Deshpande Center for Technological Innovation

The Deshpande Center for Technological Innovation serves as a catalyst for innovation and entrepreneurship by supporting the research of MIT faculty and students and facilitating collaboration with entrepreneurs, venture capitalists, and innovative businesses. It carries out its mission though several activities, including the Grant Program, the Catalyst Program, and sponsored events. The center's goal is to accelerate the movement of technology from the laboratories at MIT into the commercial marketplace where the technology can have an impact.

The Deshpande Center was founded in 2002 through a generous gift of $20 million from Jaishree and Gururaj "Desh" Deshpande, cofounder and chairman of Sycamore Networks. The center depends on the generous support of industry, the entrepreneurial community, and the MIT alumni communities to sustain its programs.

Executive Director Leon Sandler spearheads the Deshpande Center's efforts, along with Professor Timothy M. Swager, faculty director. Guidance is provided by a steering committee that includes Hillel Bachrach, founder and managing partner of 20/20 HealthCare Partners; Michael Cima, associate dean for innovation and professor of materials science and engineering; Charles Cooney, professor emeritus; Hemang Dave; Desh Deshpande; Mark Gorenberg, venture investor and member of the MIT Corporation; Helen He, founding partner of New Wheel Capital; Paul Jansen, medical device executive; Robert Langer, Institute Professor; and Lesley Millar-Nicholson, director of the MIT Technology Licensing Office and director of catalysts in the MIT Office of Strategic Alliances and Technology Transfer.

Highlights

In academic year 2021, the center continued to see more of its projects move toward commercialization. Since its inception, the Deshpande Center has funded more than 170 projects with more than $20 million in grants. Forty-four projects have spun out of the center into commercial ventures that have collectively raised more than $1 billion in outside financing.

In collaboration with the Abdul Latif Jameel Water and Food Systems Lab (J-WAFS), the MIT Deshpande Center for Technological Innovation managed the J-WAFS Solutions program and helped MIT faculty and students commercialize food- and water-focused technologies and invention. Teams worked on transforming promising ideas into innovative products and spinout companies. The J-WAFS Solutions program is sponsored by Abdul Latif Jameel Community Initiatives, which is represented on the governing committee of the program. Projects are required to align with the J-WAFS strategic research focus around water and food supply; research should be aimed at conceptualizing and developing products and services that will have a significant impact on water and food security with related economic and societal benefits.

Deshpande Grant Program Awards

The Grant Program provides research funds that permit MIT faculty and students to create and investigate new technologies and support the transfer of new knowledge and technologies from the Institute to young companies. The Grant Program consists of two types of awards: Ignition Grants of up to $50,000 and Innovation Grants of up to $150,000. Multiple experts in academia and industry review each application in the pre-proposal and full proposal stages. The center announces awards annually.

The Deshpande Center awarded 17 grants in fiscal year 2021 totaling $940,000. The awards support a wide range of emerging technologies and included 14 new and three renewal grants.

Ignition Grants

Ignition Grants target projects focusing on significant and potentially useful ideas in all areas of technology. Though it might enable only exploratory experiments to establish proof of concept, an Ignition Grant can position projects to receive further funding, such as an Innovation Grant, to take a concept to full development.

Innovation Grants

Innovation Grants benefit projects that have established proof of concept and identified a research and development path and intellectual property strategy. Each grant helps a project advance its technology and reduce technical and market risk. The goal is to reach a point where investors would invest in a startup to commercialize the technology or where an existing company might license the technology and develop it.

New Grant Recipients

Brian Anthony: Learned control of manufacturing processes

The control of a manufacturing process is critical in maintaining the consistent quality of materials or products. Machine learning, especially deep reinforcement learning, overcomes limitations of other control strategies by adapting to the characteristics of specific production equipment. This project will create a new level of manufacturing system performance using process control methods based on deep learning.

Natalie Artzi: Local hydrogel-mediated delivery of interventions for the treatment of glioblastoma

Glioblastoma is a lethal, aggressive brain cancer with a dismal median survival rate of 15 months. Tumor recurrence is inevitable after treatment—involving surgical resection followed by chemotherapy and radiation therapy—since it is impossible to eliminate all tumor cells using current strategies. This team is developing injectable, adhesive hydrogels that can be applied directly into the post-surgical cavity to mediate controlled local delivery of single and potential combination therapies. This technology will provide precise control over chemotherapy release kinetics and improve chemotherapy's brain biodistribution and selective uptake in tumor cells to enhance safety and efficacy.

Steven Barrett: Solid-state drones

Small autonomous aircraft, known more widely as drones, are being used widely. A major limitation in many potential applications is the noise from drone propellers. This team demonstrated in 2018 the first flight of a solid-state airplane (i.e., no moving parts), and showed that near-silent drone propulsion is possible for an approximately 10-second indoor flight. Since then, the team has developed the propulsion and power electronics technology needed for potentially useful missions. This project will focus on building and demonstrating a small drone that flies outside for 10 to 30 minutes, carrying a useful payload. Current uses of drones include medical supply delivery and surveillance, while potential uses include package delivery, building and structural inspection, environmental monitoring, and microdrones for indoor and military surveillance.

