

Department of Aeronautics and Astronautics

The [Department of Aeronautics and Astronautics \(AeroAstro\)](#) at MIT is among the nation's oldest and most highly regarded programs in the field. With both undergraduate and graduate programs regularly ranked among the best in the country, the department is an ever-evolving, vibrant community of students, faculty, researchers, and staff.

As articulated in the department's 2020 Strategic Plan, our shared vision is the creation of an aerospace field that is a diverse and inclusive community, pushing the boundaries of the possible to ensure lasting positive impact on our society, economy, and environment.

Furthermore, our mission is defined as follows:

- Educating leaders, creative engineers, and entrepreneurs in aeronautics and astronautics and related fields
- Engineering aerospace technologies and real-world systems that promote exploration, a sustainable environment, global security, and a prosperous economy
- Shaping the future of aerospace by engaging public and private sectors

With a shared set of values, ethics, and integrity, our mission can only be realized if we remain focused on:

- Creating an open, diverse, inclusive, and supportive environment
- Succeeding together
- Leading through excellence in research and education

Brief History of Aeronautics and Astronautics at MIT

The first appearance of an aeronautics class appeared in the AY1914 course catalog of the Massachusetts Institute of Technology. The course, titled Aeronautics and numbered 1,372, appears to have been taught in spring 1914. During 1913, Jerome C. Hunsaker began to develop the aeronautics course. The Executive Committee of the Corporation voted to appoint Hunsaker instructor in Aviation, attached to the Department of Naval Architecture. The faculty approved the schedule of studies needed to receive an SM in aeronautical engineering on April 22, 1914. The graduate course was listed and described on page 62 of the AY1915 catalog, published in December 1914.

The first graduate of the nascent graduate course was Hou-Kun Chow, recommended for a master's degree in aeronautical engineering at the June 4, 1915 meeting of the Corporation. His name appears on a list of successful candidates for graduation in the AY1916 catalog, which incorrectly lists the graduates for 1915 as having graduated in June 1914. Chow's thesis also shows a date of 1915. There were no graduates of the Aeronautical Engineering course in 1914. Jerome Hunsaker was recommended for a doctorate in engineering by vote of the Corporation on June 9, 1916. He also is listed

among successful candidates for graduation in the AY1917 catalog, with a description of his doctoral studies appearing on page 430. Another early graduate of the department (1916) was Chinese-born Wong Tsu, later to become the Boeing Company's first engineer.

Course 16 was established as an independent course by vote of the Executive Committee of the Corporation on July 7, 1925. The minutes of the meeting state: "Voted: To establish Aeronautics as a separate course to be designated by a special number and to be under the direction of Professor E. P. Warner." The schedule of studies for the bachelor's degree in aeronautical engineering was approved at a faculty meeting on March 17, 1926. The establishment of Course 16 is mentioned on pages 16 and 17 of Reports of the President and Treasurer for the year ending June 30, 1926. The course first appeared listed in the AY1927 catalog.

Aeronautical Engineering became its own department in 1939. Minutes for a meeting of the Corporation's Executive Committee held on April 11, 1939 state: "Voted: To recommend to the Corporation the establishment of a separate Department of Aeronautical Engineering, with Professor Hunsaker continuing as Head of this New Department as well as Head of the Department of Mechanical Engineering." This was confirmed by a meeting of the Corporation on June 6, 1939.

COVID-19 and the Department of Aeronautics and Astronautics

AY2020 will long be remembered as one of the most remarkable in Institute history. With a worldwide pandemic shutting the doors of the Institute and much of the world beginning in March 2020, the department found itself needing to redefine its curriculum and its practices. Staff, faculty, and students were instructed to leave the Cambridge campus, with only those students who could prove exceptional circumstances remaining. Within a single week's time, MIT and AeroAstro went from bustling university campus to ghost town.

Like the rest of MIT, the department had only two weeks in which to move its academic offerings to a purely online format. To support this effort, an ad hoc group of faculty and staff was formed to help with a wide range of issues—from online lecturing and assessment to shipping supplies for hands-on work. With respect to the former, the group promoted an approach combining tablet-based writing with synchronous presentation on Zoom, while also providing recordings for asynchronous viewing. (It is important to remember that MIT's students hail from across the globe, and, while the vast majority of undergraduate students are US citizens, a significant proportion of graduate students are international.) A best practice document was developed to help instructors and teaching assistants climb the learning curve of online lecturing. The department also provided loaner tablets to instructors and teaching assistants to ensure they had the tools they would need. This rapid transition to online learning was successful, not only through the efforts of the ad hoc group and instructional teams but also because of the commitment to learning shown by the department's students.

At the end of the spring semester, the department held a virtual faculty retreat to reflect on what had been learned and to develop preliminary plans for fall 2020. In addition to presentations from AeroAstro faculty, outside speakers from the Departments of

Chemical Engineering, Materials Science and Engineering, and Mechanical Engineering, faculty from the MIT Sloan School of Management gave talks about their experiences with online teaching. While most fall 2020 offerings did not have a significant hands-on component—with the exception of the senior capstone design sequence in aeronautical systems (16.82 Flight Vehicle Engineering in fall 2020 and 16.821 Flight Vehicle Development in spring 2021)—careful consideration needed to be given to how to move forward. The other major concern for the fall was how best to build community, especially among those individuals new to the department (e.g., sophomores and first-year graduate students). While AeroAstro is a department of moderate size, it is in fact a very close-knit community due in large part to a shared passion for aerospace engineering. Historically, that passion has been reinforced by physical proximity, something we realized would be difficult to replicate in a virtual environment.

AeroAstro was able to successfully pivot to remote work with short notice in mid-March due to the COVID-19 pandemic. All on-campus departmental activities and research were halted from March 16, 2020 until the beginning of June, when planning for the first phase of MIT's research ramp-up began. Only a handful of essential departmental staff were allowed limited access to campus prior to the start of Phase 1, which allowed for 25% occupancy of space by researchers. Building on the success of our planned and managed Phase 1 ramp-up, Phase 2 activities (50%) started at the end of August.

