacting with the physical world. He has made groundbreaking contributions in the mechanical and data-driven modeling, planning, control, and system integration of frictional interactions involved in grasping, pushing, inserting, pulling, and throwing. His work ranges from basic modeling, analysis, and machine learning of the dynamics of frictional contact to mechanical design of grippers and end-effectors, to motion planning and control, and to tactile sensing and visual perception. His works are technically deep yet practically important. His methods meet the increasing needs in the rapidly growing e-commerce and logistics industries that require picking millions of diverse items in

automated warehouses. Rodriquez is a passionate, inspirational, and highly effective teacher. He has taken the leading role in teaching our large undergraduate core subject, 2.003 Dynamics and Control I. He is an excellent citizen for our department and the community. He has served as a member of the MechE Graduate Admissions Committee, MechE undergraduate controls and dynamics curriculum committee, and the recent MechE General Faculty Search, as well as chair organizer of the MIT campus-wide Robotics Seminar series and co-creator of the virtual open seminar series Robotics Today. Since 2016, Rodriquez has served as associate head of house in the MIT graduate dorm Sydney-Pacific.

### **Betar Gallant**

Betar Gallant has been promoted to associate professor without tenure. Gallant is a rising star in the area of advanced chemistries and materials for electrochemical energy storage and CO<sub>2</sub> emissions mitigation. She has made important contributions and provided key scientific underpinnings for a new class of metal-gas primary battery based on the reaction of lithium metal and perfluorinated gases that enable safe conversion and ultra-high energy densities. Toward enabling higher-energy rechargeable lithium-ion batteries by replacing the graphite anode with a lithium anode, she has elucidated the “lithium solid electrolyte interphase” by systematically investigating interface properties to guide cycle life improvement and increase Coulombic efficiency. Furthermore, she has proposed a new approach to integrate carbon capture with electrochemical conversion from point sources by redesigning the capture chemistry to have dual function as both a sorbent and activator of CO<sub>2</sub>. Betar is a tremendous teacher and mentor. She is also a very active citizen within our department, including serving as our faculty ambassador to graduate students, and in her community.

### **Ellen Roche**

Ellen Roche has been promoted to associate professor without tenure. Roche is a rising star at the interfaces of biomechanics, medical devices, soft robotics, and engineering design and modeling. She has developed new innovative technologies that support or repair impaired organ functions to ultimately improve patient outcomes. Her current work provides disruptive bioengineering advances in cardiac and pulmonary medicine by: augmenting partially failing organs to restore their functional output; developing technologies to repair tissues and correct local defects; and using simulations and building high-fidelity ex vivo testbeds to evaluate technologies. Her research offers rigorous, computation-assisted engineering design of medical simulators and implantable devices grounded in a deep understanding of physiological and pathological biomechanics. Roche’s contributions in education and in service at the department, Institute, and in her community are excellent.

### **Svetlana Boriskina**

Svetlana Boriskina was promoted to principal research scientist. Boriskina is a leading researcher in the area of nanomaterials and nanophotonics. She is developing multi-functional materials and devices to harvest and manipulate electromagnetic fields for applications in energy, water, and public health security. Her work combines computational and experimental techniques to develop new metamaterials and devices. Boriskina is an excellent educator and mentor. She has developed and taught three subjects

at MIT. She piloted 2.S990 Fashion Engineering during Independent Activities Period (IAP) 2020 which had 150 students enrolled. She founded the MechE Communication Lab in February 2018 and since then serves as the MechE Communication Lab manager, where she recruits and supervises MechE Communication Fellows. Boriskina is also very active in the optics and materials community.

## **New Faculty Hires**

### **Assistant Professor**

#### ***Faez Ahmed***

Faez Ahmed joined MechE as an assistant professor in August 2020. Ahmed completed his PhD in Mechanical Engineering at the University of Maryland in 2019 and was a postdoctoral fellow at Northwestern University in 2019–2020. Prior to his PhD, he worked as a reliability engineer in Australia. Ahmed has established the DeCoDE lab. The lab’s vision is to create a world where humans and AI work together to design solutions to our biggest challenges. His current research centers on solving complex engineering design problems using techniques from optimization and machine learning. His recent work has focused on developing the first polynomial-time algorithm for diverse matching, showing AI-driven discovery of unseen designs, and creating computationally efficient ways for engineering material systems.

#### ***Navid Azizan***

Navid Azizan will join the MIT faculty with dual appointments in the MechE and the Institute for Data, Systems, and Society as an assistant professor effective September 2021. He is currently a postdoctoral researcher in the Autonomous Systems Laboratory at Stanford University. He received his PhD in computing and mathematical sciences from California Institute of Technology (Caltech) in 2020, his MS from the University of Southern California in 2015, and his BS from Sharif University of Technology in 2013. Additionally, he was a research intern at Google DeepMind in 2019. Azizan’s research interests broadly lie in machine learning, control theory, mathematical optimization, and network science. He has made fundamental contributions to various aspects of intelligent systems, including the design and analysis of optimization algorithms for nonconvex and networked problems with applications to the smart grid, distributed computation, epidemics, and autonomy. Azizan’s work has been recognized by several awards, including the 2020 Information Theory and Applications Graduation-Day Gold Award. He was named an Amazon Fellow in Artificial Intelligence in 2017 and a PIMCO Fellow in Data Science in 2018. His research on electricity markets received the ACM GREENMETRICS Best Student Paper Award in 2016. He was also the first-place winner and a gold medalist at the 2008 National Physics Olympiad in Iran. He co-organizes the popular “Control meets Learning” virtual seminar series.

