

Department of Civil and Environmental Engineering

The [Department of Civil and Environmental Engineering \(CEE\)](#) focuses on critical issues related to infrastructure and the environment using cutting-edge science and engineering. Today in CEE, we continue to make an impact on the world by pursuing research that begins with a fundamental understanding at the micro level, knowledge needed to achieve solutions to help society at the macro scale. We strive to leverage small-scale change that leads to large-scale global impacts.

CEE's advancement continued during the 2016–2017 academic year, with notable accomplishments exemplified through our innovative research, newly launched educational programs, and local, regional, and global gains in recognition. Through new faculty hires, we continue to enhance our leadership in the fields of infrastructure and the environment. Our new faculty complement our current faculty roster with the cross-disciplinary talents, experiences, and skills necessary to redefine civil and environmental engineering in the 21st century.

In CEE, our students think about traditional problems in unconventional ways, infusing new approaches and insights to existing challenges and opportunities. Our students are central to everything we do in the classroom, out in the field, and in the labs. Through innovating and scaling discoveries from the nano to the global level, our students are always focusing on improving human lives and conditions, anywhere in the world. We believe that the department's research and education will shape lives today and in the decades to come and that these lessons will live on through the efforts of our alumni.

Additional progress has been realized in the department's identity and messaging, particularly through the new [department website](#), increased outreach to potential students, and new [events](#), symposiums, and other [initiatives](#).

We are an integrated department whose people work to solve previously unsolvable big engineering and scientific challenges. In October 2016, we launched our [new department website](#) to reflect this vision. The modern design, featuring grand imagery from around the world, accurately reflects our global focus. To supplement the website and our new department aesthetic, staff from the Academic Programs Office (APO) and Communications teams collaborated to create print and digital advertisements for [new subject offerings](#), [events](#), and the [department](#) as a whole that align with the site's imagery and design. We also increased our presence on popular social media channels and updated our graphics and overall branding. The APO and Communications teams continued a series of recurring email communication strategies and [campaigns](#), targeting MIT freshmen with specific outreach and events designed to strengthen interaction, engagement, and understanding of our goals and mission.

The impacts of the new and improved CEE are already being felt across several strategic research areas. For example, faculty in the Ralph M. Parsons Laboratory for Environmental Science and Engineering have extended our understanding of complex [atmospheric](#) and [ocean](#) ecological systems, providing valuable insight into these dynamic ecosystems. Researchers in the Henry L. Pierce Laboratory for Infrastructure Science and Engineering have contributed to groundbreaking new [methods](#) and are

actively [designing](#) impressively strong materials that will forever change the landscape of civilizations, with impacts that are both sustainable and eco-friendly. In addition, CEE has continued to offer [fieldwork opportunities](#) to undergraduate students.

Our cross-disciplinary research culture also links seemingly disparate projects, such as Professor Marelli's use of silk fibers to preserve fresh fruit and other research focusing on optimal mechanical devices to effectively coat the fruit. A community working across boundaries toward broad-scale solutions is the best way to ensure that innovation will keep pace with civilization's current and emerging needs.

Realizing a new, more broadly empowered vision and a redefined civil and environmental engineering profession continues to require extraordinary efforts. Our role as educators must anticipate these realignments, and we must give students a deep and broad learning experience so that they have a solid foundation. This commitment is reflected in the core mission of the department to educate at all levels, from undergraduate to postdoctoral.

Our newly developed and continually evolving Course 1 undergraduate program, established in 2014, incorporates civil, environmental, and systems engineering education into a single program. The program features increased flexibility, allowing students to fulfill Institute and department requirements while encouraging personalization of tracks that best match career interests. In fall 2016, we [launched three new minors](#): civil engineering, environmental engineering science, and civil and environmental systems.

The department is working with the School of Engineering to establish the National Academy of Engineering (NAE) Grand Challenges Scholars Program (GCSP) at MIT. The program, set to launch in January 2018, rewards students in the School of Engineering for completing a set number of requirements delineated by NAE. CEE department head and McAfee Professor of Engineering Markus Buehler serves as director of the Grand Challenges Scholars Program and oversaw the application process. A number of CEE faculty are also involved in the program. Ali Jadbabaie is leading the steering committee, joined by fellow CEE faculty members Herbert Einstein, Ruben Juanes, Dennis McLaughlin, Andrew Whittle, and Heidi Nepf.

The department strives to lead by example and help set new civil and environmental engineering standards for other academic institutions, industry, and society. We continue to seek new ways to enhance our curricula and student experiences.

Selected department highlights from the past year include the following.

- The department launched a new website to accurately represent the innovation and global impact of our research.
- On March 8, the department [hosted the Infrastructure, Smart Cities and Transportation Workshop](#) to highlight potential collaboration opportunities between MIT and the Parsons Corporation based on shared research interests. The event featured presentations from CEE faculty members Carolina Osorio, Moshe Ben-Akiva, Saurabh Amin, and Ali Jadbabaie, and graduate students Joanna Moody and Adam Rosenfield moderated a question-and-answer session.

- the department hosted the fourth annual CEE New Research Alumni Breakfast on October 26, 2016; this year's event focused on vegetation hydrodynamics, self-assembly of microbial ecosystems, and disruptive innovation in agriculture through biomaterials. Department head Markus Buehler opened the breakfast with a review of the various grand challenges present in society today and the steps those in CEE are taking to solve them. Professors Heidi Nepf, Otto X. Cordero, and Benedetto Marelli made presentations on their research.
- On May 18, the department hosted the Senior Celebration and Awards Banquet, where members of the CEE community gathered together to celebrate the class of 2017 and to recognize the outstanding accomplishments of the past year. Markus Buehler announced the winners of the CEE awards, including student, faculty, researcher, and staff awards. It was also the community debut of the CEE Band, a new all-inclusive band for everyone in the department.
- In June, CEE and MIT Professional Education offered a short course on innovation and technology in agriculture and the environment for the second year. The course creates connections between CEE research and industry practitioners. Instructors included Lydia Bourouiba, Markus Buehler, Daniel Cziczko, Ben Kocar, Benedetto Marelli, Chandra Madramootoo, and Dennis McLaughlin from CEE; MIT researcher Ross Alter; Institute Professor Robert S. Langer; John Lienhard, director of the Abdul Latif Jameel World Water and Food Security Laboratory; Marco Ferroni, CEO of the Syngenta Foundation; and Dr. Sonny Ramaswamy, director of the National Institute of Food and Agriculture.
- [Three CEE alumni have been elected to serve as full-term members of the MIT Corporation](#), the Institute's board of trustees: Arunas A. Chesonis '84, Fariborz Maseeh '90, and Nicolas E. Chammas '87.
- Heightened exposure through various CEE social media channels—LinkedIn, [Facebook](#), [Instagram](#), [YouTube](#), and [Twitter](#)—is enabling greater dialogue and engagement with many audiences, especially current and prospective students. The department head has his own Twitter handle ([@ProfBuehlerMIT](#)) and uses his tweets as an innovative way to communicate with students, faculty, alumni, and other stakeholders. More details about our social media channels are provided below.

Goals, Objectives, Priorities

The Civil and Environmental Engineering Department has made great strides this past year toward realizing the full potential of a more integrated and enhanced program. It is experiencing a transformation similar to the major disruptions of the 1960s and 1980s when the introduction of computation, and then environmental science, genomics, and microbiology, influenced its direction. However, now the influences are around the earth and atmosphere, agriculture, and building sustainable cities.

Our students continue to change the world. From alumni entrepreneurs desalinating ocean waters to engineers designing more resilient, sustainable, and energy-efficient cities, MIT is redefining what it means to work in this increasingly comprehensive field. Other institutions may continue to teach practitioners while we prepare new generations of global thinkers and doers. Working together across disciplines and educational and

experience levels, our students, faculty, and researchers address the many questions and challenges civilization faces today.

As engineers, we continue to build, but our direction is now better informed by discovery and innovation at small nano levels. Data characterization, modeling, and analysis also have lent new insights to our work, allowing design experimentation to be accomplished in hours compared to what would have previously taken days, weeks, or months. New tools and instruments, such as high-powered Raman spectroscopy, along with renovated and newly created lab spaces increase our capacities. Collaboration with other scientific and engineering disciplines brings its own rich set of rewards, allowing many types of new research paradigms and relationships.

CEE's five strategic objectives remain the same as we continue our important work and build upon past accomplishments. This report articulates our advancements during the 2016–2017 academic year with respect to each objective.