Throughout the pandemic, the department has adhered to the MIT policy of “all work that can be done remotely must be done remotely.”

During the reduced occupancy of departmental space, planning continued for the renovation of lab space for Professor Zachary Cordero in the basement of the Ronald E. McNair Building (Building 37). Additionally, a new lab space was designed to allow for work on the FireFly project. Construction of these spaces will start in January 2021. The Wright Brothers Wind Tunnel project was halted for 10 weeks starting March, 20, 2020 but is making great progress and we anticipate completion by the second quarter of 2021.

Academic Year 2020 in Brief

In AY2020, the *US News & World Report* ranked the department's graduate program number one, tied with Stanford University.

As with our graduate program, the department's undergraduate program enjoys top rankings from *US News & World Report* year in and year out. In AY2020, the department's undergraduate program is ranked number one in the nation.

Per the Registrar's Office fifth week statistics, total enrollment in the department for AY2020 was 169 undergraduates and 246 graduate students.

Additionally, in AY2020, 52 SM degrees and 21 PhD degrees were awarded.

AY2020 was the first with Professors Daniel Hastings and Hamsa Balakrishnan in leadership positions for the year's entirety. While Professor Balakrishnan joined

headquarters in July 2018 as associate department head, Professor Hastings did not assume the role of department head until January 1, 2019, following a multi-year position as director of the Singapore-MIT Alliance for Research and Technology.

With the encouragement and support of leadership in the School of Engineering, Professors Hastings and Balakrishnan committed the department to the development of a new strategic plan. To that end, the department held a faculty retreat in June 2019 to deliberate, iterating and developing a new plan over the ensuing months. The 2020 strategic planning process summarizes these efforts, specifically regarding (1) changes to the external environment; (2) mission, vision, and values; and (3) future strategic directions in research, education, and culture, and leadership.

Committed to building a stronger department—one in which diversity is embraced and celebrated—leadership made additional progress in its efforts to become more diverse and inclusive. Acting on the Diversity, Equity, and Inclusion Executive Committee’s recommendation to hire a diversity officer, the department welcomed Denise Phillips on August 26, 2019. Phillips acclimated herself to the role quickly and, together with the committee, is making significant gains in creating a more welcoming environment within the department.

The long-awaited construction of the new Wright Brothers Wind Tunnel, a state-of-the-art facility, destined to be the largest, most advanced academic wind tunnel in the country, began in early AY2020 and will continue until its completion in spring 2021. In addition to construction of a new tunnel, work includes a full rehabilitation of Building 17 as well as infrastructure work in the first-floor electrical room of Building 37 and the Building 33 hangar. Overseen by the department’s manager of infrastructure, Anthony Zolnik, construction has proceeded despite COVID-19 restrictions. The Boeing Company was the principal benefactor, making a significant lead gift to begin construction of the tunnel.

From September 24 to 25, 2019, the department hosted the biennial visit of the Aeronautics and Astronautics Visiting Committee. The committee met with representatives from all department constituencies, including faculty, administrative and support staff, research staff, postdoctoral associates, graduate students, and undergraduate students. The two-day meeting proved elucidating and, as always, a valuable tool for the department as it receives counsel on both current activities and future directions.

From January 21 to 25, 2020, members of the AeroAstro Class of 2022 and one member of the Class of 2020 traveled from Boston to Virginia on the department’s sixth annual Independent Activities Period (IAP) trip. The goal of the trip is to introduce recently declared aerospace engineering majors to government and industry partners, often the first opportunity for many of them to speak with engineers working in the field. This year’s trip was the first on the East Coast, which successfully challenged the notion that the most exciting work in aerospace engineering occurs solely on the West Coast. Also of note, the 2020 trip marked the first time the sophomore IAP trip had an educational component, with credit offered for final presentations.

Faculty

As of the beginning of AY2020, the tenure/tenure-track faculty of the department consisted of:

Hamsa Balakrishnan (professor)
 Steven Barrett (associate professor)
 Edward Crawley (Ford Foundation Professor of Engineering)
 Kerri Cahoy (associate professor)
 Luca Carlone (assistant professor; Charles Stark Draper Professor)
 David Darmofal (professor)
 Olivier de Weck (professor)
 Mark Drela (Terry J. Kohler Professor)
 Carmen Guerra-Garcia (assistant professor; Boeing Professor)
 Edward Greitzer (H. N. Slater Professor in Aeronautics and Astronautics)
 Steven Hall (professor)
 R. John Hansman (T. Wilson (1953) Professor in Aeronautics)
 Wesley Harris (Charles Stark Draper Professor of Aeronautics and Astronautics)
 Daniel Hastings (Cecil and Ida Green Professor in Education)
 Jonathan How (Richard Cockburn Maclaurin Professor in Aeronautics and Astronautics)
 Sertac Karaman (associate professor)
 Paul Lagacé (professor)
 Nancy Leveson (professor)
 Richard Linares (assistant professor; Charles Stark Draper Professor)
 Paulo Lozano (professor)
 Youssef Marzouk (associate professor)
 David Miller (Jerome C. Hunsaker Professor)
 David Mindell (0.5 full-time equivalent [FTE], dual appointment with Science, Technology, and Society in the School of Humanities and Social Sciences; Frances and David Dibner Professor in the History of Engineering and Manufacturing)
 Eytan Modiano (professor)
 Dava Newman (Apollo Professor of Astronautics and Engineering Systems)
 Jaime Peraire (H. N. Slater Professor in Aeronautics and Astronautics)
 Raúl Radovitzky (professor)

Nicholas Roy (professor)
 Julie Shah (associate professor)
 Zoltan Spakovszky (professor)
 Leia Stirling (assistant professor)
 Ian Waitz (Jerome C. Hunsaker Professor)
 Qiqi Wang (associate professor)
 Brian Wardle (professor)
 Sheila Widnall (Institute Professor)
 Brian Williams (professor)
 Moe Win (professor)

Jeffrey Hoffman remains a professor of the practice (100%), as does Robert Liebeck (5%).