Ariel Furst: Single-cell encapsulation methods for enhancing microorganism viability
Probiotics, by definition, must be alive at the moment of administration, but processing methods cause significant cellular stresses and impact the viability of microorganisms. This becomes a major bottleneck in the commercialization of probiotics, specifically in the areas of manufacturing and storage. Coating probiotics to improve the microbial viability during processing and storage has shown promise. This team is developing a self-assembling, inorganic-organic hybrid cellular coating for the protection of microorganisms from stresses incurred in the manufacturing process. The coatings will passively protect cells from environmental pressures and actively combat destructive elements, including free radicals.

Satrajit Ghosh: Real-time speech modification system to enhance fluency in people who stutter
Stuttering affects about one percent of the worldwide adult population, or two million adults in the United States, and eight percent of children. For both adults and children the speech disorder has a debilitating impact on social interactions and economic productivity. This team has developed a portable solution by integrating embedded systems, signal processing technologies, and a neuroscientific model to reduce stuttering using novel alterations of auditory feedback during speech production. The goal is to eventually allow the user to speak more fluently without the device. This project aims to improve usability and better understand the practical and social hurdles of commercializing the technology.

Polina Golland: Noninvasive assessment of pulmonary edema using machine learning
Heart failure is the leading cause of hospitalization in the United States, with high readmission and mortality rates. Effective treatment for acute heart failure depends on the accurate measurement of fluid overload in the lungs, known as pulmonary edema, but this is challenging and costly. This team uses machine learning algorithms to automatically assess the severity of pulmonary edema from chest X-ray images. Combined with other clinical measurements, the project's unique fluid status visualization will provide accurate, noninvasive, longitudinal tracking of pulmonary edema and of patients' response to treatment. This visualization will enable physicians to deliver better targeted therapies.

Linda Griffith: Automated human oocyte cryopreservation device
Oocyte vitrification, or freezing eggs to preserve fertility, involves a highly trained human operator manually performing a series of delicate manipulations on the oocyte in order to successfully cryopreserve it. The sensitivity of the oocyte to the vitrification process makes the tolerance for error incredibly small; the manual process is highly operator-dependent and can result in hugely variable outcomes. Post-vitrification survival rates range anywhere from 85% at the best-equipped clinics to as low as 16.7%. Automation would improve outcomes and reduce costs. The project aims to design a fully automated oocyte vitrification system capable of successfully repeating the vitrification process in a reliable and standardized fashion by removing all human intervention.

Juejun Hu: Ultrawide field-of-view metasurface flat-optics platform
This project is developing novel metasurface flat optics for ultra-compact, high-performance optical imaging, sensing, projection, and display. The technology features a hemispherical 180-degree field of view; high-resolution, aberration-free performance over the entire field of view; a simple and ultra-compact architecture involving a single flat optical component; and a planar focal plane ideal for optical system integration. The architecture can be tailored for both detecting and emitting light beams over a wide range of operation wavelengths. It would enable applications such as ultrawide-angle 3D sensing, eye tracking, retinal imaging, light detection and ranging (LiDAR), and immersive augmented reality and virtual reality.

Jeremiah Johnson: Cleavable additives for degradable, recyclable thermoset plastics
Thermosets play a key role in the modern plastics industry, comprising about 18% of polymeric materials with a worldwide production of 65 billion tons per year. Their high density of chemical crosslinks results in excellent mechanical properties for high-performance applications but prevents them from being readily reprocessed once formed. As a result, the vast majority of these materials must be incinerated or sent to landfills. This team is developing recyclable versions of existing high-performance thermosets by incorporating small quantities of a degradable co-monomer. The team aims to provide a solution to significantly reduce the amount of plastic waste generated while creating new revenue streams from recovered plastics and reinforcing fibers, paving the way to a greener, more sustainable future.

Pattie Maes and Rosalind Picard: Augmentative communication technologies using naturalistic data and personalized machine learning
More than one million people in the United States are nonverbal or minimally verbal, including people with autism, Down syndrome, and other genetic disorders. These individuals may experience stress, frustration, and isolation when communicating in a society largely constructed around typical verbal speech. Yet, through nonspeech vocalizations, they can express rich affective and communicative information; their parents or primary caregivers are often able to interpret these sounds. Using a database of vocalizations from nonverbal and minimally verbal individuals and machine learning algorithms, this project is developing a full-feedback augmentative-communication system to “translate” non-speech sounds to speech. It would enhance communicative exchanges between nonverbal or minimally verbal individuals and the wider community.

Ellen Roche: Novel device for obstructive sleep apnea in Down syndrome
Obstructive sleep apnea (OSA) is marked by repetitive obstructions of the airway as muscle tone reduces during sleep. This team has created a custom-fit oral prosthesis with a pump that stabilizes the mouth muscles and prevents obstruction of the airway at night. The prosthesis could have a positive impact in particular for patients with Down syndrome, who have a high prevalence of OSA. Current treatments are cumbersome, uncomfortable, and disrupt the normal sleeping environment, leading to noncompliance among patients. Serious long-term consequences associated with lack of treatment for OSA in patients with Down syndrome include impaired cognitive development, reduced independence, and cardiovascular disease. The team’s goal is to provide a therapy that is discreet, comfortable for regular use, and effective in reducing apnea episodes.