- Objective 1: Renew, develop, and implement inspiring educational programs at the undergraduate and graduate levels, including the postdoctoral level
- Objective 2: Establish an effective departmental structure
- Objective 3: Focus on the future of CEE with accelerated faculty hiring and junior faculty development
- Objective 4: Show leadership in MIT-wide initiatives by engagement across the Institute, defining a clear positioning of CEE at MIT
- Objective 5: Enhance alumni engagement and resource development
- The visiting committee met in fall 2016 and continued to support the department's vision and activities under the leadership of Markus Buehler. It was recognized that the department is energized and fast moving and that the execution of its vision is a work in progress.

Objective 1

Over the past academic year, 241 students were enrolled in CEE (49 undergraduates and 192 graduate students/doctoral candidates). The department awarded 21 PhD, 6 SM, 15 MST, and 26 MEng degrees in the graduate program and 18 SB degrees in the undergraduate program. Of the 21 PhD graduates, approximately two thirds are proceeding to careers in academia.

Undergraduate Programs

The 2016–2017 academic year saw the third full-year cohort of students in the department's new 1-ENG bachelor of science degree program. The new undergraduate program is a comprehensive curriculum that better prepares graduates for their professional lives while emphasizing a strong foundation in math, computation, probability and statistics, data analysis, and design.

CEE has been approved for general engineering accreditation by the Accreditation Board for Engineering and Technology (ABET). The ABET Engineering Accreditation Commission takes into consideration curriculum and subject offerings, student

outcomes, educational objectives, and signs of continuous improvement. The department also hosted ABET representatives, with members of the commission meeting with students and faculty and reviewing laboratory spaces.

As noted above, the department was also pivotal in the development of the NAE Grand Challenges Scholars Program at MIT, which offers undergraduate students in the School of Engineering an opportunity to align their curricular and extracurricular activities with one of the 14 “grand challenges” delineated by NAE. Markus Buehler and the Academic Programs Office developed the program’s vision, requirements, and specifications. GCSP is tentatively set to launch in January 2018.

The Undergraduate Education Committee, led by Professor Colette Heald and made up of two faculty from each undergraduate core, worked to refine and improve the undergraduate curriculum. The faculty held listening sessions with students, collaborated with colleagues in an effort to improve the sequencing of subjects, and reviewed the curriculum for future refinement. Additionally, the committee established policies regarding undergraduate double majors, petitions, and minors.

The 1-ENG program prepares students for today’s jobs as well as emerging new positions such as chief resilience officer, 3D infrastructure engineer, urban agriculturist, and global system architect. Class discussions in 1.007 Big Engineering: Small Solutions with a Big Impact showed that students studying civil engineering leaned toward careers in innovating structures, architectural design, material testing, promoting net zero energy buildings, sustainable infrastructure, and geo-technology. Environmental engineering students expressed interest in exploring bio-remediation, atmospheric modeling, hydrology modeling, pollution control, enhancing food security, and mitigating climate changes. Finally, systems engineering cohorts gravitated toward applications in biological networks, traffic and transportation engineering, carbon sequestration, city planning, and mitigating infectious diseases.

Professor Admir Masic was excited to lead the second annual ONE-MA³ (Materials in Art, Archaeology and Architecture) fieldwork experience, in which undergraduates learn first-hand about the sustainability of art, archeology, and architecture over time and against the threats of nature. The program was held in Italy in June and July 2017 and involved 12 undergraduate and graduate students who will continue their research through the 1.057 Heritage Science and Technology subject. The students traveled to Privernum, Pompeii, and Turin for this unique in-field, hands-on opportunity to research the complexities of long-term preservation strategies and techniques. For the first time this year, the students were granted exclusive access to private research laboratories in the Vatican and were able to visit areas of Pompeii that are closed to the public.

The new leadership of the CEE Student Association (CEESA) continued to work constructively with APO and the department’s leadership, designating student representatives around the undergraduate cores for students to connect with during registration days and hosting freshman dinners and study breaks. In addition, the newly elected leadership has increased ties with the department, including implementing weekly meetings with APO administrators and twice-per-term meetings with the department head.

During the 2016–2017 academic year, the senior capstone class (1.013 Senior Civil and Environmental Engineering Design) focused on diverse research projects supported by multiple CEE faculty. Students enrolled in the class were invited to present their research to members of the community at the [CEE Senior Celebration and Awards Banquet](#) through an electronic poster session. Faculty in attendance heard from the students, voted on the poster presentations, and awarded Capstone Poster Prizes to two teams studying vehicle emissions in Cambridge. The winning teams included seniors Rebecca Sugrue, Kali Rosendo, Tiffany Wang, Elaine Cunha, Kathy Dieppa, Ru Mehendale, and Erin Reynolds. Sugrue, Rosendo, and Wang measured roadside emissions and calculated emission factors from cars. Cunha, Dieppa, Mehendale, and Reynolds created a model to quantify vehicle emissions in Cambridge.

Building on the success of last year's unique mini-UROP (mini Undergraduate Research Opportunities Program), the department again hosted 20 freshmen during the 2017 Independent Activities Period (IAP). In the program, spearheaded by Course 1 graduate students, graduate students and postdocs are paired individually with freshmen, and the mini-UROP students work at least 30 hours per week in direct research over IAP. As a result of their interest and progress in their projects, a number of the participants continued on as full UROP students during the spring term. One freshman and his mentor documented their unique experience in "[A Day in the Life of a Mini-UROP Mentor and Mentee.](#)"

This year as the program has evolved, the organizers quickly realized opportunities to extend program benefits to include not only course credits but also new ways to build community. For example, new projects were added to build the students' hard science and engineering skills, and other new activities were built in to develop soft skills such as collaboration and networking and help improve students' mentoring skills. In addition, APO hosted weekly luncheons to give freshmen a glimpse of the department's wide variety of research topics and opportunities. Also new this year, some of the mini-UROP participants were invited to present their work during one of the two poster sessions at CEE's [annual Research Speed Dating event](#) in March.

The department is offering three new undergraduate minors (civil and environmental systems, environmental engineering science, and civil engineering) that debuted in fall 2016. The minors are intended to attract MIT students who are majoring in disciplines outside civil and environmental engineering but want to enhance their career path with complementary knowledge and experience. CEE also endorsed and participates in the environment and sustainability minor offered by the MIT Environmental Solutions Initiative.

Graduate Programs

CEE's graduate education programs also saw changes, improvements, and several new activities over the past year. Professor John Ochsendorf and Professor Dennis McLaughlin assumed leadership of CEE's MEng program. In addition, new ways to support graduate student and doctoral candidate initiatives were introduced, including increased departmental sponsorships of events and activities. Staff and faculty also volunteered to serve as judges at competitions and promote initiatives.

[MIT-TREES \(Talks on RELiable Environmental Science\)](#) is another student-driven organization that has developed a unique partnership with CEE. TREES identified

a growing public interest in environmental topics such as climate change and air, water, and soil pollution and responded by producing short videos to illustrate scientific concepts in a creative, easily consumable form. The department's APO and Communications staff work closely with TREES representatives during scripting and production to ensure scientific accuracy and relatability for lay audiences.

As mentioned above, the successful reprisal and enhancement of the mini-UROP program held over IAP would not have been possible without the leadership of the graduate students who set up the program with the assistance of the CEE APO administrators. In 2017 Julia Hopkins and Fatima Hussain, the mini-UROP graduate student leaders, were honored by the Office of the Dean for Graduate Education (ODGE) as Graduate Women of Excellence. Hussain and Hopkins were recognized for starting the mini-UROP program, which gives freshmen the opportunity to conduct hands-on research in CEE labs over IAP.

The 2016–2017 academic year also saw the introduction of two new graduate subjects. In the fall term, Professor Martin Polz introduced 1.S82 Special Problems in Environmental Microbiology and Chemistry, a hands-on, research-oriented subject reviewing species and population concepts as they relate to microbes. In the spring Professor Serguei Saavedra launched 1.S977 Modeling Community Dynamics, a subject focusing on the fundamentals of quantitative ecology and their application toward understanding the dynamics and persistence of ecological communities.

Our graduate committee (GradCom), along with other graduate students in the CEE community and CEE faculty and staff, worked closely together during this past year in developing stronger relationships with the department head and tapping mutual resources for improved program delivery and support.

Postdoctoral Program

CEE's postdoctoral committee has continued its path of success, providing a forum for discussion and involvement with the approximately 65 postdoctoral researchers in the department. The committee has made great progress in understanding and addressing the professional and career development needs of postdoctoral researchers, identifying and improving mentoring opportunities, providing the researchers with opportunities to contribute to the department's educational programs, and enhancing their MIT and CEE experience. In addition to [workshops and seminars geared toward the specific needs of postdoctoral scholars](#), a CEE postdoctoral social committee has been formed to enhance opportunities for networking among faculty, postdoctoral scholars, graduate students, and staff. Professor John Williams serves as the postdoctoral committee chair.