Faculty with joint appointments in the department as of June 1, 2019, included Richard Binzel (professor in the Department of Earth, Atmospheric and Physical Sciences [EAPS]); Sara Seager, Class of 1941 Professor of Planetary Sciences (EAPS); Russell Tedrake, Toyota Professor (EECS); and Danielle Wood, Benesse Corporation Career Development Professor of Media Arts and Sciences (assistant professor in the Program in Media Arts and Sciences).

Of the 35.5 tenure/tenure-track faculty in the department at the conclusion of AY2020, seven are women—Balakrishnan, Cahoy, Guerra-Garcia, Leveson, Newman, Shah, and Widnall—and six are from underrepresented minority groups—Harris, Hastings, Linares, Lozano, Peraire, and Radovitzky.

Departures

Leia Stirling accepted a position as associate professor in the Department of Industrial and Operations Engineering at the University of Michigan at Ann Arbor as of September 1, 2019. Stirling remains affiliated with the department as a visiting professor.

Promotions Effective July 1, 2019

Kerri Cahoy promoted to associate professor with tenure
 Sertac Karaman promoted to associate professor with tenure
 Hamsa Balakrishnan promoted to full professor

Promotion Cases Presented during AY2020, Becoming Effective July 1, 2020

Steven Barrett will be promoted to full professor
 Youssef Marzouk will be promoted to full professor

Professor of the Practice Re-Appointment Case Presented during AY2020, Effective July 1, 2020

Jeffrey Hoffman will be reappointed professor of the practice

Faculty on Sabbatical, Junior Faculty Leave, or Institute Leave during AY2020

Ian Waitz: Institute leave as vice-chancellor of MIT, July 1, 2019 to June 30, 2020

Steven Barrett: sabbatical July 1, 2019, to June 30, 2020

Qiqi Wang: sabbatical July 1, 2019, to December 30, 2019

Edward Crawley: sabbatical January 1, 2020, to June 30, 2020

Jaime Peraire: teaching relief January 1, 2020, to June 30, 2020

David Miller: professional leave as chief technology officer of the Aerospace Corporation July 1, 2019, to June 30, 2020

David Mindell: professional leave with startup Humatics July 1, 2019, to December 31, 2019

Richard Linares: family leave January 1, 2020, to June 30, 2020

Course 16 alumnus and co-founder of Orbital Science Systems David W. Thompson joined the department as Jerome C. Hunsaker Visiting Professor of Aerospace Systems for AY2020. Conceived of by Major Lester D. Gardner, the endowed chair received a special monetary gift from Glen L. Martin in honor of his mother Minta Martin, which provides for an annual lectureship. After a 15-year hiatus, the department reinstated both the professorship and lectureship in the person of Thompson.

Faculty Search

Allocated one hire to be announced for FY2021 (i.e., with the search to be conducted in AY2020), the department began a broad search, which encouraged applicants in all areas related to aerospace engineering, with particular interest in candidates in aircraft propulsion, fluid mechanics, and acoustics; aircraft design and optimization; aerospace materials and manufacturing; and the interaction of humans and machines.

Sixty-five complete applications were received. Of these, six candidates were invited to campus for a full interview. One of the invited individuals withdrew their candidacy, and thus five applicants visited campus for full two-day interviews. Based on the results of those interviews and subsequent deliberations, the Department Faculty Search Committee unanimously recommended Adrián Lozano-Durán be offered a position as an assistant professor in the Department of Aeronautics and Astronautics. The school agreed, and the department was given approval to extend an offer, which was accepted. Currently a postdoctoral researcher at Stanford University, Lozano-Durán is a Spanish citizen and a J-1 visa holder. It is hoped that he will be granted the appropriate visa to begin his employment on January 1, 2021. Of note, Lozano-Durán's areas of expertise include turbulence, computational fluid dynamics, reduced-order modeling, and aerodynamics.

The department eagerly awaits those faculty hired as a result of the FY2020 search—Zachary Cordero and Chuchu Fan. Both are anticipated to join the department on July 1, 2020.

Awards and Acknowledgements

- Nicholas Roy received the 2019 Capers and Marion McDonald Award for Excellence in Mentoring and Advising.
- Luca Carlone and the MIT Spark Lab joined the Jet Propulsion Laboratory, California Institute of Technology, and Korea Advanced Institute of Science and Technology to form the Collaborative Subterranean Autonomous Robots team, which won second place in the Defense Advanced Research Projects Agency (DARPA) Subterranean Challenge—a large international competition sponsored by DARPA that has the goal of demonstrating technologies for autonomous exploration and mapping of underground tunnels using teams of robots.
- Julie Shah has been named a co-head (along with Professor David Kaiser, Germeshausen Professor of the History of Science) of social and ethical responsibilities of computing in the MIT Schwarzman College of Computing.
- Jonathan How received the 2020 American Institute of Aeronautics and Astronautics Intelligent Systems Award “for outstanding and sustained contributions to the decision making and control of intelligent autonomous aerospace vehicles.”
- Danielle Wood was inducted into the International Academy of Astronautics during the International Astronautical Congress in Washington, DC.
- Richard Linares and Sertac Karaman attended the National Academy of Engineering Frontiers of Engineering conference as invited Frontiers of Engineering fellows.
- Eytan Modiano received the 2020 Institute of Electrical and Electronics Engineers (IEEE) International Conference on Computer Communications (INFOCOM) Achievement Award, the highest honor bestowed on a researcher in the INFOCOM community.
- Nancy Leveson received the 2020 IEEE Medal for Environmental and Safety Technologies, which recognizes outstanding accomplishments in the application of technology in the fields of interest of IEEE that improve the environment and/or public safety.

Research Volume

The department’s research volume for FY2020 was \$33.2 million, a significant increase over FY2019 (\$30.8 million). Of note, FY2020 was the largest year ever in unadjusted dollars.

Students

Promoting Excellence in Graduate Education

AeroAstro received 797 applications for admission to its graduate programs for fall 2020, admitting 108 applicants. Of the 108 admitted, 76 enrolled, for a yield of 70%. Of the entering class, 36% were women, and 16% were from underrepresented minority groups.

