MIT Media Lab

The MIT Media Lab's 2017–2018 fiscal year began with its third annual summer event, Defiance, on July 21, 2017. This symposium attracted speakers and participants from around the world, including Bahraini human rights activist Esra'a Al Shafei, journalist and author Masha Gessen, European Parliament member Julia Reda, Pulitzer Prize-winning journalist and filmmaker Jose Antonio Vargas, the FBI's Edward You, and MIT Vice President for Research and Earle A. Griswold Professor of Geophysics Maria Zuber. The program included sessions on nonviolent resistance; immigration, citizenship, and identity; and the relationship between science and faith. In the closing session of the conference, Media Lab Director Joi Ito presented the first annual $250,000 Media Lab Disobedience Award, funded by LinkedIn co-founder Reid Hoffman. Out of more than 8,000 nominations, the selection committee chose Michigan pediatrician Mona Hanna-Attisha and Virginia Tech engineering professor Marc Edwards, who investigated and made public the problem of lead-tainted water in Flint, Michigan, and also exposed official misconduct in the crisis. Hanna-Attisha and Edwards donated the $250,000 prize to the people of Flint.

The quality of the applications led Hoffman to provide funds for three $10,000 honorable mentions. These were awarded to James Hansen—widely recognized as a pioneer of climate change research; the co-founders of Freedom University Georgia (Lorgia García-Peña, Betina Kaplan, Bethany Moreton, and Pamela Voekel); and the Water Protectors of Standing Rock (represented by LaDonna Brave Bull Allard, Phyllis Young, Jasilyn Charger, and Joseph White Eyes).

In FY2018, the lab established one new research group, Space Enabled, led by MIT and NASA alumna Danielle Wood. The group's work advances justice and development by improving designs for complex systems with designs enabled by space capabilities such as earth observation, microgravity, and systems engineering. The group works in collaboration with communities that are improving their use of complex systems in public service sectors such as environment, public health, education, and law enforcement.

We welcomed our newest cohort in the Director's Fellows program, now in its sixth year. Some of the 10 new fellows include Jamira Burley, a youth and social justice advocate; Ifeoma Fafunwa, founder and creative director of a Nigerian production company driving social change through performance art; Liz George, an "ancient photon wrangler" who builds instruments to study the universe; Giorgia Lupi, who designs engaging visual narratives that connect numbers to stories, people, and ideas; Julia Reda, a member of the European Parliament for the German Pirate Party; and Harper Reed, a hacker/engineer creating paradigm-shifting technologies and leading others to do the same.

Over the course of AY2018 we solicited nominations for the new Adventurous Science Fellowship via two concurrent efforts: sending email and paper-based invitations to more than 450 nominators, and a web-based call for nominations that ran for six months. The selection committee narrowed the 145 nominations to a short list of 11 candidates. We are currently soliciting and reviewing a last round of nominations before scheduling interviews with the short list candidates. The Media Lab will be scheduling interviews during fall 2018 and anticipate announcing the first cohort in early 2019.

In terms of diversity-focused programming, this past year the Media Lab engaged in efforts aimed at increasing discussion, support, and community at the lab. There was significant growth in MAS admission of underrepresented minority women—historically the smallest demographic at the lab. Also, in partnering with other MIT offices, the Media Lab was able to support new initiatives and encourage Media Lab participation in campus-wide activities.

Sampling of Media Lab Research

Agonist-antagonist Myoneural Interface (AMI): In order to create a more complete prosthetic control experience, researchers invented the agonist-antagonist myoneural interface (AMI), a method to restore proprioception to persons with amputation.

AlterEgo: This is a closed-loop, non-invasive, wearable system that allows humans to converse in high-bandwidth natural language with machines, artificial intelligence assistants, services, and other people—without opening their mouths and without externally observable movements—simply by vocalizing internally.