Specific program activities included once-a-semester town halls with the department head, a series of "lunch and learns" on topics of interest to postdoctoral researchers (e.g., web presence, publishing, digital education), and networking events for CEE postdoctoral researchers and faculty members. Also, teaching fellowships are available that allow postdoctoral researchers to be involved in teaching and education as part of their career development. On April 24, the department held a CEE "Postdoc Innovation Pub" event at which postdocs presented brief overviews of their research.

Postdocs have also contributed to CEE teaching activities through the postdoctoral teaching fellows program. This program has been very successful for postdocs, faculty, and students, and it has provided valuable training for our postdocs. Most notably, in March, [former CEE postdoc Andrew Babb](#)in was appointed as an assistant professor in the Department of Earth, Atmospheric and Planetary Sciences (EAPS).

Objective 2

The administrative staff continues to evolve and engage with all communities, including current and prospective students, their parents, faculty, other MIT faculty and staff, external peers, alumni, and news media. We accomplish this outreach through speaking engagements, seminars, stories in print and online, and other activities. Additional accomplishments and events are listed elsewhere in this report.

The department strengthened the collaboration between its two laboratories, the Ralph M. Parsons Laboratory (Building 48) and the Henry L. Pierce Laboratory (Building 1). The Parsons Laboratory focuses on natural systems and on understanding and engineering human adaptation to a changing environment. The Pierce Laboratory engages in science and engineering research critical to improving living conditions for humankind, advancing the innovation of materials, transportation systems, cities, and energy resources. This increased interaction continues to bind the disparate locations and was apparent at many formal and informal gatherings throughout the year. Examples include our internal CEE Research Speed Dating event, led by Pierce Laboratory assistant professor Tal Cohen and Parsons Laboratory assistant professor Serguei Saavedra, and the creation of the CEE Band, an inclusive department-sponsored ensemble featuring students and researchers from both labs.

CEE continued to refine its strategic focus around five challenge areas: ecological systems, resources and sustainability, structures and design, societal systems, and global systems. Our research and education within and across these strategic objectives are imperative to help create a better world and improve lives.

MIT Context for the Role of CEE

The department's intellectual focus is discovery and innovation to sustain life and society in changing conditions. CEE's two research labs, the Pierce Laboratory and the Parsons Laboratory, conduct research designed to better understand and solve the grand challenges of our time, from problems created by human activity to those that exist as natural systems. Our contributions are at the core of new products and applications that are being developed today in agriculture, wetlands management, renewable energy, sustainable structures, and large-scale systems design. The Department of Civil and Environmental Engineering is committed to playing a central role to support MIT's leadership in these domains.

Our long-term objective in the area of infrastructure, implemented in the Pierce Laboratory, is to become a center of excellence in the design, manufacturing, and operation of infrastructure. The Pierce Laboratory pushes the frontiers of infrastructure science and engineering by addressing fundamental issues critical to society and the environment. Through our faculty's diverse expertise and collaborations with others, CEE addresses issues that are critical to society and the environment, such as

infrastructure sustainability, resilience to catastrophic events, durability, and improved energy management.

We also made continued progress on a priority identified in 2015 to apply radically new approaches to the design and manufacturing of infrastructure materials. In January, CEE doctoral student Gang Seob Jung, Min Jeong Kang MEng '16, Research Scientist Zhao Qin, and Professor Markus Buehler designed a sponge-like material that is both strong and lightweight, with the capability to be 10 times stronger than steel. The [findings, published in Science Advances](#), received a considerable amount of [publicity on CNN](#) and [National Public Radio](#). Additionally, new CEE faculty hires such as Assistant Professor Tal Cohen are already advancing research and education in this area, highlighting both the department's and MIT's thought leadership and impact.

Our long-term objective in the area of the environment, implemented in the Parsons Laboratory, is to engineer human adaptation to a changing environment. Human activities are affecting the global environment at historically high rates, and the impact of these changes on people and the environment is not known at present. Working from very small discoveries to large-scale solutions, researchers in the Parsons Laboratory aim to better understand global environmental changes in water, agriculture and food, species evolution and coexistence, environmental quality, natural hazards, and public health, among other areas.

In terms of advances made this year, Professor Dara Entekhabi, who in February was elected to the National Academy of Engineering, used data from the National Aeronautics and Space Administration's Soil Moisture Active Passive satellite to study [global soil moisture](#). This research, published in Nature Geosciences, provides critical insight into climate, agriculture, and weather on a global scale. Other efforts from Parsons similarly shed light on the impact of climate change: [research](#) conducted by Professor Elfatih Eltahir and postdoc Mohamed Siam showed that the flow of the Nile River will become increasingly variable, with more droughts and floods, as a result of climate change. This work was published in Nature Climate Change and was also [featured in Scientific American](#) and [Nature Middle East](#). Looking toward the future, one of the department's young hires, [Otto X. Cordero was selected to lead a new Simons Foundation collaboration](#) with Professor Roman Stocker of ETH Zurich and a multidisciplinary team of researchers from across the United States and Europe. The collaboration aims to discover the laws and principles of how microbial communities form and function.

Laboratory Renovations

The tremendous ongoing accomplishments in the department are paralleled by our efforts to upgrade and improve our laboratories and facilities. We have successfully completed renovations to include state-of-the-art laboratories and work space in both the Pierce Laboratory (Building 1) and the Parsons Laboratory (Building 48). For example, in addition to office renovations and improvements, renovations have been made to the Fluid Dynamics of Disease Transmission Laboratory and the Marelli Laboratory in Building 1 and to the Atmospheric Chemistry and Composition Modeling Laboratory and the Eltahir Research Laboratory in Building 48.

The Fluid Dynamics of Disease Transmission Laboratory, a biological laboratory in the sublevel of Building 1, was commissioned. The subsequent activity and growth of Professor Bourouiba's group reflect the success of the department. This laboratory is able to handle biological, agricultural, and health-related research within CEE's physical space. It not only brings a unique research direction rooted in physical science and fluid dynamics to the main campus but also allows for broader biological work to be initiated within the confinements of the more traditionally civil engineering-oriented branch of CEE.

After last year's renovation of the Atmospheric Chemistry and Composition Modeling Laboratory of Professor Heald, another computational renovation was completed for the Eltahir Research Laboratory. Both of these labs were challenged with an aging infrastructure and asbestos, as is much of the CEE community's space. These renovations enable Heald and Eltahir's individual computational laboratory groups to be housed in a single space with ergonomic and state-of-the-art computational capabilities.

The Marelli Laboratory continues to grow, and in response we have expanded the biological and fluids laboratory in the sublevel of Building 1. This space enhances the rapid expansion of the Marelli Laboratory, where researchers are actively working on structural biopolymers, agriculture, and materials assembly, which are instrumental in the natural and man-made systems of the world. Plans for further expansion are on the horizon for this active and successful research laboratory.

With the addition of Professors Tal Cohen and Ali Jadbabaie, improvements of old offices were in order. Professor Cohen now enjoys a durable laminate floor, chalk board walls, and state-of-the-art projection. Professor Jadbabaie was able to easily improve his space with new carpet and furnishings that brighten up his office space overlooking the DuPont Courtyard.

We have also transformed some extremely outdated office space and continue to make gradual progression in space improvements, as can be seen in the Transit Laboratory. This 22-seat office suite, located in 1-235, is now clean and organized, offering an improved working space.

Objective 3

Using the momentum of the visiting committee recommendations, the department embarked on aggressive faculty searches over the past two years. There was an unprecedentedly large pool of candidates and, as a result, the department was able to add two new junior faculty members during AY2017: Tal Cohen and Ali Jadbabaie (details on these faculty hires are provided below).

Our future success depends in large part on internalizing our new vision across our two research labs (Pierce and Parsons), developing our junior faculty, and attracting top new faculty. The following are associated highlights and accomplishments in these critical areas. Our strategic priorities also include fueling emerging frontiers of innovation and creative design and empowering our students and faculty to lead Institute-wide cross-cutting initiatives. Hiring excellent faculty is arguably the most critical component to supporting these activities.