Department of Aeronautics and Astronautics Application and Enrollment Statistics, AY2012–AY2020

Year	Applicants	Admitted	Accepted (%)	Enrolled	Yield (%)
2012	515	116	23%	80	69%
2013	549	90	16%	64	71%
2014	526	93	18%	70	75%
2015	561	80	14%	59	74%
2016	618	87	14%	59	68%
2017	638	90	14%	66	73%
2018	721	109	15%	71	65%
2019	725	89	12%	57	64%
2020	797	108	14%	76	70%

Department of Aeronautics and Astronautics Entering Class, Women and Underrepresented Minority Group Statistics, AY2015–AY2020

Year	Women	Students from underrepresented minority groups
2015	20%	10%
2016	15%	6%
2017	24%	10%
2018	32%	11%
2019	31%	12%
2020	36%	16%

US News & World Report Graduate Program Rankings, AY2012–AY2020

	2012	2013	2014	2015	2016	2017	2018	2019	2020
MIT	1	2	1	1	1	1	2	1	1
Stanford University	3	1	3	2	2	2	1	3	1
California Institute of Technology	1	2	1	2	2	4	4	1	3
Georgia Institute of Technology	4	4	5	5	5	2	2	4	4
University of Michigan	5	5	3	4	4	4	5	5	5
Purdue University	6	6	6	5	6	6	6	6	5
University of Illinois Urbana-Champaign	7	7	7	7	7	8	9	8	7
University of Texas at Austin	10	8	8	8	8	7	8	8	7
Princeton University	7	8	9	9	11	12	10	8	9

Promoting Excellence in Undergraduate Education

The department's undergraduate program is among the best in the nation, consistently ranked number one by *US News & World Report*:

US News & World Report Undergraduate Program Rankings, 2012–2020

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MIT	1	1	1	1	1	1	1	1	1	1
Georgia Institute of Technology	2	2	2	2	3	2	2	2	2	2
California Institute of Technology	5	5	5	7	4	5	6	5	3	3
University of Michigan	3	3	3	3	2	3	3	2	4	4
Purdue University	4	4	4	6	5	4	4	6	5	5
Stanford University	6	6	6	4	6	6	5	4	6	5
University of Illinois Urbana- Champaign	6	7	8	5	7	7	7	6	7	9
University of Texas at Austin	8	12	7	8	9	10	8	8	8	7
Embry-Riddle Aeronautical University	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8

Program evaluators from the Accreditation Board for Engineering and Technology (ABET) were on campus September 15–17. They toured the department’s undergraduate labs; met with Institute and department leadership, faculty, and students; and reviewed the self-study reports and extensive collection of materials that David Darmofal and Nicolene Hengen (AeroAstro Academic Program accreditation manager) put together over the past year. ABET is expected to send its final accreditation reports in late summer 2020.

The department remains committed to promoting undergraduate research by hiring students through the Undergraduate Research Opportunity Program (UROP). In AY2020 (including summer 2020), Course 16 had 341 UROP positions. Of those, 51 were for credit, 122 (36%) were filled by women, and 84 were first-year students (of whom 24% were women).

Leadership of the department continues to require reflective memos from undergraduate instructors as a means of promoting improvement in faculty teaching performance. Following the submission of a reflective memo, the associate department head meets with instructors to review same.

Awards and Acknowledgements

Student Awards and Acknowledgements

- Students from the MIT Driverless team, including a number of AeroAstro students, together with students from Delft University of Technology (TU Delft), placed third overall—in a field of 20 university competitors—in the driverless category at the 2019 Formula Student Germany competition in Hockenheim, Germany. The intercontinental MIT-TU Delft team placed first in Cost and Manufacturing, second for Business Concept, and third for Engineering Design and Presentation.

- A team of MIT students, including AeroAstro students, competed at the 2019 SpaceX Hyperloop Pod Competition, emerging as the top US university team at the annual competition and placing fifth worldwide. They also earned a SpaceX Innovation Award.
- PhD student Hugh Carson received the 2019 Student Poster Competition Award from the US National Congress on Computational Mechanics for his poster “Output-based Anisotropic Mesh Adaptation for Continuous Finite Element Methods.”
- PhD students Ben Zhang (AeroAstro/Computational Science and Engineering) and Pasquale Antonante (AeroAstro/Laboratory for Information and Decision Systems) were awarded MathWorks Engineering Fellowships from MathWorks and the MIT School of Engineering.
- The US National Aeronautics and Space Administration (NASA) awarded a Silver Achievement Medal to the Transiting Exoplanet Survey Satellite (TESS) team, which recognizes government and non-government individuals or teams for “a stellar achievement that supports one or more of NASA’s core values, when it is deemed to be extraordinarily important and appropriate to recognize such achievement in a timely and personalized manner.”
- Graduate student Carla Grobler won the Joseph Hartman Student Paper Competition for her paper, “Marginal Climate and Air Quality Costs of Aviation Emissions,” published in IOPScience last year. This competition recognizes the best ideas concerning the reduction of aviation noise and emission, alternative jet fuel production and use, aviation operations, and more. Grobler was also named a Martin Family Society of Fellows for Sustainability beginning in September 2020.
- Graduate student Morgan Blevins received a Graduate Research Fellowship Program award from the National Science Foundation as well as a Draper Fellowship.
- Graduate student Lena Downes received a Draper Fellowship for her PhD studies. She is a previous recipient of a Draper Fellowship for her master’s degree studies.
- Graduate student Alex Trujillo is co-winner of the recent NASA Model Based Systems Engineering Habitat Library Challenge for his contribution to developing a library of models for human space habitat elements.
- Kanika Gakhar, Katherine Carroll, Paula do Vale Pereira, and Laura Yenchesky were among the laureates honored during Aviation Week Network’s 63rd Annual Awards. The Aviation Week Network, in collaboration with the American Institute of Aeronautics and Astronautics, named them among the winners of Tomorrow’s Technology Leaders: The 20 Twenties, which recognize students earning science, technology, engineering, and mathematics (STEM) degrees who are nominated by their universities based on their academic performance, civic contribution, and research or design project.