#### ***Carlos Portela***

Carlos Portela joined MechE as an assistant professor in August 2020. He received his PhD in mechanical engineering from Caltech in 2019. He was a postdoctoral researcher at Caltech under the guidance of professors Julia Greer, Dennis Kochmann, and Chiara Daraio. Portela’s research lies at the intersection of materials science, mechanics, and



nano-to-macro fabrication with the objective of designing and testing novel materials— with features spanning from nanometers to centimeters— that yield unprecedented mechanical, optical, and acoustic properties. His recent accomplishments have provided routes for fabrication of these so-called “nano-architected materials” in scalable processes as well as testing nanomaterials in real-world conditions such as supersonic impact, in collaboration with researchers at MIT’s Institute for Soldier Nanotechnologies. His present application areas involve the creation of novel lightweight armor materials, ultrasonic devices for medical purposes, and new generations of ultra-strong structural materials. Portela is the recipient of several awards including the Gold Paper Award at the Society of Engineering Science Meeting in 2019, the Centennial Award for the Best Thesis in Mechanical and Civil Engineering at Caltech, and the Caltech Rolf H. Sabersky Graduate Fellowship.

### ***Vivishek Sudhir***

Vivishek Sudhir joined MechE as an assistant professor in August 2020. He completed his PhD at the Ecole Polytechnique Federale de Lausanne (EPFL) in 2016. His PhD thesis demonstrated the most precise measurement of the quantum fluctuations of a mechanical oscillator ever performed, work for which he won the EPFL Thesis Prize and was runner-up for the APS Dissertation Award. Prior to this, he studied theoretical quantum optics at Imperial College London, and electrical engineering in India. Sudhir’s research aims to realize displacement measurements with a precision sufficient to confront fundamental theories of physics. The ability to do so enables all kinds of applications, from the detection of gravitational waves from colliding black-holes, to understanding why large objects do not exhibit strange quantum mechanical behavior, to the development of a new generation of sensors and transducers that harness quantum mechanics for their advantage, and a new paradigm for controlling motion at these scales. Sudhir develops the theoretical ideas to probe these questions, and performs ultra-precise experiments to answer them. He hails from a town in Kerala renowned for its musical heritage; he however prefers to oil paint, indulge in large format photography, or go on long bike rides.

### **Associate Professor of the Practice**

#### ***Jeremy Leghorn***

Captain Jeremy Leghorn was appointed to Professor of the Practice for the Naval Construction and Engineering program. He succeeded Captain Robert Bebermeyer in the summer of 2021. Captain Leghorn is one of the national leaders in the engineering, management, maintenance, and repair of submarines as well as surface ships for the US Navy.

### **Departmental and School Leadership**

- Professor John G. Brisson II has been named director of Centers for Mechanical Engineering Research and Education at MIT and SUSTech.
- Professor Nicolas Hadjiconstantinou was named to the new transitional support coordinator role. As part of his role, he will provide support to graduate students as they transition through various academic and personal development throughout their time at MIT.

- Asegun Henry was named faculty diversity chair for MechE and chair of the MechE DEI Task Force. The MechE DEI Task Force is composed of faculty, staff, and students who defined our community values and developed a 5-year Action Plan.
- On June 30, 2021, Anette “Peko” Hosoi, Neil and Jane Pappalardo Professor and professors of MechE and Mathematics, stepped down from her position as assistant dean of the School of Engineering, a role she has held since August 2017.
- In February 2021, Ken Kamrin, associate professor in MechE, assumed the role of undergraduate officer. As part of his role, he will oversee all aspects of the MechE undergraduate degree programs including the Undergraduate Office.
- Nicholas Makris, William I. Koch Professor and professor of Mechanical and Ocean Engineering, was reappointed as director of the Center for Ocean Engineering through 2022.
- In October 2020, Professor Thomas Peacock was named head of Area 1—Mechanics: Modeling, Experimentation, and Computation.
- Yang Shao-Horn, W. M. Keck Professor of Energy and professors of MechE and Materials Sciences and Engineering, was reappointed as a member of the MIT Energy Council through 2023.