The faculty search process has been changed to focus on several necessary criteria that differ from those of searches conducted in past years:

- Identify the highest-caliber candidates in compelling intellectual frontiers.
- Look for relevance to the vision and domains of CEE, especially those identified as critical needs.
- Build on CEE's strengths in areas where it can lead. Candidates should be dedicated to educating our students in such a way as to equip them to work as scholars and academic leaders, professionals, and entrepreneurs.
- Find candidates who support and are supported by intellectual communities

New Faculty Hires

Professor Ali Jadbabaie joined CEE in July 2016 in a dual appointment with the Institute for Data, Systems, and Society. [Jadbabaie is currently the JR East Professor of Engineering](#), the director of the Sociotechnical Systems Research Center, and the associate director of IDSS. Jadbabaie received his MS in electrical and computer engineering from the University of New Mexico and his PhD in control and dynamical systems from the California Institute of Technology. After a year as a postdoc at Yale University, he joined the faculty at the University of Pennsylvania in July 2002. He has made foundational contributions to the field of collective autonomy and opinion dynamics, and [his current research interests](#) include the interplay of dynamic systems and networks with a specific emphasis on multi-agent coordination and control, distributed optimization, network science, and network economics. [Jadbabaie presented his research at the Infrastructure, Smart Cities and Transportation Workshop](#) in March.

Professor Tal Cohen joined CEE in November 2016. [Cohen participated in the 2015 CEE Rising Stars Workshop](#) for early-career women in civil and environmental engineering and related fields. After she received her PhD in aerospace engineering in 2013 from Technion University in Israel, she came to MIT for a two-year postdoctoral position in the Department of Mechanical Engineering. She served as a postdoc at Harvard University before coming to MIT. Cohen works in mechanics, especially the mechanics of structures subjected to extreme loading conditions and shock wave propagation. Her work on the mechanics of stretchable materials that can undergo extreme deformations and the mechanics of growth in both biology and engineering exploits analogies with related fields. By employing complex nonlinear material models, Cohen's research group will focus on deriving theoretical models that can significantly affect our understanding of observed phenomena but are still simple enough to be applied in the design or characterization of materials. In March, Cohen presented her research at CEE's Research Speed Dating event.

Faculty Promotions

[Professor Xuanhe Zhao was granted tenure](#) in May. Zhao, whose research involves solid mechanics, soft materials, and bio-inspired design, has a joint professorship in CEE and the Department of Mechanical Engineering.

[Professor Saurabh Amin was promoted to associate professor without tenure](#) effective July 1, 2017. Amin works in the area of cyber-physical infrastructure systems.

[Professor Carolina Osorio was also promoted to associate professor without tenure](#) effective July 1. Osorio works at the intersection of urban transportation and operations research.

Faculty Professorships

In May, Assistant Professor Serguei Saavedra was selected as the recipient of the Institute-wide Mitsui Chair Professorship. Saavedra's research focuses on understanding how environmental variations affect the structure of species interaction networks and how this in turn affects the maintenance of biodiversity. The Mitsui chairs were established in 1980 by the Mitsui Group, one of the oldest and largest industrial organizations in Japan, to encourage cultural and technological exchange between the United States and Japan. The professorship has a three-year term beginning on July 1, 2017.

Faculty Retirements

Professor Harold Hemond retired in June after 39 years at MIT. He joined the CEE faculty in 1978 after earning his PhD at MIT in 1977. Hemond dedicated his career to studying the Earth's biochemical cycles and has made numerous seminal contributions to the biogeochemistry of heavy metals, the cycling of carbon and nitrogen, and the mechanisms of pH control and methane emissions in natural waters. A beloved advisor and mentor to students and colleagues, Hemond served for 10 years as director of the Parsons Laboratory and is a recipient of the Bose Teaching Award, the Maseeh Teaching Award, and the Irwin Sizer Award. He is also the lead author of the widely used textbook *Chemical Fate and Transport in the Environment* and has received numerous awards from professional societies. [Hemond's research on the Thoreau Bog](#) was featured in the fall 2016 edition of MIT Spectrum.

[Professor Joseph Sussman of CEE and IDSS retired in January](#) after 50 years in the department. Sussman joined the MIT faculty in 1967 after earning a PhD in civil engineering systems at the Institute. During his tenure as a faculty member, Sussman served as head of the Department of Civil and Environmental Engineering and as director of the Center for Transportation Studies. In his research, where he applies a systems approach to transportation, he has worked in rail freight transportation operations, intelligent transportation systems, regional strategic transportation planning, and passenger rail, emphasizing high-speed rail. [In 1991 Sussman was named MIT's first JR East Professor](#), and he played an instrumental role in building a strong relationship between MIT and the East Japan Railway. A revered advisor and mentor to students and colleagues, he led several generations of graduate students in the study of complex sociotechnical systems. Sussman is the author of the graduate text *Introduction to Transportation Systems* and is the recipient of many awards from professional societies.

Faculty Deaths

[T. William "Bill" Lambe, professor emeritus in civil engineering, passed away on March 6, 2017](#). He was 96 years old. Lambe (SM '44 and PhD '48, both in CEE) arrived at MIT to pursue graduate studies after a brief stint working in the engineering industry. As a graduate student in 1945, Lambe began working as an instructor at MIT. By July 1959,

he was a full professor of civil and environmental engineering. He was the Edmund K. Turner Professor of Civil Engineering from 1969 until his retirement from teaching in June 1981. His academic contributions to geotechnical engineering were fundamental and far reaching and included research on soil chemistry, soil stabilization and freezing, the stress path method, and formalization of geotechnical prediction. Following his retirement from MIT, Lambe returned to the engineering industry, serving as a consultant on numerous international projects. Lambe was a member of the National Academy of Engineering, and his more than 100 publications earned him many awards, including the Norman Medal, the highest award bestowed by the American Society of Civil Engineers (ASCE), in 1964; the ASCE Terzaghi Award in 1975; and the North Carolina State University Distinguished Engineering Alumnus Award in 1982.

Annual Research Speed Dating Event

The [seventh annual CEE Research Speed Dating event](#) on March 10 brought together undergraduate and graduate students, postdocs, research scientists, and faculty members to share their research and inspire new ideas. This year additional community members were able to participate through electronic poster sessions, including freshmen who completed the mini-UROP program over IAP. The event was held at MIT's Samberg Conference Center.

Cross-Disciplinary Seed Funding for New Faculty Research

In April 2017, the [MIT Tata Center for Technology and Design awarded funds for visiting professor Chandra Madramootoo to conduct research](#) over the 2017–2018 academic year. Madramootoo will design and evaluate an integrated tool to alleviate information gaps constraining crop yields.

Also in April 2017, Assistant Professor Caitlin Mueller received funding from the Tata Center to research low-cost, low-carbon structural components for housing in India.

Objective 4

Over the 2016–2017 year, the department invested in reinvigorating CEE's online presence. Through launching a redesigned website, being active on social media platforms, and creating a new student blog initiative, we are empowering the department to share new research and happenings and start new conversations.

CEE Communications and the Academic Programs Office collaborated to recruit undergraduate students to write about their experiences being a Course 1 major. The blogs share the undergraduate experience in a casual setting and encourage students to share how they use civil and environmental engineering principles around the world. Topics ranged from an [inside look into a Course 1 class](#) to a student's perspective on fieldwork experiences such as [Traveling Research Environmental Experiences \(TREX\)](#) and the [Materials in Art, Archaeology and Architecture \(ONE-MA3\)](#) program. Through this new initiative, Communications and APO have strengthened their connection with undergraduate students.

These investments in CEE's online presence enhance our ability to connect with alumni, potential students, industry leaders, and news media outlets.

Social Media Outreach and Statistics

The following statistics reflect continued growth in awareness and engagement of CEE online. Note that the statistics do not include any staff or faculty online accounts. For example, Department Head Markus Buehler also has significant growth in followers of his professional LinkedIn and Twitter accounts.

Departmental Facebook Page

In June 2016, our Facebook page had 10,431 “likes” (people who subscribe to CEE posts). This increased in June 2017 by 14% to 11,903 page “likes.”

Departmental Instagram Page

CEE has a strong presence on Instagram, a social media platform primarily used for sharing photos and videos. CEE had 550 followers in June 2016 and reached 1,122 followers in June 2017, a 104% increase. From 2015 to 2016, we averaged 21 “likes” per photo, and this increased during 2016–2017 to an average of 74 “likes” per photo, a 252% increase. In early 2017, we had one of our Instagram posts re-shared on the @mitpics account, which has 41,100 followers. CEE hosts two photo competitions, one in winter and one in summer, that encourage CEE community members to interact with the department and share their adventures using #CEESummer or #CEE_IAP with the chance to win prizes. The competitions are always well received and receive a vast number of submissions.