Graduate Student Outstanding Leadership Awards

- Outstanding Leadership: AeroAfro: Arthur Brown
- Graduate Association of Aeronautics and Astronautics: Maria Regina Apodaca Moreno, Amelia Gagnon, Charlotte Lowey, and Jessica Todd
- Graduate Women in Aerospace Engineering: Rosemary Davidson (for her leadership in engagement and remote social activities), Annick DeWald (for advocating for students on lesbian, gay, bisexual, transgender, and queer issues), and Paula do Vale Pereira (for her passionate leadership in mentorship and outreach)

Graduate and Undergraduate Student Outstanding Leadership Awards

- Apollo Program Prize Award: Rachel Morgan (G)
- General James H. Doolittle Prize Award: Madeleine Schroeder '20
- James Means Memorial Award: Olek Peraire-Bueno '20 and Humberto Caldelas '20
- Graduate Recognition for the Rene H. Miller Prize in Systems Engineering: George Lordos (G)
- Morsa Prize Award: Mohammed Kabir '21
- Yngve K. Raustein Memorial Award: The Unified Class of 2020
- Henry Webb Salisbury Award: Hunter Fields '20, Jim Koldada '20, Mia LaRocca '20, Olek Peraire-Bueno '20, Madeleine Schroeder '20, and Michelle Xu '20
- Undergraduate Teaching Assistantship Award: Marcus Abate '20, 16.405[[J] Robotics: Science and Systems
- Graduate Teaching Assistant Award: Christopher Courtin (G) 16.82 Flight Vehicle Engineering, and Johannes Norheim (graduate) 16.885 Aircraft Systems Engineering

Faculty and Staff Awards

- Wings Award: Beata Shuster
- Spirit of XVI Award: Marie Stuppard

Vickie Kerrebrock Awards

- Undergraduate Winner: Ethan Sit '20
- Graduate Winner: Maria Regina Apodaca Moreno
- Faculty Winner: Luca Carlone
- Research Staff/Postdoc Winner: Rebecca Masterson, principal research scientist
- Staff Winner: Sara Cody, communications officer

Administrative and Support Staff

New Hires

- Esther Allen, administrative assistant 2, provides support to Steven Barrett and the Laboratory for Aviation and the Environment, as well as to Peter Belobaba and Jayant Sabnis.
- Sara Cody, the department's new communications officer, is responsible for overall management of the department's communications strategy.
- Hannah Ovaska was hired into a new position, that of Human Resources (HR) administrator (HRA). The HRA provides a wide range of HR services from the development, administration, and implementation of HR policies, procedures, and activities to managing the annual salary review processes, departmental searches, and more. This role also participates in the department's strategic initiatives by consulting, advising, and adding strategic planning input.
- Denise Phillips was also hired into a new position, that of diversity officer, which came about at the suggestion of the department's Diversity, Inclusion, and Innovation Committee.
- Having been without a development officer for over a year, the department hired Kate Reynolds as senior development officer. This is an expansion of the role from 0.5 FTE to 1.0 FTE.

Promotions

Anthony Zolnik was promoted to a new position, manager of infrastructure, in which he will have responsibility for both the department's physical plant and its information technology.

Events

From July 8 to August 4, 2019, MIT Lincoln Laboratory Beaver Works Center, the School of Engineering, and the Department of Aeronautics and Astronautics co-sponsored the 2019 MIT Beaver Works Summer Institute. More than 240 students from across the country gathered in AeroAstro department space to work on hands-on projects, take online courses, and attend lectures.

On August 29, 2019, the department hosted a team-building event aboard the *Majesty*, a ship sailing out of Long Wharf. With more than 100 faculty, staff, and members of their families aboard, the evening was a great success, with fireworks, camaraderie, fine food, and a spectacular kickoff to the new academic year.

On September 18, AeroAstro co-hosted The Future of AI Meets the Future of Space, as part of MIT-IBM Watson's AI Research Week and NASA's Destination Station. Richard Linares and Danielle Wood were featured research speakers, and graduate students Daniel Jang, Axel Garcia, and Charles Oestreich were among the participants in the *Shark Tank*-style project pitch event.

The department hosted a remembrance service, honoring the life and work of former department head Jack L. Kerrebrock, on Sunday, November 17. Speakers and guests came from across the country to honor Professor Kerrebrock and celebrate a life well lived.

David W. Thompson presented the Minta Martin Lecture, titled “The History of and Prospects for Commercial Space Activities,” to an engaged audience on February 18, 2020. Thompson’s presentation would prove to be one of the last in-person events of the department’s academic year.

The 2020 Lester D. Gardner Lecture, “Leading through Unprecedented Times,” was presented by Major General Charles Bolden, to an enthusiastic albeit virtual crowd. Retired astronaut and the 12th NASA administrator, Bolden reflected on his personal experience as well as the history and future of aerospace, from the Wright brothers’ first flight in 1903 to NASA’s Mars Exploration initiatives, connecting them back to today’s challenges of mastering deep space human exploration in the era of the novel coronavirus (COVID-19).

Scheduled to be held at University of Colorado at Boulder in 2020, the Women in Aerospace Symposium (co-sponsored by MIT, Stanford University, and University of Colorado at Boulder) was postponed because of the nationwide shutdown. Last held at MIT in 2019, the event offers female doctoral candidates and recent PhD recipients working in the aerospace field an opportunity to showcase their work to, and network with, their colleagues in academia, university faculty, industry, and government.

An end-of-year, all-department virtual barbecue and party was held on Friday, May 22. Undergraduate and graduate students, researchers, administrative and support staff, as well as faculty, Zoomed for a late afternoon of fun and game playing. More than 125 community members celebrated the end of the semester and reveled in the sheer delight of seeing one another.

Another all-department event was slated for May 27, 2020, for the inaugural launch of SpaceX Crew Dragon. Although the launch was scrubbed due to weather, the department was able to enjoy a last-minute Q&A session with Course 16 alumnus and NASA astronaut Mike “Spanky” Fincke. More than 100 community members had tuned in for the launch with the majority staying on for the Q&A.

The rescheduled SpaceX Crew Dragon launch successfully on May 30, 2020, and was history making. More than 100 members of the AeroAstro community watched it happen together. The department’s ability to maintain its collective identity despite its physical distance from one another has been remarkable.