Donald Sadoway: A prototype of low-cost aluminum molten salt battery for nonintermittent off-grid power supply
Renewable sources of energy, such as wind and photovoltaic solar, require storage batteries to deliver energy when the wind is not blowing or the sun is not shining. However, the high cost of batteries has limited their widespread deployment. This team aims to demonstrate a prototype of a radically new battery based on aluminum metal and common molten salt. With a target cost of electrodes and electrolyte below $10/kWh and a self-sustaining operating temperature of below 150°C, this battery would meet all the performance requirements of stationary electricity storage, including that of the single-family home.

Marin Soljačić: Wide-field-of-view chip-scale LiDAR for autonomous machines
Autonomous vehicles and machines have the potential to change the world, but they are limited by light detection and ranging (LiDAR) sensors that cannot meet the demands of cost, reliability, sensing performance, and scalability. This team is developing a next-generation LiDAR sensor that will enable autonomous machines and vehicles to see and navigate. Based on research in collaboration with MIT Lincoln Laboratory, this patented technology promises a solid-state LiDAR sensor that is higher performing, more reliable, truly scalable, and lower in cost than other solid-state sensors in development or on the market. The technology is based on a novel nanophotonic architecture that allows for a field of view of 160 degrees by 25 degrees and lower electronic complexity than other solid-state technologies.

Joel Voldman: Point-of-care integrated sample-sparing system for monitoring sepsis
Sepsis is a systemic inflammation that arises from serious bloodstream infection. In the United States, more than one million people are hospitalized annually for sepsis. It is a fast-moving disease, and there is currently no method of rapidly monitoring patients' sepsis state and responses to treatment. This team has developed and tested an integrated microfluidic system for the label-free isolation and downstream functional assessment of leukocytes from less than 50 microliters of peripheral blood in a few minutes. The method uses a microfluidic device that assesses leukocyte activation by measuring the electrical properties of the cells. The measurements from this approach were more highly correlated to sepsis severity than the current clinical practice of measuring peripheral blood leukocyte counts and differentials; the method additionally supplements vital signs monitoring by assessing the immune cell response. This project aims to commercialize a sepsis monitoring system based on this technology.

Catalyst Mentors

Volunteers from the business community, called Catalysts, are integral to the Deshpande Center's mission of helping MIT innovators achieve market impact.

Catalysts are a highly vetted group of individuals with experience relevant to innovation, technology commercialization, and entrepreneurship. They provide individual contributions to the center and do not represent any company interests in their role as Catalysts.

Catalysts are chosen based on the following qualifications:

- Experience in commercializing early-stage technologies and/or mentoring researchers and entrepreneurs, as well as industry expertise

- Willingness to provide assistance proactively to MIT research teams
- Willingness to abide by time commitment, confidentiality, and conflict-of-interest guidelines
- Commitment to the interests of MIT researchers and the Deshpande Center

All Catalysts must sign a guidelines document and agree to abide by the Deshpande Center's volunteer guidelines for managing privileged information and conflict of interest.

Deshpande Center Events

Through its sponsored events, the Deshpande Center seeks to bring together the components needed for MIT technologies to reach commercialization. These events connect faculty and students with members of the emerging technology industry.

IdeaStream

The Deshpande Center held its annual IdeaStream symposium on the weekend of April 14–15, connecting MIT researchers with the entrepreneurial community. Due to the coronavirus pandemic, IdeaStream was held as a virtual event. The symposium included presentations highlighting the research of each team, along with breakout sessions. IdeaStream was attended by entrepreneurs, industry executives, and MIT researchers. IdeaStream 2021 had the generous support of three corporate sponsors.

Catalyst Events

Near the start of each semester, the Deshpande Center arranges a small reception to celebrate the latest grant recipients. This event is held in advance of announcing the grant round to the general public. It is an opportunity for the grant recipient teams and Catalysts to meet and mingle with each other, staff, and other volunteers. All new grant recipients are also asked to give a brief pitch of their project.

Innovation Showcase and Open House

Due to the Covid-19 pandemic, the Deshpande Center did not host its premier fall event, the Innovation Showcase and Open House. Grant project teams usually exhibit a poster and share their research findings with attendees.

Other Collaborations

The Deshpande Center met with delegates from many national and international universities and organizations to discuss the center's approach to innovation and technology commercialization. Deshpande Center staff also spoke at numerous forums, conferences, and events; the center is seen as an internationally renowned model for stimulating technological innovation.

Within the MIT community, the Deshpande Center actively collaborates with other members of MIT's innovation ecosystem, including the Technology Licensing Office, the Martin Trust Entrepreneurship Center, the Venture Mentoring Service, the Industrial Liaison Program, the Sandbox, and numerous student organizations.

Leon Sandler
Executive Director