Twitter Activities

Between June 2015 and June 2016, we tweeted an average of 41 times a month. This increased by 27%, to an average of 52 tweets per month (not including retweets), in June 2017. In 2015–2016, an average of 2,241 people visited our Twitter page each month. This increased by 46% in 2016–2017, with 3,273 people on average visiting our Twitter page each month. As of June 2016 we had 1,571 followers, and by June 2017 we had reached 2,394 followers (a 52% increase). In 2015–2016, we had an average of 50 “mentions” (tweets from other accounts that tag @MIT_CEE) per month; during 2016–2017, we were mentioned an average of 52 times each month.

LinkedIn Page

As of June 2016, the CEE LinkedIn page had attracted 476 followers. In June 2017, our number of followers increased to 742, a 56% increase. Over the past two years, LinkedIn has undergone major university page site renovations. LinkedIn university pages now have an increased ability to customize posts and links to increase engagement.

Objective 5

CEE Resource Development hosted the New Research Alumni Breakfast (as noted above), which attracted approximately 70 alumni to campus. In the spring, CEE again hosted an alumni breakfast to coincide with the extended MIT Commencement weekend.

CEE continues to produce its seasonal newsletter for alumni and friends. In spring 2017, [CEE redesigned the newsletter into a digital format](#) and produced a limited run of print publications. Also, the newsletter was renamed Course One, and the changes were well

received. Analytics show that open rates for the newsletter exceed the average education industry standards.

In partnership with Resource Development, the Alumni Association, and friends of MIT, the department continues to expand its efforts to increase philanthropic support for CEE. Department fundraising efforts helped support our mission of providing faculty and students with innovative education and research programs to develop real-world applications that have a large-scale impact on people and sustainability.

Alyssa Feit joined the department in December 2016 as the new CEE development officer. Feit leads the resource development effort with alumni, CEE friends, and the central MIT Office of Resource Development. Her addition to the department represents a renewed investment in resource development; Feit joined the staff in a full-time position (the position was previously part time).

School Development has worked to increase the visibility of the department's central themes in order to inform and engage both alumni and friends of CEE. In partnership with central resource development, CEE has benefited from several seven-figure commitments to the department. Furthermore, Feit has begun to engage the department faculty through a variety of speaking engagements.

Accomplishments

Faculty Activities and Initiatives

The US Environmental Protection Agency announced on August 8, 2016, that [MIT was the recipient of one of only six grants awarded](#) to research organizations that are developing and using inexpensive air pollution sensor technology while engaging surrounding communities to learn about their local air quality. Principal investigators Jesse Kroll and Colette Heald received the grant to set up an air quality network around the island of Hawaii with the aim of providing information on how the Kilauea Volcano affects local air quality and atmospheric chemistry. This work expands on previous efforts carried out as part of the Traveling Research Environmental Experiences program and will help guide future TREX projects. The funds will support a collaboration in which CEE, MIT's Center for Environmental Health Sciences, and the Kohala Center (in Waimea, Hawaii) will work with local schools and health centers to educate the community on topics related to local air quality.

In fall 2015 MIT launched Solve: Learn, one of four focus areas under the MIT Solve initiative that aims to help solve world challenges by bringing together leaders from the private, public, nonprofit, and academic sectors to partner, fund, and implement promising solutions. On September 28, 2016, [Professor Admir Masic served as a judge for the Solve: Learn competition](#). Masic is also the Solve: Learn challenge leader.

Assistant Professor Carolina Osorio was cited as one of the top engineers in the United States between the ages of 30 and 45 and invited to talk at the National Academy of Engineering's EU-US Frontiers in Engineering symposium, held in Finland in October 2016. In her talk, Osorio discussed her work on simulation-based transportation optimization.

On November 2, 2016, Professor Pedro Reis invited [renowned Mugaritz chef Andoni Luis Aduriz to speak at MIT on a panel about creativity](#). The panel, which included professors from several Institute departments, was followed by a screening of *Off-Road* (a documentary about Mugaritz) and ended with a Q&A with Aduriz.

Professor Lydia Bourouiba was featured in the fall 2016 edition of MIT Spectrum. [Bourouiba was profiled in a series titled Seven Ways Data Are Making a Difference](#) and was [featured in the article “Leading with Data”](#) for her research on the spread of infectious disease through sneezes and coughs.

On December 5, 2016, Associate Professor Marta Gonzalez spoke during a National Academies of Sciences, Engineering, and Medicine panel discussion held at the Data-Driven City Planning and Policy symposium. The discussion focused on research and critical challenges in data-driven policy and planning for cities.

In January 2017, Breene M. Kerr Professor Elfatih Eltahir launched a new collaborative project with the Massachusetts Department of Public Health to study *Aedes* mosquitoes, the carriers of dengue and Zika. The project is sponsored by the US Centers for Disease Control and Prevention. Eltahir delivered a related lecture (“Impact of Climate Change on Public Health: A Global Perspective”) at the winter meeting of the Massachusetts Infectious Diseases Society.

In January MIT and Conservation International (CI), a nonprofit environmental organization, announced that [Donald and Martha Harleman Professor Heidi Nepf will work with scientists from CI to further develop a model describing the effectiveness of mangrove forests in damping waves and storm surges](#). Nepf and her team will develop and test their models using CI’s field offices in the Philippines.

The American Academy in Rome, a nonprofit that supports the arts and scholars, announced in February that Class of 1942 Professor of Architecture John Ochsendorf had been selected as its [23rd director](#). Ochsendorf will return to MIT after the three-year appointment, which begins in July 2017.

On March 2, a ceremony was held to recognize the 25th anniversary of the [JR East/MIT partnership](#). In 1991, CEE professor Joseph Sussman was named to the inaugural JR East Professorship, a chair that enabled the establishment of a long-standing and productive partnership between the East Japan Railway Company and MIT. The JR East Professorship is now held by CEE faculty member and IDSS assistant director Ali Jadbabaie.

Assistant Professor Lydia Bourouiba was featured in the third episode of *Science Friday’s Breakthrough: Portraits of Women in Science* series on March 30. This series on women in science focuses on six distinguished scientists and their research. The aims of the series are to increase the public’s access to science and to inspire and increase the numbers of minorities in STEM (science, technology, engineering, and mathematics). The episode highlighting Bourouiba’s research and her path to MIT was called “Breakthrough: Connecting the Drops.”

Yossi Sheffi, Elisha Gray II Professor of Engineering Systems and director of the Center for Transportation and Logistics, [wrote an op-ed](#) for the Wall Street Journal on how companies should address supply chain logistics during Donald Trump's presidency. Sheffi highlighted the uncertainty of the business climate under President Trump and offered advice for business leaders on maintaining control of their supply chains during such times. The piece was published on April 3.

On April 26, Professor John Ochsendorf [provided insight](#) into the tilework and architecture of the Grand Central Oyster Bar, a 104-year-old restaurant below New York City's Grand Central Station, for *Eater New York*. Ochsendorf previously wrote a book about the designers of Grand Central Station and the restaurant.

In April, Markus Buehler was chosen as president-elect of the Society for Engineering Science (SES). Buehler will serve a three-year term beginning in 2018. He will serve as vice president for one year, followed by a term as president in 2019 and a final term as past president in 2020. SES encourages collaboration between various disciplines in engineering, sciences, and mathematics. The society hosts an annual meeting that draws participants from many diverse fields and sponsors several distinguished awards.

In May, Admir Masic announced the establishment of the new [MIT Refugee ACTION Hub](#) (MIT ReACT), an Institute-wide initiative aimed at increasing access to education among refugees. Masic is the faculty founder of ReACT, which was inspired by his personal experience.

Associate Professor Ruben Juanes, along with researchers from Harvard University, traveled to Spain in May and [delivered a report](#) to the country's minister of energy confirming that gas injection at an offshore gas storage platform was the cause of a series of earthquakes in 2013. The Spanish government had requested the report from MIT and Harvard.

Associate Professor Ruben Juanes participated in a June meeting of Spanish scientists working in the United States. Juanes contributed to the opening panel, which addressed scientific keys to global challenges for sustainable development. Israel Ruiz, MIT's vice president and treasurer, and Carmen Vela, Spain's secretary of state of investigation, development and innovation, were also among those attending the meeting, which was held at MIT.

Professor Harry Hemond penned a poem, ["Some Musings on Retirement After 40 Years at MIT,"](#) for the spring 2017 edition of MIT's faculty newsletter. The poem reflects on his tenure and how MIT has evolved over the past 40 years.

Associate Professor Jesse Kroll presented at the Cardinal and Grey Society luncheon during Commencement weekend in June. Kroll spoke on "Tracking Air Pollution: Where It's From and How It Changes" to a large group of alumni. The Cardinal and Gray Society is a group of alumni who have reached the 50th anniversary of their graduation.