Diversity Efforts

AeroAstro’s Diversity, Equity, and Inclusion Committee devoted AY2020 to identifying and eliminating inequities within the department, whether based on physical, cultural, historical, or intellectual differences. With a mind to ensuring that AeroAstro is a welcoming community, the committee focused its immediate actions on increasing the number of women and people from underrepresented minority groups in the department to match or surpass MIT numbers and eventually mirror the national population.

Resource Development

AeroAstro is expanding its efforts to increase philanthropic support from alumni and friends. The department hired its first full-time development officer, Kate Reynolds, in August 2019. In this role, Reynolds is focused on raising funds for priority areas, including the Wright Brothers Wind Tunnel, fellowships, professorships, diversity initiatives.

In collaboration with the School of Engineering and Resource Development, the department created marketing materials and naming opportunities for the Wright Brothers Wind Tunnel to raise awareness of the project and share funding needs. During the course of FY2020, Professor Hastings presented on the wind tunnel and other funding priorities with Resource Development, Industrial Liaison Program, and an online Alumni Association Faculty Forum.

Communications

Internal Communications Tool: Roundup Emails

In order to build community, department leadership and new communications officer Sara Cody improved internal communications through the development of so-called roundup monthly emails. A digest of news items that includes content submitted by the community (such as awards, honors, fellowships, recent publications, media mentions, fun lab activities, and the like) as well as news articles, videos, and images gathered from external sources, the email is sent by the department head each month, with the exception of January and July. This has proven successful on many levels, offering not only a visual and interactive source of information but also an effective platform of user-generated content that creates a sense of connection among community members.

Pandemic Response: Covid Updates

With extraordinary amounts of information pouring into the department from not only the Institute but also the Commonwealth of Massachusetts and federal governments, it was decided to offer the AeroAstro community a single COVID-19 daily update email, modeled after the Roundup email format. The purpose was to communicate information critical to operational, educational, and research efforts by summarizing Institute information, updates, and resources in an easily digestible format while also clarifying Institute messaging and putting it into context for AeroAstro. The update email was intended to be a reliable, consistent mechanism of communication that anchored the AeroAstro community to a central resource in order to be sensitive to information overload.

Pandemic Response: Virtualizing Events

Since the Institute shutdown in March 2020 and the cancellation of in-person events, any and all gatherings—small or large—have by necessity been virtual. Sara Cody has worked behind the scenes to keep the department connected, making the quick adjustment to a Zoom-centric world. The following are some of the many events offered via Zoom.

Newly Accepted Graduate Student Open House: March 13, 2020

Historically one of our most successful graduate student recruiting activities, the Grad Open House was the first event we needed to move online. To accomplish

this, we partnered with MIT Video Productions to host an interactive live stream for presentations and panels. Event materials were compiled on a microsite to centralize resources in an attempt to replicate the in-person event, including new student information, student volunteer bios, dorm room tour photos, and laboratory summaries with WebEx/Zoom login information, videos, photos, and so on. A newly-produced video about the graduate program also was premiered at the event.

Rescheduled Lectures

Later in the semester, the department hosted two lectures that had been rescheduled because of the shutdown. The first was a special lecture focusing on leadership, delivered by Deborah James, the 23rd Secretary of the US Air Force, on May 4, 2020. The second was the department's annual Lester D. Gardner Lecture featuring Charles Bolden, delivered on April 29, 2020.

Commencement: May 29, 2020

Immediately following MIT's Commencement event, AeroAstro hosted its own Virtual Commencement Celebration for 2020 department graduates via Zoom webinar. Daniel Hastings provided opening and closing remarks, the event featured well-wishes from notable AeroAstro alumni, and a photo slideshow of graduating Course 16 seniors, master's, and PhD students.

Human Resources

Visiting Appointment Restrictions

MIT announced that new appointments of visiting faculty, student, scholars, scientists, engineers, and affiliates would not be permitted during the fall 2020 and spring 2021 terms. Remote visiting appointments were also no longer options.

Travel and Visa Announcements

On March 11, 2020, the US government announced it was suspending entry into the United States for certain foreign nationals who had been physically present in the Schengen Area (which included most European countries) in the 14 days preceding their entry or attempted entry. This restriction went into effect on Friday, March 13, 2020.

On April 22, 2020, Donald Trump signed an executive order suspending entry of immigrants who presented a risk to the labor market during the COVID-19 outbreak. The proclamation narrowly restricted certain persons outside the US (including those with immigrant visa stamps issued by US Consulates after April 23) from entering the United States. The restrictions did not apply to nonimmigrant visas, including B, F, J, H, E, TN, or O visas.

On May 24, 2020, Trump issued a proclamation restricting travel to the US by individuals who had been to Brazil within the previous 14 days. The travel restriction, originally to take effect on May 28, was amended and took effect on May 26, 2020.

On June 22, 2020, Trump issued a proclamation, effective June 24, 2020, suspending entry by foreign nationals in certain J-1 categories and H-1B, H-2B, and L-1 workers until December 31, 2020.

AeroAstro Research Laboratories

The Aerospace Controls Laboratory (ACL) researches topics related to autonomous systems and control design for aircraft, spacecraft, and ground vehicles. Theoretical research is pursued in areas such as: decision making under uncertainty; path planning, activity, and task assignment; estimation and navigation; sensor network design; and robust control, adaptive control, and model predictive control. A key part of ACL is Real-time indoor Autonomous Vehicle test Environment (RAVEN), a unique experimental facility that uses a Vicon motion capture sensing to enable rapid prototyping of aerobatic flight controllers for helicopters and aircraft; robust coordination algorithms for multiple helicopters; and vision-based sensing algorithms for indoor flight. The lab's principal investigator (PI) is Jonathan How.

The Dynamics, Infrastructure Networks, and Mobility group at the Massachusetts Institute of Technology's Department of Aeronautics and Astronautics conducts research on topics related to the modeling, analysis, control, and optimization of modern infrastructure systems, including air traffic networks, airports, advanced aerial mobility, aircraft emissions modeling and mitigation, control of networked systems, and congestion management in transportation systems. The group's PI is Hamsa Balakrishnan.

