ENVISION 2030

The Strategic Plan of the Division of Engineering and Applied Science at the California Institute of Technology

Caltech Mission

The mission of the California Institute of Technology is to expand human knowledge and benefit society through research integrated with education. We investigate the most challenging, fundamental problems in science and technology in a singularly collegial, interdisciplinary atmosphere, while educating outstanding students to become creative members of society.

EAS Vision

The EAS community works at the leading edge of fundamental science to invent the technologies of the future.

Cover: An artist's illustration of the concept of topological dissipation in a photonic resonator network. Credit: Nicolle R. Fuller, Sayo Studio

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Current EAS Landscape

Through our educational and research activities, the Division of Engineering and Applied Science (EAS) works at the leading edge of fundamental science to invent the technologies of the future.

EAS is the largest of Caltech's six Divisions in terms of number of faculty and declared undergraduate majors. The Division is home to seven departments: Aerospace (GALCIT), the Andrew and Peggy Cherng Department of Medical Engineering, Applied Physics and Materials Science, Computing and Mathematical Sciences, Electrical Engineering, Environmental Science and Engineering, and Mechanical and Civil Engineering. The Division operates two major laboratory centers: the Center for Autonomous Systems and Technologies (CAST) and the Kavli Nanoscience Institute (KNI); supports many non-laboratory-based centers and programs, including Information Science and Technology (IST), Sensing to Intelligence (S2I), and the Institute for Quantum Information and Matter (IQIM); and has many links to the Jet Propulsion Laboratory (JPL). Most of the research in the Division is supported by federal grants and contracts: we received $72.8 million in federal funding in fiscal year '21 and $66.6 million the previous fiscal year.

68% of Undergraduates

34% of Graduates

24.5% of Faculty

20% of Postdocs

16% of Staff

EAS as a part of Caltech

Of the overall Caltech population, 24.5% of faculty, 20% of postdoctoral scholars, 34% of graduate students, 68% of undergraduate students (not including first-year students), and 16% of the divisional administrative staff belong to EAS.

Strategic Planning as a Tool to Guide the Division

In 2019, the EAS Visiting Committee made a first-priority recommendation to the Division to develop a strategic plan. The development, implementation, and periodic updating of a comprehensive strategic plan with a 5- to 7-year time horizon is a top priority for EAS. Envision 2030 is designed to be a multi-year template to guide decision-making in several areas: faculty hiring, identification and support of priority research areas, teaching and curriculum, and the broad engagement of our community. The plan will be coupled to an effective communications strategy so that everyone—trustees, administration, faculty, students, staff, alumni, industry and government leaders, donors and foundation officials, as well as potential members of our community and the public at large—has an appreciation of our engineering mission, objectives, and strategy.

CORE VALUES

Integrity in research,
education, and mentoring

•

Excellence and leadership in
fundamental science and technology

•

Deliberate focus on areas where
EAS can fundamentally change
the intellectual landscape

•

Connections to the diverse array
of science programs at Caltech

•

A community which is inclusive,
diverse, and equitable

•

An open-minded and supportive community
based on relationships between individuals
unimpeded by bureaucracy

Embed Mathematics and Computing into Every EAS Discipline

Almost all EAS research and teaching rests on a strong quantitative and mathematical foundation.

However, the accelerating rate at which modern mathematical and computational methods — exemplified by data science, machine learning, and artificial intelligence — is providing new research opportunities presents a challenge. There is a need and an opportunity to widely deploy computational thinking and methods across every EAS department and academic option.

The EAS Division will consider what every engineering student and researcher should learn and know about modern mathematical and computational methods and assess and implement the most effective ways to bring appropriate depth in these areas to each department and research program in the Division.

Address Grand Challenges for Engineering and Society

The Division spans a diverse array of engineering disciplines and topical areas, resulting in a heterogeneous culture. Caltech's tradition of empowering its faculty as the Institute's Principal Investigators has led us to focus, in most research areas, at the scale of individual investigator programs and initiatives within a highly collaborative culture distinguished by low barriers to cross-disciplinary efforts. However, the nature of applied science and engineering demands thinking about how to connect the 'scientific push' of research at which Caltech excels to the 'societal pull' of increasingly complex and multi-dimensional large-scale challenges. With a desire

to bridge this gap to address engineering Grand Challenges in a multi-investigator mode, key activities that we have identified are:

Address climate change and the energy transition

Integrate and develop quantum information science and technologies for precision measurement

Create resilient physical infrastructure and information systems

Engineer an AI revolution in diverse fields including robotics, chemistry, astronomy, and biology

Design systems via fusion of sensing and large-scale computation

**Advance fluid mechanics and materials for hypersonics and space engineering**

Develop informatics-enabled medical devices, therapeutics, and solutions, including for cancer