Dormio: This app uses a hand-worn sleep-stage tracking system, social robots' unique interactive and embodied capabilities, and auditory feedback on sleep-stage transitions to influence, extract information from, and extend hypnagogic microdreams. Users of the system dreamed about themes chosen by experimenters prior to subject sleep, and active use of hypnagogia—the transitional state from being awake to falling asleep—with the app can augment human creativity as measured by flexibility, fluency, elaboration, and originality of thought. This interaction is enabled by custom-built, open-source hardware and software tailored specifically for hypnagogia.

8K Brain Tour: This is an 8K (7680 x 4320 pixels) visualization system for terabyte-scale, 3D microscopy images of a brain slice that can facilitate neuroscience research. High-resolution, large-format (85 inch, or 188 cm x 106 cm) rendering allows the viewer to dive into the massive dataset of 700 billion voxels capturing thousands of neurons, and simultaneously investigate nanoscale and macroscale structures of the neurons.

Flexible Piezoelectric Devices for Gastrointestinal Motility Sensing: This is a design for an ingestible, flexible piezoelectric device that senses mechanical deformation within the gastric cavity. The work may lead to the development of ingestible piezoelectric devices to safely sense mechanical variations and harvest mechanical energy inside the gastrointestinal tract for the diagnosis and treatment of motility disorders, as well as for monitoring ingestion in bariatric applications.

Gender Shades: This research pilots an intersectional approach to inclusive product testing for AI. Automated systems are not inherently neutral. They reflect the priorities, preferences, and prejudices—the coded gaze—of those who have the power to mold artificial intelligence. The false assumption of machine neutrality presents the risk of losing gains made with the civil rights and women's movements.

In-Vivo Networking: These are new technology that can wirelessly power and communicate with tiny devices implanted deep within the human body. Such devices could be used to deliver drugs, monitor conditions inside the body, or treat disease by

stimulating the brain with electricity or light. The implants are powered by radio frequency waves, which are safe for humans. In tests in animals, results showed that the waves can power devices located 10 centimeters deep in tissue from a distance of one meter.

Voxel-Printing for the Digital Fabrication of Data Across Scales and Domains: A voxel-printing method enables the physical visualization of datasets commonly associated with scientific imaging. Leveraging voxel-based control of multi-material 3D printing, this method enables additive manufacturing of discontinuous data types such as point cloud data, curve and graph data, image-based data, and volumetric data. By converting datasets into dithered material deposition descriptions through modifications to rasterization processes, this research demonstrates that data sets frequently visualized on screen can be converted into physical, materially heterogeneous objects.

Programmable Droplets employs a lab-on-a-chip that uses electric fields to replace the tedious and costly process of manually moving liquid samples using disposable pipettes. The device will enable high-volume, low-cost biology experiments, drastically cutting the time and price of drug development and medical sample testing.

Seeing Through Realistic Fog: This is a method of seeing through dense, dynamic, and heterogeneous fog conditions. The technique, based on visible light, uses hardware that is similar to LiDAR (Light Detection and Ranging) to recover target depth and reflectance. The system relies on ultrafast measurements that are used to computationally remove inclement weather conditions such as fog. It then produces a photo and depth map as if the fog weren't there.

Shelley—Human-AI Collaborated Horror Stories: Can machines learn to scare us? Shelley is a deep-learning-powered AI trained on original horror stories from Reddit. Once trained, the AI takes a bit of inspiration in the form of a random seed, or a short snippet of text, and starts creating stories. The AI also works collaboratively with humans, learning from their nightmarish ideas, creating scary new tales.

The Spread of True and False Information Online: This is an investigation of the spread of all verified news stories—verified as either true or false—distributed on Twitter from 2006 to 2017. Contrary to conventional wisdom, robots accelerate the spread of both true and false news at the same rate. This implies that false news spreads more than the truth because humans—not robots—are more likely to spread it.

The Story Learning Machine: This project uses deep neural networks to identify emotional arcs in films and predict audience responses. The researchers are also developing methods to analyze how emotional and semantic narratives affect viewer engagement with these stories.

Tools for Recording High-Speed Brain Dynamics: This is a new robotic system that automates the process of recording electrical signals from inside neurons. Knowing how neurons communicate is fundamental to basic and clinical neuroscience. This technology aims to allow users to look at what is happening inside a cell in terms of neural computation.