The Communications and Networking Research Group (CNRG) designs network architectures that are cost-effective, scalable, and robust. CNRG is working on a wide range of projects in the area of networks and cyber-physical systems. An important aspect of the group's research is the development of architectures and algorithms that are optimized across multiple layers of the protocol stack. To that end, CNRG research crosses disciplinary boundaries by combining techniques from network optimization, machine learning, queueing theory, graph theory, network protocols and algorithms, and physical layer communications. The group's PI is Eytan Modiano.

There are three main thrusts to the research in the Model-Based Embedded and Robotics Systems group: goal-driven interaction with robots, natural human-robot teaming, and robotic reasoning about the environment. When combined, these research topics allow the creation of cognitive robots that can be talked to like another human, can work with a team member to finish a task, can recover from many failures without assistance, and can collaborate with a human to recover from a failure that the robot cannot solve alone. Researchers enable these cognitive robot abilities by using model-based techniques. At the heart of these techniques are engineering models of how the robot works, and models of how the robot's environment behaves. In addition to these models, researchers have developed algorithms that enable the robot to reason over how it believes the world works, much like humans do. The group's PI is Brian Williams.

The Reliable Autonomous Systems Lab at MIT group designs, analyzes, and verifies safe control systems. The work lies at the intersection of control theory, machine learning, and formal methods, with a particular focus on safety in systems with nonlinear, high-dimensional, and difficult-to-model dynamics. The lab's PI is Chuchu Fan.

The research goals of the Robust Robotics Group are to build unpersonned vehicles that can fly without global positioning systems (GPS) through unmapped indoor

environments, robots that can drive through unmapped cities, and social robots that can quickly learn what people want without being annoying or intrusive. Such robots must be able to perform effectively with uncertain and limited knowledge of the world, be easily deployed in new environments, and immediately start autonomous operations with no prior information. This engineering challenge will require algorithmic advances in decision-theoretic planning, statistical inference, and artificial intelligence. Researchers specifically focus on problems of planning and control in domains with uncertain models, using optimization, statistical estimation, and machine learning to learn good plans and policies from experience. The group's PI is Nick Roy.

The Space Telecommunications, Astronomy, and Radiation Laboratory is part of the Space Systems Laboratory. Researchers in the lab achieve new scientific results from sensors on distributed space-based platforms, innovating and using new commercial components to address technological challenges for future science missions, reducing cost and risk. Research focuses on weather sensing—development, operation, and analysis of data from nanosatellites that host miniaturized weather sensing instruments, such as microwave radiometers and GPS radio occultation receivers. They also study connectivity—developing the ability to support high-rate crosslink communications with precision timing/ranging between a large number of resource-constrained individual nanosatellite agents. Research also includes exoplanet detection and characterization, and nanosatellite technology. The lab's PI is Kerri Cahoy.

The Sensing, Perception, Autonomy, and Robot Kinetic Laboratory operates at the cutting edge of robotics and autonomous systems research with the goal of enabling human-level perception and world understanding on mobile robotics platforms (drones, self-driving vehicles, ground robots) operating in the real world. Toward this goal, a combination of rigorous theory and practical implementations is employed. Particular research interests include nonlinear estimation and probabilistic inference, numerical and distributed optimization, and geometric computer vision applied to sensing, perception, and decision making in single and multi-robot systems. The lab's PI is Luca Carlone.

The Wireless Information and Network Sciences Laboratory focuses on establishing a framework for cooperative network localization and navigation, determining the fundamental performance limits, developing distributed filtering algorithms, and designing error mitigation methods using measurement data. Cooperative network localization and navigation can achieve reliable and accurate location awareness, particularly in harsh environments. The lab's PI is Moe Win.

The Aerospace Computational Design Laboratory's (ACDL) mission is the advancement and application of computational engineering for the design, optimization, and control of aerospace and other complex systems. ACDL research addresses a comprehensive range of topics including advanced computational fluid dynamics and mechanics, uncertainty quantification, data assimilation and statistical inference, surrogate and reduced modeling, and simulation-based design techniques. The laboratory director is Youssef Marzouk and additional researchers include Dave Darmofal, Mark Drela, Adrián Lozano-Durán, Jaime Peraire, Qiqi Wang; and PIs Bob Haimes and Ngoc Cuong Nguyen.

The Astrodynamics, Space Robotics, and Controls Lab works at the intersection of astrodynamics, autonomy, and controls to further space exploration. The group's research topics include astrodynamics, space situational awareness and space traffic management, satellite guidance and navigation, estimation and controls, reinforcement learning, and optimal control. The lab's PI is Richard Linares.

The Design in Chaos group optimizes using simulations that exhibit chaotic dynamics, with particular interest in turbulent flows, simulated using high-fidelity computational fluid dynamics simulations. These include direct numerical simulation, large eddy simulation, and detached eddy simulation. The group's PI is Qiqi Wang.

Low-Energy Autonomy and Navigation (LEAN) is an interdisciplinary research group focusing on the co-design of algorithms and hardware for next-generation, low-energy autonomous vehicles. These vehicles include miniature robots such as insect-size flyers, water striders, and chip-size satellites, as well as high-endurance vehicles that can operate months or years at a time such as autonomous blimps, underwater gliders, soft robots, and printable robots. Autonomy capabilities for these vehicles will be unlocked by building their computers from the ground up, by co-designing the algorithms and hardware for autonomy and navigation. The LEAN research group has developed methods, algorithms, and computing hardware for visual-inertial navigation, motion planning, mutual information-based exploration, depth estimation, robot perception, and more. Sertac Karaman is the group's PI and Vivienne Sze is the group's co-director.

The Interactive Robotics Group (IRG) performs research in aid of creating a more harmonious human-robot interaction. In everyday settings, from factories to hospitals, it is increasingly common to see robots working alongside people. But because robots lack the intelligence to accommodate their more dynamic human partners, robots and humans work independently. In nearly every industry, the either/or tasking of people and robots results in massive inefficiency in producing goods and services. IRG seeks to enhance human capability to work with robots by designing machine intelligence that enables robots to work alongside humans as highly effective teammates. The group's vision is to harness the relative strengths of humans and robots to accomplish what neither can do alone. The group's PI is Julie Shah.