### **Chairs and Professorships**

- Assistant Professor Faez Ahmed was appointed to the Brit (1961) and Alex (1949) d’Arbeloff Career Development Professorship effective July 1, 2020.
- Assistant Professor Carlos Portela was appointed to the Brit (1961) and Alex (1949) d’Arbeloff Career Development Professorship effective July 1, 2020.
- Associate Professor Alberto Rodriguez was appointed to the Class of 1957 Career Development Professorship effective July 1, 2020.
- Assistant Professor Giovanni Traverso was appointed to the Karl R. Van Tassel (1925) Career Development Professorship effective July 1, 2020.
- Professor Xuanhe Zhao was appointed to the George N. Hatsopoulos (1949) Faculty Fellowship in Interdisciplinary Research effective October 21, 2020.

### **Faculty Retirements**

John Heywood retired as an active faculty member on June 30, 2021 and began his role as professor emeritus.

### **Research Highlights**

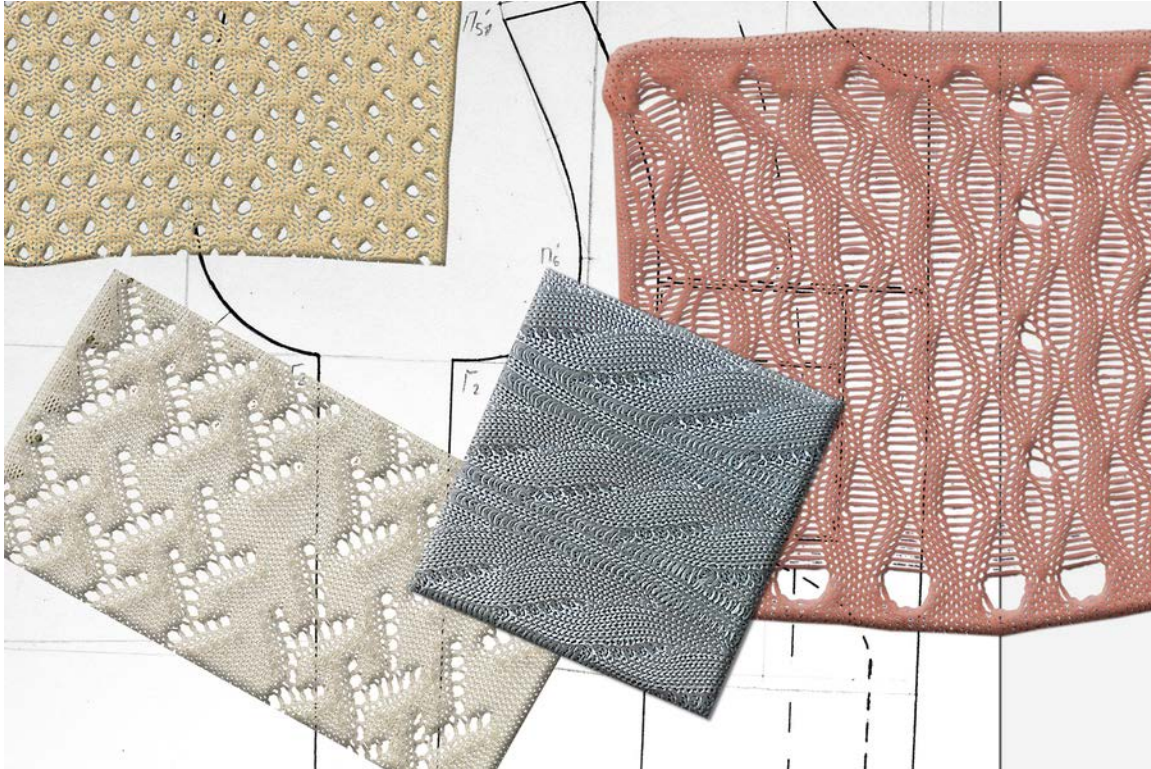
Our faculty are innovators and problem solvers, always with an eye toward developing technologies that will make the world a better place. Much of our research is focused on major global challenges including the health of our planet, design and manufacturing, global energy sustainability, and robotics, autonomy, and intelligent systems.

## Selected Articles

Here we provide a snapshot of the varied and diverse research conducted in the department that was published in peer-reviewed journals.

### **Svetlana Boriskina**

- “Sustainable polyethylene fabrics with engineered moisture transport for passive cooling,” *Nature Sustainability*
- MIT News: Could we recycle plastic bags into fabrics of the future?



MIT researchers design a new kind of sustainable textile from polyethylene fibers that may help humans adapt to and combat the effects of climate change. Image: Felice Frankel

### **Tonio Buonassisi**

- “A data fusion approach to optimize compositional stability of halide perovskites,” *Matter*
- MIT News: Homing in on longer-lasting perovskite solar cells

### **Betar Gallant/Evelyn Wang**

- “Bubble growth and departure modes on wettable/non-wettable porous foams in alkaline water splitting,” *Joule*
- MIT News: Controlling bubble formation on electrodes

**Linda Griffith and David Trumper**

- “Primary Human Colonic Mucosal Barrier Crosstalk with Super Oxygen-Sensitive *Faecalibacterium prausnitzii* in Continuous Culture,” *Med*
- MIT News: A new tool for modeling the human gut microbiome