Strengthen the connections between medical engineering and neuroscience

On an ongoing basis, we will foster discussion and a series of convocations on a prioritized set of grand-challenge themes that have the potential to change the perspectives of Caltech faculty, our peers, and colleagues throughout academia, industry, and the public sector. By developing these research initiatives, we will lay the groundwork for future large-scale collaborations that heighten the impact of EAS research and engage a broad audience to support and understand the Grand Challenges that we address.
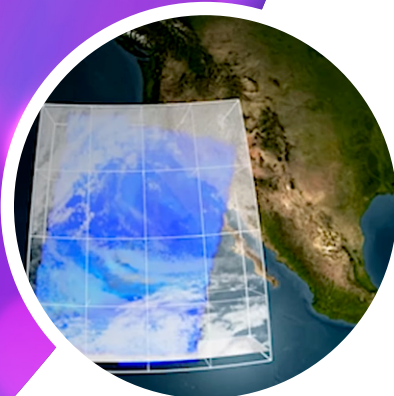
As an EAS community, identify engineering Grand Challenges suited to Caltech's strengths and characteristics, and develop an action plan for the Division to address these challenges.

Make Diversity a Strength

The EAS Division's approach to diversity is founded on the premise that powerful new ideas emerge from diverse groups operating in an inclusive and nurturing environment. The Division commits to engage in processes to improve the climate for all members, ensuring a climate where everyone can share their best ideas. The Division leadership needs to both reflect and support diversity, and will provide Division-level staffing and financial support for faculty hiring and initiatives to expand diversity and inclusion. In Caltech's research-intensive culture, the faculty set the tone for the research operations and environment; faculty commitment to increasing diversity is essential. The postdoctoral scholar and graduate student cohorts, which form the primary scientific and technical workforce for the Division, must also grow in diversity, as should the staff which supports all these groups.

Build an Inclusive, Equitable EAS Community

We believe our common pursuit of scholarship is enhanced by the unique perspectives and ideas arising from our individual identities. We are thus committed to providing equitable treatment and access to resources to each member of our community. We welcome and respect all members regardless of their role at Caltech or their race, gender, gender identity, sexual orientation, disability, neurotypicality, socioeconomic status, ethnicity, culture and family background, national origin, religion, immigration status, and parental status. We strive to promote diverse leadership within departments and centers and transparency in division-level decisions and practices.

Manage the COVID Disruption

The global pandemic has disrupted and altered the course of EAS research, teaching, learning, and staffing, and has also challenged the building of community, especially for those newly arrived to campus during this time. Thus, an immediate goal is to manage the on-going disruption to campus life, and the attendant repercussions on research, education, staffing, supply-chain, social and group activities, and individual well-being. Further, to become more resilient, we will absorb the lessons — both negative and positive — derived from changes to life under COVID.

Assess how EAS can most effectively foster diversity and inclusivity among all our constituencies, and identify best practices and mechanisms for the recruitment and inclusive support of a diverse community dedicated to Caltech's engineering mission.

Launch Faculty Searches in Broader Thematic Areas

The Division's typical hiring process is to allot searches to specific departments resulting in appointment of faculty to those departments, and this process serves EAS well in many cases. Because the Division's research and educational mission is inherently interdisciplinary, EAS will also launch faculty searches in broader thematic areas spanning traditional departmental boundaries and will compose search committees with representation from multiple departments, as appropriate to each thematic area. The Division will also respond to opportunities to expand the diversity of our faculty by continually searching for outstanding candidates from all backgrounds and quickly composing search committees to respond to such opportunities.

Renew the Graduate Student Recruiting Process and Enhance the Graduate Student Experience

As a Division, EAS educates the largest number of graduate students at Caltech. To foster excellence in the development of our cohort of graduate students,

departments will develop transparent and widely communicated criteria for student admission and will leverage Caltech's small size advantage to personalize recruitment to the greatest extent possible. Each department will also set objectives for expanding the diversity of its graduate student community and for enhancing the quality of the graduate student experience.

Enhance Staff Experience

Recognizing that a diverse, resilient, and excellent technical and administrative staff is necessary to support the educational and research mission of the Division, EAS will continue to explore ways to enhance our recruitment, training, and retention of outstanding staff members.
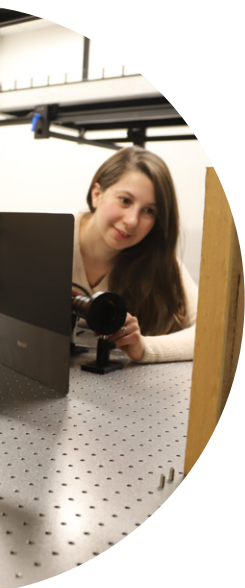
EDUCATION