Student Outreach

On August 11, 2016, the department hosted its first annual CEE Kids Camp, inviting children, friends, and neighbors of CEE community members of all ages and abilities to visit the campus for a day to experience what it is like to be a civil and environmental engineer at MIT. Students, faculty, postdocs, and researchers came together to host activities in which children learned about the wide range of research in the department. About 20 visitors attended the camp, and many of the hosts noted how much fun it was to share their work with students. CEE is planning to host another Kids Camp in August 2017.

Also in August 2016, the week before freshman orientation, CEE hosted 20 incoming freshmen for a pre-orientation program called Discover Course 1. Led by civil and environmental engineering seniors Bryan Lilley and Tiffany Wang, Discover Course 1 allowed students to participate in hands-on modules focusing on the three CEE cores: systems, mechanics and materials, and environmental engineering science. The modules included testing water quality in the Charles River, constructing bridges from silkworm cocoons, and using virtual reality to examine different monuments and buildings around MIT. The week closed with a presentation of projects from the students in which they used their newly acquired knowledge to propose a solution to a hypothetical dam rebuilding.

During the fall and spring semesters, CEE hosted “grilled cheese study breaks” encouraging students to take some time to relax amid stressful exam periods. Professors volunteered a few hours to cook grilled cheese for students and members of the community. Markus Buehler, Ali Jadbabaie, and Colette Heald participated in the fall event, and Saurabh Amin, Herbert Einstein, Ali Jadbabaie, and Gordana Herning attended during the spring.

On November 30, 2016, the Academic Programs Office hosted an open house for freshmen to learn about the global opportunities offered to CEE students. The information session focused on the ONE-MA³ summer fieldwork experience. The event was a full house, and freshmen were invited to mingle with current CEE students and speak with Professor Admir Masic about ONE-MA³.

The department hosted its annual holiday party on December 9, bringing together faculty, researchers, and students. The event featured an open mic for reflection and cookie decorating. Undergraduate student Amber VanHemel recited a poem she wrote about CEE to the tune of “The Night Before Christmas.”

On March 9, spring-boarding on the Institute’s “Random Acts of Kindness” initiative, the department hosted a Random Act of Kindness gesture for members of the CEE community. CEE students, postdocs, and researchers were invited to come to headquarters and pick up a surprise—a gift card to a local restaurant. Students were encouraged to take a friend to lunch and spread kindness and to share their experience using #CEEKindness. Also for Random Acts of Kindness week, the department hosted a soup and coloring relaxation break for CEE students.

On March 20, admitted graduate students visited the campus to learn about the department. The day concluded with a reception at the MIT Media Laboratory with faculty, staff, and current graduate students. Current students were encouraged to attend and to share their experiences with prospective students.

On March 23, the CEE Outings Committee once again organized an evening of ice skating, music, and hot chocolate at MIT's Johnson Ice Rink. The event was attended by more than 90 students. Graduate student Jane Chui offered skating lessons to the attendees.

The Academic Programs Office and CEE hosted the first “Taste of CEE” event, a sampling of the academic and extracurricular offerings in the department, on April 4. Complete with a burger bar, the event was attended by freshmen, current CEE students, and a number of faculty members, including Saurabh Amin and Colette Heald. The room was divided by research topic, ranging from civil engineering to environmental engineering.

On April 6, during the spring 2017 Campus Preview Weekend, the CEE Academic Programs Office and members of CEESA hosted a taco bar and an afternoon of lawn games. On April 7, APO hosted a booth for prospective freshmen to learn about the department. The CEE booth was one of the most attended at the event. Campus Preview Weekend offers admitted freshmen an opportunity to learn about the various departments across MIT.

The fourth annual CEE Video Competition, held on April 13, highlighted the wide range of approaches CEE students take to solving the world's most challenging problems and the creative ways they share their research. This year's entries ranged from women in science to humanitarian aid trips and fieldwork experiences. Junior Alexa Jaeger won first place and People's Choice for her video *UAVs in Precision Agriculture*. Senior Kathy Dieppa won second place for her entry, and graduate student Tiziana Smith finished third.

The department continues to host photo competitions on social media so that students and members of the CEE community can interact with the department when they are off campus and show how their activities reflect CEE's vision. The department's summer-themed photo contest encourages students to use #CEEssummer on Twitter and Instagram. In the winter, CEE hosts the IAP photo contest with the hashtag #CEE_IAP. Prizes are awarded to the student who submits the most photos and to a student who posts a picture that accurately reflects CEE's mission and vision.

CEE CC Mei Distinguished Speaker Series

Professor Lydia Bourouiba expanded her CC Mei Distinguished Speaker Series to include more speakers, further raising visibility for CEE and its vision beyond MIT audiences. Topics and speakers included:

- “Traveling Reports from an ‘Illegal Alien’: Crossing into Scientific Domains without a Degree” by Professor Luis Amaral of Northwestern University
- “Dynamic (Non-Equilibrium, Rate, Time, and History-Dependent) Adhesion and Rupture Forces in Material, Soft Matter and Biological Systems” by Professor Jacob Israelachvili of the University of California, Santa Barbara
- “Representing Information and Adaptivity in Transportation Network Planning” by Professor S. Travis Waller of the University of New South Wales
- “The Frontiers of Tsunami Hydrodynamics” by Professor Costas Synolakis of the University of Southern California

- “Inventing Environmental Technologies for the Bottom of the Pyramid: Some Lessons Learnt” by Professor Ashok Gadgil of the Lawrence Berkeley National Laboratory
- “Speciation and Biogeochemical Cycling of Arsenic in a Minerotrophic Peak Wetland” by Professor Ruben Kretzschmar of ETH Zurich
- “Soft Matter in Construction: Computational Statistical Physics of Sustainable Cements” by Professor Emanuela Del Gado of Georgetown University

Research Highlights

The department’s research is diverse and crosses many disciplines. CEE proposal submissions have increased from 101 to 103 since last year. Research volume remained flat, which was expected due to retirements, Professor Roman Stocker’s return to Europe, and new junior hires just coming on board.

Professor Franz J. Ulm, Senior Research Scientist Roland Pellenq, and MIT Energy Initiative postdoctoral fellow Katerina Ioannidou aim to make concrete more sustainable, strong, durable, and climate friendly. Their research team [identified the nanoscale forces](#) that control how particles pack together during the formation of cement “paste” and want to control those forces to improve the paste while reducing harmful production impacts on the environment.

Research Scientist Jeremy Gregory and Randolph Kirchain, a principal research scientist in the Materials Processing Center, are working together to create a [decision-support tool to help cities in India](#) optimize the way they collect, transport, and treat their daily waste. The tool will interpret various parameters to create a waste management system catered to individual cities’ needs.

Breene M. Kerr Professor Elfatih Eltahir and his former students Teresa K. Yamana SB ’04, SM ’10, PhD ’15, and Arne Bomblies PhD ’09 presented the results of a decade-long study on the impact of climate change on malaria transmission in West Africa in an article published in *Nature Climate Change*. The CEE team did field observations and created a sophisticated model simulating village-scale malaria transmission. Mosquitos breed in shallow pools of water, laying their eggs in muddy puddles formed by rainfall, making climate change relevant. Mosquito numbers in West Africa typically peak during the rainy season between June and September, but with rising temperatures fewer mosquitos will survive, which will help limit malaria outbreaks.

Postdoctoral associate Justin Chen and researchers from the Computer Science and Artificial Intelligence Laboratory (CSAIL) created a [new imaging technology called Interactive Dynamic Video \(IDV\)](#) that allows users to “touch” objects in videos. Using traditional cameras and algorithms, IDV looks at tiny vibrations of the objects recorded to create video simulations that users can interact with. Predicted uses range from visual effects in film to monitoring of structures.

Ford Professor of Engineering Emeritus Chiang C. Mei and Jing Haixiao of the University of Technology in Xi’an, China, described in *Mathematical Biosciences* an

analytical theory of blood hammer in a long and stiffened artery due to rapid blockage. Blood hammer is a phenomenon known to occur in cerebral arteries, where sudden blockage by blood clots can cause acute rises in blood pressure and lead to intracerebral hemorrhage. The researchers based their model on viscous fluid in laminar flow, derived clear expressions of oscillatory pressure and wall shear stress, and studied the effects blocking time and plaque had on blood pressure and wall shear stress.