**Ming Guo**

- “Volumetric Compression Induces Intracellular Crowding to Control Intestinal Organoid Growth via Wnt/ $\beta$ -Catenin Signaling,” *Cell Stem Cell*
- MIT News: To make mini-organs grow faster, give them a squeeze

**Asegun Henry/Yang Shao-Horn**

- “Enhancement of ion diffusion by targeted phonon excitation,” *Cell Reports Physical Science*
- MIT News: Phonon catalysis could lead to a new field

**Roger Kamm and Peter So**

- “Tumor cell nuclei soften during transendothelial migration,” *Journal of Biomechanics*
- MIT News: Cancer cells soften as they metastasize, study suggests

**Rohit Karnik**

- “Engineering and characterization of gymnosperm sapwood toward enabling the design of water filtration devices,” *Nature Communications*
- MIT News: MIT engineers make filters from tree branches to purify drinking water

**Jeehwan Kim**

- “Long-term reliable physical health monitoring by sweat pore-inspired perforated electronic skins,” *Science Advances*
- MIT News: Sweat-proof “smart skin” takes reliable vitals, even during workouts and spicy meals

**Gareth McKinley**

- “Time–connectivity superposition and the gel/glass duality of weak colloidal gels,” *PNAS*
- MIT News: “Colloidal gels,” ubiquitous in everyday products, divulge their secrets

**Carlos Portela**

- “Supersonic impact resilience of nanoarchitected carbon,” *Nature Materials*
- MIT News: Ultralight material withstands supersonic microparticle impacts

**Yang Shao-Horn**

- “Ultra-high-voltage Ni-rich layered cathodes in practical Li metal batteries enabled by a sulfonamide-based electrolyte,” *Nature Energy*
- MIT News: Design could enable longer lasting, more powerful lithium batteries

**Vivishek Sudhir**

- “Approaching the motional ground state of a 10-kg object,” *Science*
- MIT News: Physicists bring human-scale object to near standstill, reaching a quantum state

**Giovanni Traverso**

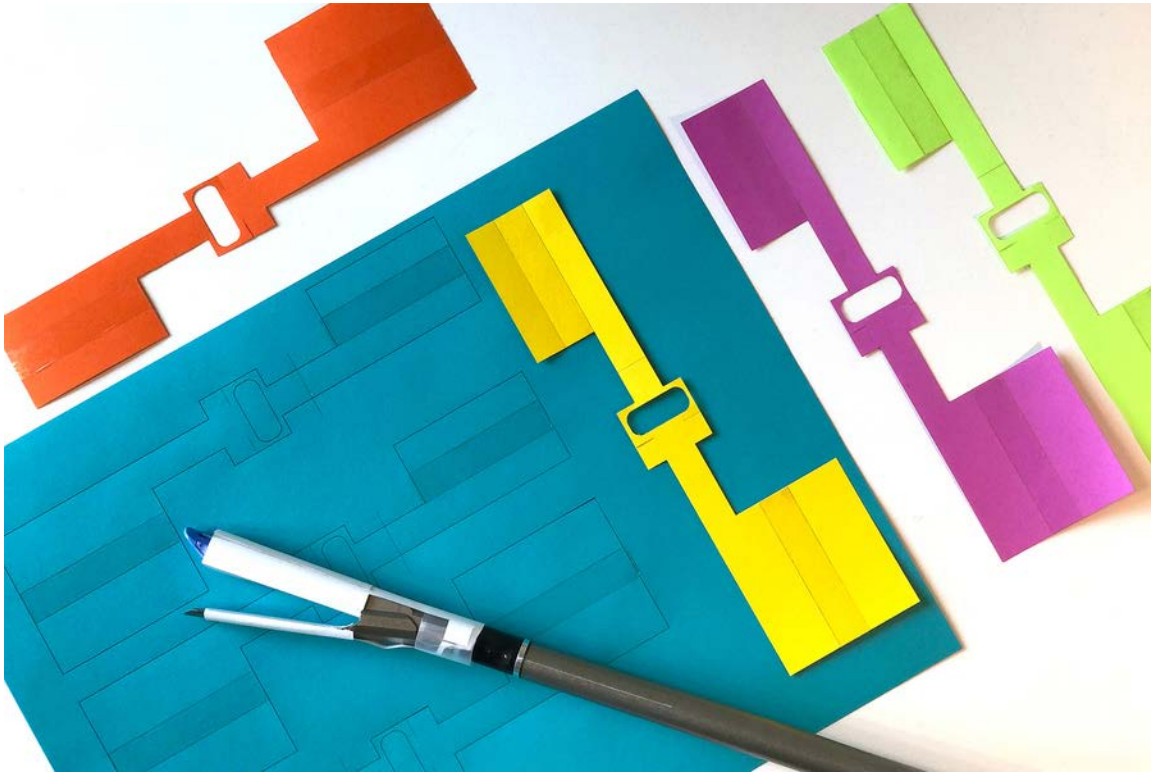
- “Gastrointestinal synthetic epithelial linings,” *Science Translational Medicine*
- MIT News: Synthetic coating for the GI tract could deliver drugs or aid in digestion

**Kripa Varanasi**

- “Crystal critters: Self-ejection of crystals from heated, superhydrophobic surfaces,” *Science Advances*
- MIT News: How to get salt out of water: Make it self-eject

**Xuanhe Zhao**

- “A Multifunctional Origami Patch for Minimally Invasive Tissue Sealing,” *Advanced Materials*
- MIT News: An origami-inspired medical patch for sealing internal injuries



MIT engineers have design paper-like medical tapes (shown here) that can fold around surgical tools and transform into soft, strong adhesives when pressed against tissues. Credit: Felice Frankel.