Founded in 1995, the Space Systems Laboratory engages in cutting-edge research projects with the goal of directly contributing to the present and future exploration and development of space. The objective of the laboratory is to explore innovative concepts for the design and integration of future space systems and to train the next generation of researchers and engineers. The lab's PI is Richard Linares while Dave Miller is on leave of absence; other lab members include Principal Research Scientist Becky Masterson and Alvar Saenz-Otero.

The Aerospace Plasma Group specializes in gas discharge and plasma physics phenomena, including their interaction with air and space-borne vehicles, and as technological solutions to different aerospace challenges. By combination of experimental, analytical, and numerical methods, the group's work aims to transition from empiricism to design by analysis in disciplines that have traditionally relied on

empiricism and testing (e.g., lightning strike protection of aircraft); and to facilitate the incorporation of plasma technologies in the aerospace field. Current research interests include lightning discharge to aircraft, nonthermal plasma technologies for combustion and propulsion, and the physics of different gas discharge regimes and their transitions. The group's PI is Carmen Guerra-Garcia.

The Engineering Systems Lab studies the underlying principles and methods for designing complex, socio-technical systems that involve a mix of architecture, technologies, organizations, policy issues, and complex networked operations. The group's focus is on aerospace and other systems critical to society such as product development, manufacturing, and large-scale infrastructures. The faculty director is Olivier de Weck and other faculty members include Nancy Leveson, Daniel Hastings, Edward Crawley, and affiliated faculty Danielle Wood.

- The System Architecture Group studies the early-stage technical decisions that will determine the majority of the system's performance. It also has helped architect systems from Earth observation networks to lunar surface exploration vehicles.
- The goal of the System Safety and Cybersecurity Group is to create new tools and processes that will allow people to engineer a safer world. Engineering safer systems requires multidisciplinary and collaborative research based on sound system engineering principles—requiring a holistic systems approach.
- The Strategic Engineering Research Group studies long-lived systems on Earth and in space. This includes the design and operation of critical infrastructures such as industrial manufacturing; transportation; Earth observation; defense; water, energy, and food supply systems; as well as the challenges of sustained human and robotic exploration and settlement of outer space.
- The Systems Engineering Advancement Research Initiative seeks to advance the theories, methods, and effective practice of systems engineering applied to complex socio-technical systems through collaborative research.

Research at the Gas Turbine Laboratory is focused on advanced propulsion systems and turbomachinery with activities in computational, theoretical, and experimental study of:

- Loss mechanisms and unsteady flows in fluid machinery
- Dynamic behavior and stability of compression systems
- Instrumentation and diagnostics
- Advanced radial fluid machinery for turbocharging, energy conversion, and rocket propulsion
- Gas turbine engine and fluid machinery noise reduction and aero-acoustic
- Novel aircraft concepts for reduced environmental impact
- Hybrid-electric propulsion systems for electrified aviation and power generation
- Multiphase and non-ideal fluid machinery design, such as supercritical carbon dioxide compressors

The lab's PIs are Zoltán Spakovszky and Edward Greitzer; senior research engineer is Choon Tan.

The Human Systems Laboratory (HSL) was originally founded in 1962 as the Man Vehicle Laboratory and was renamed in 2018. HSL performs research to improve the understanding of human physiological and cognitive capabilities to optimize human-system effectiveness and to develop appropriate countermeasures and evidence-based engineering design criteria. Research is interdisciplinary, using techniques from biomechanics, sensory-motor physiology, human performance assessment, human factors engineering, signal processing, artificial intelligence, and biostatistics. These methods are applied to space suit and exoskeleton design, wearable and virtual/augmented reality technologies, planetary mission resource utilization, space teleoperation, astronaut and pilot disorientation, artificial gravity, automation/autonomy, human-system task modelling, and display and control design. Systems evaluated include exoskeletons, aircraft, spacecraft, and vehicles. Jeffrey Hoffman is the professor of the practice for the lab.

The International Center for Air Transportation group has as its mission the improvement of safety, efficiency, capacity, and environmental performance of domestic and international air transportation and its infrastructure. With such a broad mandate, research areas are varied, including air traffic management, air transportation infrastructure and economics, aviation safety and weather, airline management and operations, human factors, flight instrumentation, and the environmental impact of aviation. The group's PIs are R. John Hansman, Hamsa Balakrishnan, Amedeo Odoni, and Peter Belobaba.

For more than two decades, the Laboratory for Aviation and the Environment (LAE) and its predecessors at MIT have developed methods that help understand and quantify the environmental impacts of aviation and of cognate industries (e.g., transportation and energy). In addition, LAE researchers apply their methods to quantify the costs and benefits of operational, regulatory, and technological mitigation options to reduce these impacts. The LAE team also assesses and develops novel technologies that help reduce the environmental footprint of aviation. The team is focused on the following fields: climate; air quality; fuels; and technology. The lab's director is Steven Barrett, the associate director is Raymond Speth; and the executive officer is Florian Allroggen.

The Space Propulsion Lab (SPL) has a strong program in both theoretical and experimental research in diverse types of propulsion systems and related technologies. It is because of the need to increase performance and reduce costs of space systems that a dynamic research environment in which advanced technologies are conceived and developed now flourishes, with a significant fraction of SPL's research focusing on the development and modeling of scalable space thrusters. The lab's PI is Paulo Lozano.

The Nano-Engineered Composite Aerospace Structures (necstlab, pronounced "next lab") research group explores new concepts in engineered materials and structures. The group's mission is to lead the advancement and application of new knowledge at the forefront of materials and structures understanding, with research contributions

in both science and engineering. Applications of interest include enhanced (aerospace) advanced composites, multifunctional attributes of structures such as damage sensing, and also microfabricated topics. A significant effort over the past decade has been to use nanoscale materials to enhance performance of advanced aerospace materials and their structures through the industry supported Nano-Engineered Composite Aerospace Structures Consortium. Brian Wardle is the group's PI.

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