While adaptive radiation as a mechanism of rapid diversification of organisms is well known in animals and plants, it has remained unclear in microbes. In an article published in *Nature Communications*, researchers from CEE were able to show the evolution of different ways bacteria consume an algal polysaccharide, a discovery that illustrates adaptive radiation does exist in microbes. The lead authors of the research, who worked under the supervision of Professors Martin Polz and Eric Alm, were graduate student Philip Arevalo, former postdoc Jan-Hendrik Hehemann, and former graduate student Manoshi Datta. This discovery could allow for new applications that create more economical and renewable biofuels or innovative biomedical chemicals and products.

Research Scientist Zhao Qin and Department Head Markus Buehler generated a [new analysis](#) that could allow graphene, an incredibly stiff, strong, and light material composed of a single layer of carbon atoms, to be combined with living tissue. Buehler and Qin worked with researchers from Tsinghua University in Beijing to examine how water, graphene, and biological tissue interact to conduct heat from graphene to cell membranes. They discovered that the layer of water in their sandwich model turned to a crystal-like structure and helped dissipate heat, and their research now opens the door for graphene to be used in the human body as a sensor and drug dispenser in the future.

Professor Oral Buyukozturk and postdoc Hao Sun teamed up with Professor Nafi Toksöz and postdoc Aurélien Mordret, both of EAPS, to create a [computational model](#) that utilizes ambient vibrations to indicate the stability of a building. To test their model, the researchers placed 36 accelerometers on several floors of MIT's Green Building to record vibrations and movements. These accelerometers, combined with a complex, data-filled computer simulation of the Green Building, allowed the researchers to determine intrinsic properties of the building and survey it for damage.

Professor Andrew Whittle is serving as a co-principal investigator on an interdisciplinary MIT collaboration with the AMS Institute in Amsterdam to help solve the city's challenges in areas such as water, energy, waste, food, data, and mobility. The first proposal to emerge from the collaboration is [ROBOAT](#), a project that will use autonomous boats for transportation of goods and people. Additionally, the boats can serve as temporary floating devices or bridges that can be assembled in just hours. While the boats will be used for practical purposes, they will also monitor water quality through environmental sensors, which can help predict issues related to public health, pollution, and the environment.

The MIT Concrete Sustainability Hub [published a paper](#) in which quantitative information was used to look at the full environmental impact of buildings, from the beginning of construction to the end of the building's use. The research identifies major issues in current buildings and also offers suggestions for future research.

William E. Leonhard Professor Harold Hemond has studied Thoreau's Bog, named after Henry David Thoreau, for four decades, looking at airborne metals, nutrients, trace gases, and atmospheric acids released by society and analyzing the chemical footprint left behind. Hemond and his students are working as part of a team with members of the Departments of Chemistry and Biological Engineering; the team, supported by MIT's Environmental Solutions Initiative, is [analyzing how new environmental chemicals can affect the health of humans](#).

Bacardi and Stockholm Water Foundations Professor Dara Entekhabi and a team of researchers found that extreme precipitation is expected to increase in California due to Earth's warming climate. The researchers studied large-scale atmospheric features from 1979 to 2005, and their results were published in the *Journal of Climate*.

CEE and Mechanical Engineering associate professor Xuanhe Zhao and mechanical engineering graduate student Hyunwoo Yuk have created [gel-based robots that move when water is pumped in and out of them](#). The robots are almost invisible when in water and have many potential uses.

Assistant Professor Caitlin Mueller was featured on [MIT News](#) for her role in creating a computer simulation that can help architects optimize designs and energy consumption. The simulation allows architects to explore how architectural form impacts future operational energy.

PhD students Yongji Wang and Yunteng Cao are members of change:WATER Labs, a group seeking to create a [compact, evaporative toilet](#) that can be used in houses without water or plumbing. The toilets have numerous potential uses, but the group has identified refugee camps as their initial use.

Paul M. Cook Career Development Professor Benedetto Marelli published research in *Nature Nanotechnology* on a new technique that changes silk protein into a strong and ultralight material. [The bioinspired technique](#) is also programmable across the nano, micro, and macro scales. The research was published through the Silk Lab at Tufts University, where Marelli was previously a postdoctoral associate.

CEE and Mechanical Engineering associate professor Xuanhe Zhao created [wearable sensors](#) that light up in the presence of certain chemicals. The sensors are made of sheets of hydrogel and contain live cells. They can detect chemicals in the body and the environment.

Former CEE PhD student Chia-Ching Chou '15, Research Scientists Fran Martin-Martinez and Zhao Quin, and CEE department head Markus Buehler published [research](#) that used protein from the strong and adaptable jaw of a marine worm to model its behavior in various environments. The jaw is made of soft, organic matter but becomes as strong as bones and minerals in different environments, and thus it can be used to control soft robotics. The research was conducted in collaboration with the Air Force Research Laboratory and was recently published in *ACS Nano*.

Work carried out by Rogier Braakman, a CEE postdoc affiliated with the labs of Institute Professor Penny Chisholm and Professor Mick Follows of EAPS, shows that the evolution of *Prochlorococcus*, the smallest and most abundant photosynthetic cell, can

provide insight into the evolution of ecosystems. The [research](#) was recently published in the *Proceedings of the National Academy of Sciences*.

Associate Professor Xuanhe Zhao and a team of researchers recently developed a [workout suit](#) that responds to heat and sweat. The suit is made of live microbial cells that open and close based on changes in humidity.

[Research into the structure, strength, and toughness of conch shells](#) from graduate student Grace Gu, postdoc Mahdi Takaffoli, and Professor Buehler was recently published in *Advanced Materials*. The researchers showed how the shells' unique structure could be used for individualized helmets and body armor.

Researchers in the Concrete Sustainability Hub have created an [online tool](#) that predicts hazard mitigation breakeven costs for counties along the Atlantic coast that are susceptible to damage during hurricane season. The tool, called the Break-Even Mitigation Percentage Dashboard, helps builders determine how much extra money can be spent on a building plan while still breaking even on the cost over a building's lifetime.

Institute Professor Penny Chisholm and graduate student Andres Cubillos-Ruiz (now a postdoc at the Institute for Medical Engineering and Science) [published research](#) showing that *Prochlorococcus* varieties can each produce more than two dozen different peptides belonging to a class of compounds called lanthipeptides. Most bacteria that produce these compounds, often functioning as antibiotics or signaling compounds, make only one or two. The researchers found that the way the resulting peptides evolve has never been observed before. The findings were published in the *Proceedings of the National Academy of Sciences*.

Awards and Recognition

In March, QS World University Rankings released its [2017 rankings](#), and CEE was ranked among the top. The department was named first overall for civil and structural engineering and third overall for environmental science. The QS rankings are intended to educate prospective students about the leading schools in their preferred field.

Faculty Awards and Recognition

The faculty in CEE have received numerous significant awards, reflecting their excellence and impact within the Institute and beyond.

In October 2016, Associate Professor Pedro Reis received the 2017 GSOFTE Early Career Award for Soft Matter Research from the American Physical Society. He was recognized for his seminal experimental and numerical contributions to the understanding of elastic instabilities and geometric nonlinearities in soft matter.

Assistant Professor Carolina Osorio was awarded the 2016 Outstanding Paper in Urban Transportation Planning and Modeling prize by the Transportation Science and Logistics Society of INFORMS (Institute for Operations Research and the Management Sciences) in November 2016. She was recognized for her paper "A Simulation-based Optimization Framework for Urban Transportation Problems," which was published *Operations Research*.

In February, Bacardi and Stockholm Water Foundations Professor Dara Entekhabi was elected to the National Academy of Engineering for his leadership in the hydrologic sciences.

On April 28, CEE professor David Simchi-Levi and his PhD students Yan Zhao and Xiao Fang received the 2017 SIAM (Society for Industrial and Applied Mathematics) Data Mining Best Research Paper Award for “Uplift Modeling with Multiple Treatments and General Response Types.”

On May 1, Professor Dennis McLaughlin received the Frank E. Perkins Institute Award at the MIT Awards Convocation. The award is presented to a professor who demonstrates excellence in graduate advising and mentorship.

On May 2 Cambridge Crops, a company inspired by the research of Assistant Professor Benedetto Marelli, [won first place](#) at the second annual Rabobank-MIT Food and Agribusiness Innovation Prize competition for its edible, tasteless coating that can be applied to crops to extend their shelf life and delay spoiling. Cambridge Crops consists of a team from MIT and Tufts University.

Professor John Ochsendorf received the Creative Advising Activity Award in May for his freshman seminar on [art, engineering, and architecture](#). The award recognizes an advisor who has shown exceptional creativity by organizing unique activities and building a community for students.

Professor Elfatih Eltahir received the 2017 Hydrologic Sciences Award from the American Geophysical Union (AGU) in June. The award is granted by the AGU Hydrology Section for outstanding contributions to the science of hydrology over one’s career, with an emphasis on the past five years. It is the highest Hydrology Section disciplinary recognition for senior scientists.