## Education Highlights

### Undergraduate Enrollment, AY2016–AY2020

Course by year	AY2016	AY2017	AY2018	AY2019	AY2020
Course 2 sophomores	88	66	71	64	53
Course 2-A sophomores	99	103	94	80	76
Course 2-OE sophomores	1	2	2	1	0
<b>Sophomore subtotal</b>	<b>188</b>	<b>173</b>	<b>167</b>	<b>145</b>	<b>129</b>
Course 2 juniors	83	97	70	86	59
Course 2-A juniors	92	90	69	71	61
Course 2-OE juniors	3	2	3	2	1
<b>Juniors subtotal</b>	<b>177</b>	<b>189</b>	<b>152</b>	<b>159</b>	<b>121</b>
Course 2 seniors	81	78	93	70	61
Course 2-A seniors	89	94	83	72	80
Course 2-OE seniors	6	3	3	3	2
<b>Seniors subtotal</b>	<b>176</b>	<b>175</b>	<b>179</b>	<b>145</b>	<b>143</b>
Course 2 fifth year students	3	8	6	4	2
Course 2-A fifth-year students	7	8	4	9	8
Course 2-OE fifth-year students	0	0	0	0	0
<b>Fifth-year students subtotal</b>	<b>10</b>	<b>16</b>	<b>10</b>	<b>13</b>	<b>10</b>
<b>Total</b>	<b>551</b>	<b>553</b>	<b>508</b>	<b>462</b>	<b>403</b>

## Graduate Enrollment, AY2016–AY2020

Graduate level	AY2016	AY2017	AY2018	AY2019	AY2020
Master's	213	221	190	187	194
Doctoral	309	302	294	268	244
MEng	15	11	9	11	9
MechE	0	1	0	2	1
Eng (naval)	30	28	31	27	25
<b>Total</b>	<b>567</b>	<b>564</b>	<b>524</b>	<b>495</b>	<b>473</b>

## Honors and Recognition

Our department, faculty, and students are all recognized for their accomplishments through a number of awards and honors each year. Here we provide a small sampling of the recognition the department and its faculty and students received this year:

### Rankings

- No. 1 Undergraduate Program in 2021 US News & World Report Rankings, [MIT News](#) | [US News & World Report](#)
- No. 1 Graduate Program in 2022 US News & World Report Rankings, [MIT News](#) | [US News & World Report](#)
- No 1 in 2021 QS University Subject Rankings, [MIT News](#) | [QS Ranking](#)

### Faculty, Research Staff, and Teaching Staff Awards and Honors

- Steve Banzaert: 2021 Teaching with Digital Technology Award
- Cullen Buie: American Institute for Medical and Biological Engineering's College of Fellows
- Domitilla del Vecchio: Fellow of the Institute of Electrical and Electronics Engineers (IEEE) and Newton Award for Transformative Ideas during the Covid-19 Pandemic
- Sili Deng: National Academy of Engineering's 27th annual US Frontiers of Engineering Symposium
- Nicholas Fang: The Optical Society Fellow
- Betar Gallant: NSF CAREER Award
- Linda Griffith: American Academy of Arts and Sciences and National Academy of Engineering's 2021 Bernard M. Gordon Prize for Innovation in Engineering and Technology Education
- Neville Hogan: Pioneer in Robotics and Automation Award in 2021 from the IEEE Robotics and Automation Society

- Barbara Hughey: 2020 Teaching with Digital Technology Award and Mechanical Engineering Exceptional Educator Award
- Ian Hunter: 2022 IEEE Joseph F. Keithley Award in Instrumentation and Measurement
- Rohit Karnik: National Academy of Inventors Senior Member
- Mathias Kolle: Human Frontier Science Program
- Hermano Igo Krebs: 2021 IEEE-Engineering in Medicine and Biology Society Distinguished Lecture
- John Lienhard: American Society of Thermal and Fluids Engineers Fellow
- John Liu: Infinite Mile Award
- Tony Patera: Keenan Award for Innovation in Undergraduate Education
- Ellen Roche: Trailblazer Award for New and Early Stage Investigators by the National Institute of Biomedical Imaging and Bioengineering and Single Ventricle Research Fund Award from Additional Ventures
- Themistoklis Sapsis: Bodossaki Award on Basic Sciences in Mathematics
- Warren Seering: 2021 Ruth and Joel Spira Award for Excellence in Teaching
- Yang Shao-Horn: National Academy of Inventors Fellow, Dr. Karl Wamsler Innovation Award, and 2020 Humbolt Prize
- Simona Socrate: Mechanical Engineering Exceptional Educator Award
- Giovanni Traverso: Popular Science's 100 Greatest Innovations of 2020, WIRED UK's "32 innovators who are building a better future", and STAT Madness Winner
- Wim van Rees: US Department of Energy's 2020 Early Career Research Program and Army Research Office Early Career Award
- Kripa Varanasi: Second place at the Rice Business Plan Competition
- David Wallace: 2020 Teaching with Digital Technology Award
- Evelyn Wang: 2020 International Conference on Nanochannels, Microchannels and Minichannels Prominent Researcher Award