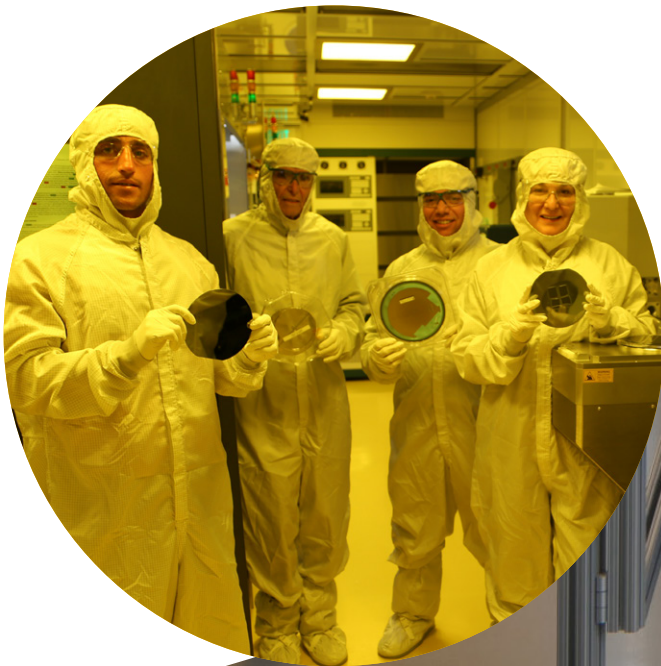# Enhance Undergraduate Teaching and Mentoring

Given our role of educating the largest fraction (by declared major) of Caltech's undergraduate population, EAS has a responsibility to foster an excellent and distinct educational experience for our undergraduate students. We will consider opportunities to further develop an undergraduate curriculum that enables students to focus on in-depth learning and that supports success for all EAS undergraduate students. In addition, the Division seeks to leverage Caltech's small size to create research-based extracurricular and personalized educational experiences for students, as well as to find new ways to deploy our instructional space to enhance learning and the student experience. Because teaching faculty play a significant role in the education and mentoring of large numbers of EAS undergraduates, support for teaching faculty is a priority.

Enhance Centers and Shared Facilities

EAS administers and/or supports centers and shared facilities that enable our international leadership position, including the Center for Autonomous Systems and Technologies (CAST), the Kavli Nanoscience Institute (KNI), the American Institute of Mathematics (AIM), Sensing to Intelligence (S2I), Information Science and Technology (IST), the Institute for Quantum Information and Matter (IQIM), the Keck Institute for Space Studies (KISS), and the Resnick Sustainability Institute (RSI). The Division will support the leadership and resource needs of our centers, and will remain alert to future needs, including expanded support for high-performance computing and facilities for the characterization of materials and devices.
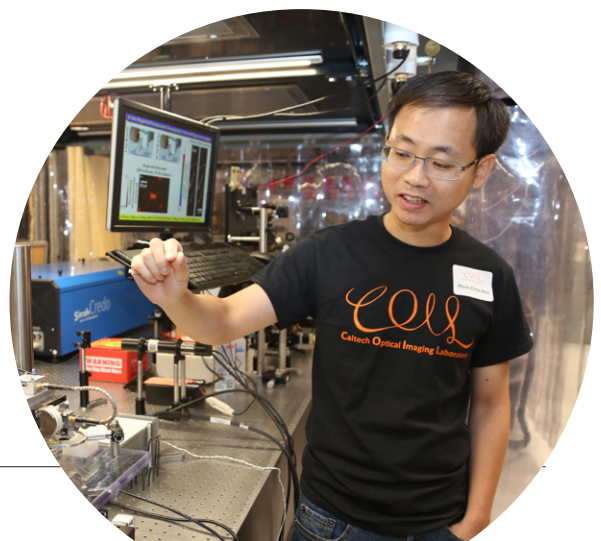
Expand External Partnerships

The Division's research mission leverages significant external partnerships, including those with JPL and the Office of Science at the DOE; key corporate partners such as Amazon Web Services, Amgen, and Boeing; and clinical researchers at the City of Hope, Cedars Sinai, UCSF, the Keck School of Medicine at USC, and the Geffen School of Medicine at UCLA. EAS will look to deepen and expand our partnerships to enable key goals such as responding to future opportunities for EAS participation in hub-scale and regional research centers, particularly in Grand Challenge areas, and supporting the burgeoning demand for high-performance computing.

METRICS and ASSESSMENT

The EAS Division will assess the success of this strategic plan by reviewing links between investments and commitments of human and financial resources to research and educational outcomes. On an annual basis, the Division Chair and the Division Executive Council will review (i) resource commitments; (ii) processes for implementation of new initiatives; (iii) the assessment and development of indicators for success by relevant EAS units; and (iv) key outcomes in each of the areas defined in this strategic plan.

EAS

Division of
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