Student Awards and Recognition

In October 2016, the Shoji Award for outstanding information technology (IT) contributions in civil engineering was presented to Dr. Seonkyoo Yoon PhD ’16 for his accomplishments in the area of hyper-reduced-order modeling applied to subsurface flow. Dr. Shoji, a supporter of CEE research since 1991, was a visiting professor in the department in 2006 and has spent several months conducting research on IT automation in the construction industry. He has visited CEE nearly every year for more than 20 years and created the Shoji Award in 2011.

In December 2016, graduate student Joanna Moody of Professor Joseph Sussman’s Regional Transportation and High-Speed Rail Research Group was selected to receive the Charley V. Wootan Memorial Award, given annually by the Council of University Transportation Centers for an outstanding master’s thesis in policy and planning. Joanna, now a PhD candidate in the Interdisciplinary Doctoral Program in Transportation, was recognized for her thesis “Development of a Predictive Coalition Building Analysis for Stakeholders of Sociotechnical Systems.”

Zoe Temco MEng ’17 received the Marvin E. Goody Award for her thesis proposal “The Foundation of the Central Towers of British Cathedrals.” The aims of the award

are to extend the horizons of existing building techniques and use of materials, to encourage links between the academic world and the building industry, and to increase appreciation of the bond between good design and good building.

In January Grace Xiang Gu, a mechanical engineering graduate student and member of Markus Buehler's Laboratory for Atomistic and Molecular Mechanics, received a top 5 poster award at the 2017 Global Young Scientists Summit for "Printing Nature: Enhanced Impact Resistant Composites." Gu presented her poster to several Nobel Laureates, including David Gross and Gerard Hooft, who also served as competition judges. The summit was held at the Singapore University of Technology and featured plenary lectures, panel discussions, and interactive small group sessions with distinguished speakers.

On March 7, [Julia Heyman '17](#) received the [2017 Carroll L. Wilson Award](#), a prize that funds a year of research. She will be pursuing a project on the implementation of wheelchair sensors in Indonesia.

Graduate student Rami Abi Akl of Professor Tal Cohen's Nonlinear Solid Mechanics Group won second place at "My Thesis in 180," an event held at MIT in May. In this competition, graduate students briefly present an abridged version of their thesis in French, showing their passion in an elegant and concise way.

In June, graduate student Reza Mohammadi Ghazi won the Probabilistic Methods Competition best paper and presentation award at the Engineering Mechanics International Conference. Murat Uzun, also a graduate student, received the Structural Health Monitoring and Control Competition best paper and presentation award. Both Ghazi and Uzun are members of Professor Oral Buyukozturk's group.

Also in June, André Snoeck, a PhD student in the Interdepartmental Doctoral Program in Transportation, received the Outstanding Paper Award at the 10th International Conference on City Logistics. Snoeck was recognized for "Establishing a Robust Urban Logistics Network at FEMSA through Stochastic Multi-Echelon Location Routing," which he co-authored with Matthias Winkenbach, director of the MIT Megacity Logistics Lab, and Esteban Mascarino, a graduate student in the interdepartmental Master of Science in Transportation program.

Mary Hwang '17 was inducted into Phi Beta Kappa, the oldest liberal arts and science society in the nation, on June 8. Hwang is among the less than 10% of the Class of 2017 to be nominated for membership by a faculty committee.

2017 Annual Departmental Awards: Faculty, Staff, and Students

The [CEE Awards](#) celebrate all that is CEE. This past year the department added several new awards to stimulate the local community to identify and further the excellence within the department. The awards were presented at the Senior Celebration and Awards Banquet in May.

The CEE Best Undergraduate Research Award was given to seniors Elaine Cunha and Tess Hegarty. Cunha was commended for her dedication to research, specifically her

work on a collaborative project with Massachusetts General Hospital. Hegarty was honored for her original research on the embodied carbon of structures, which was conducted as part of a two-year UROP project.

Junior Jillian Dressler received the CEE Leadership and Community Award for her hard work and dedication to CEE, particularly her role as social chair for the CEE Student Association.

The Juan Hermosilla (1957) Prize, given to a student demonstrating exceptional talent and potential for future contributions at the intersection of mechanics, materials, structures, and design, was awarded to senior George Varnavides. Varnavides's senior capstone project focused on the Mosul Dam in Iraq. The project was inspired by a *New Yorker* article on the dam, which was constructed under Saddam Hussein.

The Leo (Class of 1924) and Mary Grossman Award, which is given annually to an undergraduate student with a strong interest in transportation and a strong academic record, was presented to sophomore Mark Mockett. Mockett was recognized for his dedication and thorough research during a UROP market selection project for the East Japan Railway Company and a project involving a high-speed rail link between Los Angeles and Las Vegas.

Senior Rebecca Sugrue received the Paul L. Busch (1958) Prize, which is awarded to undergraduate students in environmental science and engineering for academic achievement and contributions to the CEE community. Sugrue has been involved with many facets of CEE, from serving as a faculty liaison in CEESA to participating in freshman pre-orientation programs.

Senior Bryan Lilley was the recipient of the Tucker-Voss Award, presented to an undergraduate or graduate student who shows particular promise in the field of building construction. For his senior capstone project, Lilley worked with Professor Masic on how to minimize the carbon footprints of different materials. The award was created in the 1950s, when the Department of Building Construction merged with the Department of Civil Engineering. The award is named in memory of Professor Ross F. Tucker and Professor Walter C. Voss, who were the first two heads of the Department of Building Construction.

A number of graduate students were also recognized for their various contributions to the department during the year and throughout their time at MIT. Qingjun "Judy" Yang was awarded the Trond Kaalstad (Class of 1957) Fellowship, presented annually to a graduate student who has displayed leadership and contributed significantly to the well-being of the CEE community. Yang was recognized for being a founding member of the MIT-TREES student organization, which aims to make environmental science more accessible to all audiences.

The Maseeh Award for Excellence as a Teaching Assistant went to Xiaojing "Ruby" Fu, a graduate student and highly rated teaching assistant in 1.000 Computer Programming for Engineering Applications. Fu is also chair of the Henry L. Pierce Laboratory Social Committee and an active participant in community events.

The third graduate student prize, the CEE Best Doctoral Thesis Award, was given to Anna Tarakanova. This award honors scholarly and academic excellence and a high level of distinction among CEE graduate students. Tarakanova was recognized for her thesis “Molecular Structure, Hierarchical Assembly and Stimuli—Responsive Mechanics of Tropoelastin and Elastin Biomaterials.”

Stefan Thiele, a postdoc in Professor Martin Polz’s lab, received the CEE Postdoctoral Scholar Mentoring, Teaching, and Excellence Award. The award is given in recognition of mentoring, teaching, and other exceptional contributions by a postdoc. In addition to volunteering as a mentor for the mini-UROP program, Thiele has worked tirelessly to ensure that the department engages in the most environmentally sustainable options and introduced an initiative to reuse bowls and utensils to reduce waste.

Students, researchers, faculty, and staff were also given the opportunity to nominate faculty members for a number of awards. Gilbert W. Winslow Career Development Professor Pedro Reis was presented the Maseeh Excellence in Teaching Award, given annually to the most outstanding faculty instructor in the past year. Reis was acknowledged for his energetic teaching style and his willingness to engage with students outside of the classroom.

The CEE Distinguished Service and Leadership Award was given to JR East Professor of Engineering Joseph Sussman. This award recognizes outstanding departmental service and leadership contributions on the part of a CEE faculty member. Sussman was honored for his friendship and mentorship to both students and fellow faculty members and for his support of all CEE community events.

Class of 1942 Professor of Architecture and CEE professor John Ochsendorf was awarded the Samuel M. Seegal Prize for his engagement with and dedication to his students. The prize alternates annually between CEE and the Sloan School of Management and is given to a professor who inspires students to pursue and achieve excellence.

The Ole Madsen Mentoring Award, a new award for 2017, was presented to Associate Professor Jesse Kroll. The award honors a faculty member for his or her contributions to mentoring and educating CEE students outside the classroom and inspiring them to pursue a career in the field of civil and environmental engineering. Kroll was recognized for his passion for the environment and his willingness to help and mentor students.

Two staff members received CEE Excellence Awards for their outstanding contributions to the CEE community, including their commitment to professionalism, dedication, and best practices and their fostering of a culture of diversity, inclusiveness, and innovation. The awards were presented to Allison Dougherty of CEE Communications and Jackie Foster, an administrative assistant in the Parsons Laboratory.

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