## **Administrative Staff Awards**

### ***2021 Infinite Mile Awards***

The Infinite Mile Awards (IMA) support the Institute's objectives for excellence. Launched in 2001, the awards recognize and reward members of the MIT School of Engineering's administrative, support, sponsored research, and, when appropriate, academic staff. This year, six MechE staff received IMAs including:



- Joanne Mathias, administrative officer
- Susan Amrose, research scientist
- Remote Kit Team: Maral Banosian, Steve Banzaert, Catherine Forrest and Emily Welsh

### ***Joseph “Tiny” Caloggero Service Award***

This award is given annually to a member or members of the support staff for outstanding service to the Department of Mechanical Engineering. This year’s award was given to Alexandra Cabral.

### ***MechE Covid-19 Hero Awards***

These awards are to recognize the extraordinary efforts of teaching, administrative, and support staff members in the department whose ongoing efforts during the Covid-19 crisis have enabled new capabilities and made the transition easier for MechE colleagues, work groups, and overall community. This year’s award was given to the following staff:

- Maral Banosian, Steve Banzaert, Catherine Forrest, and Emily Welsh
- William Cormier, Stephen Haberek, Tasker Smith, and Scott Spence
- Harris Crist, Tom Graffeo, Dan Herrick, and Sarah Pham
- Adam Eisenstein, Peter Pflanz, and Tony Pulsone
- John Freidah
- Mary Beth Gallagher, Kim Tecce, and Theresa Werth
- Dan Gilbert
- Barbara Hughey
- Shibani Joshi, John Liu, Daniel Shea, and Una Sheehan
- Emily Kierstead
- David Sella
- Simona Socrate

### ***New England Emmy Award Nomination***

John Freidah was nominated for a New England Emmy Award for the MIT MechE videos, [“Teaching Mechanical Engineering in a Pandemic”](#) and [“Building the Next Generation of Electronics.”](#)

### ***Council for Advancement and Support of Education Circle of Excellence Award***

John Freidah won a CASE Circle of Excellence Award for the [Celebrating the MIT MechE Class of 2020](#) video shown at last year's virtual Commencement event.

### **Student Awards**



*Graduate student Hilary Johnson was named the winner of the "Eat it!" Lemelson-MIT Program Student Prize for her work on centrifugal pumps. Credit: Gurkarian Singh.*

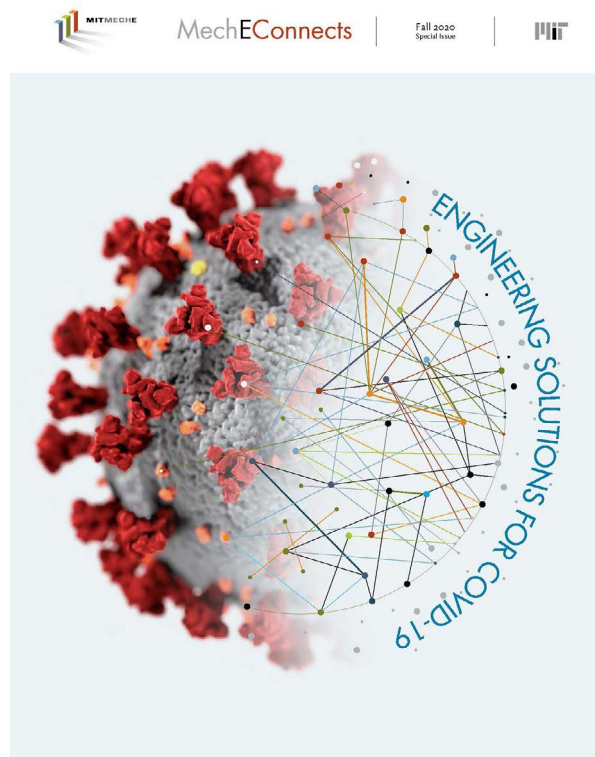
- 2020 Fall Materials Research Society (MRS) Graduate Student Silver Award: Xinyue Liu
- 2021 School of Engineering Graduate Student Extraordinary Teaching and Mentoring Award: Michael Rainer Braun
- Apple Scholar: Jaya Narain
- Best Poster Award—MRS 2020 Fall Meeting: Lenan Zhang
- Collegiate Inventors Competition: Hyunwoo Yuk
- Edward L. Horton Fellowship Award 2021: Shashank Agarwal and Maytee Chantharayukhonthorn
- Frederick H. Todd Scholarship by Society of Naval Architects and Marine Engineers: Andreas Mentzelopoulos
- Fulbright Fellowships: Jenny Chan, Miki Hansen, Laura Huang, and Tony Terrasa

- Goodwin Teaching Award: Georgia Van de Zande
- Hugh Hampton Young Fellow: Emily Hanhauser
- iBuild Fellowship: James Zhang
- Knight-Hennessy Scholars: Orisa Coombs and Max Kessler
- Lemelson-MIT Student Prize— Eat It: Hilary Johnson
- MIT Abdul Latif Jameel Water and Food Systems Lab (J-WAFS) 2021 World Water Day Video Competition—First Place: Hilary Johnson
- MIT Outstanding Event Award: Crystal Owens and Maytee Chantharayukhonthorn
- Schmidt Science Fellows: Alvaro-Miguel Fernandez Galiana

## Communications

The MechE media team continued to share MechE's stories in compelling ways across a variety of channels this past year.

## MechE Connects



*MechE Connects Fall 2020 Special Issue on Covid-19.*

This year's issues of MechE Connects, the newsletter for the Department of Mechanical Engineering, focused on the ways our faculty, students, and alumni are having meaningful impact in solving some of the biggest challenges our world faces.

In the Fall 2020 special issue of MechE Connects, we highlight just a few examples of how our faculty, students, staff, and alumni have used their minds, hands, and hearts to innovate, develop solutions, and support others in response to the Covid-19 pandemic. [Read MechE Connects.](#)

### MIT News Stories

Throughout the year, twenty articles originating from MechE and written by Mary Beth Gallagher were published by MIT News. Eight of these were the Spotlight of the Day on MIT's main website. A number of these Spotlights had a corresponding video produced by John Freidah. Stories included:

- July 1, 2020: [Guided discovery in teaching structural mechanics](#) (Spotlight)
- July 9, 2020: [MIT research on seawater surface tension becomes international guideline](#)
- September 2, 2020: [Lessons from the Clean Air Car Race 50 years later](#)
- September 19, 2020: [Teaching mechanical engineering in a pandemic](#) (Spotlight)
- November 10, 2020: [The poster session goes virtual](#)
- November 30, 2020: [Slowing the spread of Covid-19](#)
- December 3, 2020: [Illustrating Covid-19 hygiene best practices](#)
- December 11, 2020: [Students present product prototypes inspired by kindness](#)
- January 5, 2021: [Delivering life-saving oxygen during a pandemic](#)
- January 7, 2021: [Heather Theberge, mechanical engineering staff member, dies at 42](#)
- January 11, 2021: [Deploying no-contact vitals-sensing kiosks across campus](#)
- February 7, 2021: [Reducing inequality across the globe and on campus](#) (Spotlight)
- February 25, 2021: [Healing with hydrogels](#) (Spotlight)
- March 9, 2021: [Yo-yos offer a first foray into manufacturing at scale](#) (Spotlight)
- March 29, 2021: [Sustainable solutions at home and abroad](#)
- April 14, 2021: [Professor Emeritus Ernest Cravalho, an expert in thermodynamics and pioneer in thermal fluids education, dies at 82](#)
- April 16, 2021: [An artistic approach to designing medical devices](#) (Spotlight)
- April 23, 2021: [Navigating beneath the Arctic ice](#) (Spotlight)
- May 5, 2021: [Innovations in water accessibility](#) (Spotlight)
- May 28, 2021: [Phonon catalysis could lead to a new field](#)

## MechE Videos

Video production continues to be a priority for MechE's communication team. This year, the department released eight videos on its YouTube channel. These videos were produced by John Freidah, senior producer and creative lead. They received 82,351 total views on YouTube.

These videos are also posted natively on Facebook and often repurposed by the main Institute social media channels on Facebook and YouTube.

## Social Media

MechE's social audience continued to grow throughout AY2021. Channel specific strategies were employed to ensure that key demographics were targeted on the channel they most often use. The most dramatic increase in followers and engagement was on LinkedIn, which saw a 70% increase in followers from 6,583 (June 30, 2020) to 11,206 (June 30, 2021). Twitter saw a 23% increase in followers from 10,110 (June 30, 2020) to 12,430 (June 30, 2021). Instagram saw a 19% increase in followers from 17,258 (June 30, 2020) to 20,518 (June 30, 2021). Note that Facebook continues to be a platform with less brand presence for higher education institutions across the board, which saw a 0.5% increase from 36,325 (June 30, 2020) to 36,501 (June 30, 2021).

## Website Traffic

The [MechE homepage](#) is constantly updated with engaging content including articles about groundbreaking research, students and faculty profiles, start-up and product news, and award highlights. The website received 1,573,671 pageviews by 346,756 users in AY2021.

## Space Renovations

### Construction Complete

- Jeehwan Kim's Laboratory (Room 31-399): We completed the updates to this room to include power, chilled water, and exhaust for new equipment.
- Jung-Hoon Chun's Laboratory (Room 35-018): Due to lack of space elsewhere, we moved Professor Jung-Hoon Chun's Laboratory to this room, removing existing equipment, and refreshing this room.
- Sili Deng's Laboratory (Room 31-156): Phase 2 construction of this lab will be completed on August 15, 2022. In phase 2, we added 394 square feet to her existing lab. The new area will have a glove box, gas lines, process cooling water, a new electrical panel, and laser setups for her research.
- Laboratory for Vivishek Sudhir (Room 5-030): We completed the extensive change of space from student seating to a clean room, which will be class 1,000, and the laser table where his research will happen is class 100. We managed to fit the laser table along with all the mechanical equipment and an anti-room to enter before entering the laboratory.

- Faez Ahmed Laboratory (Room 3-470): We completed the renovations, turning an under-utilized area into a new laboratory for a new faculty. The constructions were completed August 2021.
- Offices and Research Seating for New and Existing Faculty: We completed several renovations of offices for new faculty and research seating for our new and existing faculty, including electrical work, painting, carpeting, asbestos abating, new lightening, tiling, and other improvements. For example, we renovated Room 5-324A as an office for Vivishek Sudhir including removing a door and soundproofing the space. We emptied and renovated Room 3-435A as an office for Faez Ahmed. We renovated Room 1-304B as an office for Carlos Portela. In Room 1-314, we removed a wall and opened up the space to accommodate more student seating for several faculty. We also added new seating to Room 3-471. We completed many other upgrades for our existing faculty.

### Construction in Progress

- MechE Staff Lounge (Room 3-148): This under-utilized student lounge is being renovated into a much-needed conference room and lunch room for MechE staff and community. This is in progress and we expect to be complete in September 2021.
- Assistant Professor Carlos Portela Laboratory (Building 31, third floor): We completed the first phase of the construction on the top floor of Building 31 (Rooms 31-383 and 31-383A), including a new laser room, furnaces, and a wet lab. The second phase will involve adding capacity for two fume hoods on the third floor and is expected to be complete by September 2021. The separation into two phases allowed significant savings for MIT and MechE.

### Construction in Planning Stage

- Ziggurat Renovation (Buildings 3 and 1, fourth floor): This renovated space will include a hub for research at the intersection of computing and hardware systems. It will offer a combination of spaces that enable collaborative research, research reflections, gatherings, meetings, and functions. The renovations will change the outdated look of the Ziggurat and increase our usable space into a modern, state-of-the-art space for collaborative engineering research and educational activities. Over the last year, we have worked with MIT's Office of Campus Planning, Facilities Engineering, Office of the Provost, and the Dean of the School of Architecture and Planning. We selected Ann Beha Architects to create the concept design and organized workshops during the spring and summer 2021 to refine our ideas, as well as to discuss sustainability, energy usage, building codes, and other modalities. We are also turning the whole space into an ADA-compliant space. The concept design should be completed by September 2021.
- Headquarters Reconfiguration and renovation (Building 1, first floor): We are in the initial planning phase for the reconfiguration and better use of space so to accommodate headquarter staff, accounting for the new modalities of flexible working options.

- Assistant Professor Ritu Raman: We have started renovating an office for new faculty Ritu Raman as well as the planning of the renovation of her research laboratory and facilities.
- Assistant Professor Loza Tadesse: We have started the planning of the renovation of the research lab and facilities for new faculty Loza Tadesse, including studies of air capacity in the basement of Building 5.
- Assistant Professor Kaitlyn Becker: We have started discussing the needs for the research lab and facilities for new faculty Kaitlyn Becker.

## Conclusion

MIT's Department of Mechanical Engineering continues to be a global leader in mechanical engineering research and education. A commitment to making the world a better place is at the core of everything we do. As educators, we strive to train mechanical engineers who can think critically, develop creative solutions, and remain flexible in the face of abrupt change. In the coming year, we will continue to develop new educational initiatives and models that better prepare mechanical engineers of the 21st century.

As with last year, AY2021 posed unique challenges for our faculty, students, and staff in light of the Covid-19 pandemic. During this difficult time, our community demonstrated an ability to come together, innovate, and develop solutions for the difficult problems we now face.

AY2022 will be another year filled with transitions and challenges as the MIT community returns to campus. Our faculty and staff will continue to ensure we are able to execute our educational and research missions in the face of any uncertainty. Undergraduate enrollment, research related to the Health of the Planet as well as our other MechE Grand Challenges, further integration of computing into our class offerings, supporting our students' career interests, and diversity, equity, and inclusion will be a top priority in the coming year.

**Evelyn Wang**

**Head**

**Gail E. Kendall Professor**

**Pierre Lermusiaux**

**Associate Department Head for Operations**

**Professor of Mechanical Engineering**

**Rohit Karnik**

**Associate Department Head for Education**

**Professor of Mechanical Engineering**