Visits

Visiting dignitaries to the Media Lab in FY2018 included Justin Trudeau, prime minister of Canada; the crown prince of Saudi Arabia; Ashton Carter, the former United States secretary of defense; the mayor of Leipzig, Germany; Australia's chief scientist and head of Future Industries; and Admiral John Richardson. Other visitors included a delegation from the US Military Academy, the director of the Smithsonian Museum of Natural History, and the librarian of Congress. High-profile individual visits included actor Ashton Kutcher, actor and rapper Jaden Smith, screenwriter Paul Attanasio, and Dropbox co-founder and CEO Drew Houston. Visits from foundations included the Gates Foundation, Stavros Niarchos Foundation, Sunny Varkey Foundation, and the Wellcome Trust.

Media LabTalks

In its seventh year, the MLTalks series continued to bring speakers from unexpected and varied disciplines and areas of expertise to participate in live conversations with Media Lab director Joi Ito or other members of the Media Lab community. Talks this year included the following:

- Cecilia Conrad, head of the MacArthur Fellows Program

- Learning Initiative director Philipp Schmidt in conversation with Professors Danielle Bassett (bioengineering) and Perry Zurn (philosophy) of the University of Pennsylvania

- Award-winning scholar and New York Times best-selling author Ibram X. Kendi in conversation with Danielle Wood

- Harvard professor Jill Lepore in conversation with Media Lab associate director Andrew Lippman

- Faculty and alumni from Freedom University Georgia

- Science fiction author Neal Stephenson in conversation with the Space Exploration Initiative's Joe Paradiso and Ariel Ekblaw

- Harvard professor Martha Minow, Fr. Eric Salobir, the Venerable Tenzin Priyadarshi, Professor Max Tegmark, and Joi Ito

- Artist Lars Jan in conversation with Pattie Maes

- Conservation activist (and new Director's Fellow) Margarita Mora

Selection of Media Lab Events

Defiance (July 21, 2017), the Media Lab's third annual summer event, explored the impact of dissent. Activists, scientists, engineers, designers, legal experts, and leaders of institutions discussed the boundaries of nonviolent resistance for the benefit of a productive and healthy society.

The 53% Conference (September 5–6, 2017), an invitation-only convening of futurists, designers, technologists, researchers, public health experts, policymakers, and private

sector collaborators to re-imagine what is possible for the Special Supplemental Nutrition Assistance Program for Women, Infants and Children (WIC) program in the digital age.

The Boston University/MIT Technology and Cyberlaw Clinic (September 15, 2017) hosted its first open office hours of the year—a time when current MIT students can stop in with legal questions related to their research, ventures, projects, or other innovative activities.

Global Community Bio Summit (September 22–24, 2017). The Media Lab's new Community Biotechnology initiative held an international event on community biotechnology, aiming to provide a space for the global community of bio-hackers and members of independent and community laboratories to convene, plan, and build fellowship.

AI Afternoons (September 21 and 28, 2017). As part of the Ethics and Governance of Artificial Intelligence project, the Media Lab and Harvard's Berkman Klein Center co-hosted a series of gatherings, alternating between the lab and the center.

Muriel Cooper event (October 19, 2017). The Media Lab and MIT Press celebrated the design pioneer whose work continues to inspire outspoken creativity and positive change. Cooper's former colleagues, students, friends, and family explored the indelible mark she left on the field of graphic design and marked the 50th anniversary of Cooper joining the MIT Press as its first art director.

Zero-Gravity Research Flight (November 17, 2017). The Media Lab's Space Exploration Initiative chartered a zero-gravity research flight to allow students to conduct research experiments that make explicit use of the unique affordances of microgravity. This flight was the Initiative's first research deployment, and the first step toward realizing the mission statement of democratizing access to space. Projects ranged across disciplines, including design, architecture, engineering, biology, music, robotics, and beyond. The researchers are imagining and prototyping for humanity's future in space, beyond the basic concerns of survival.

City Science Lab @ TaipeiTech launch (November 28–30, 2017). The City Science group celebrated the launch of this long-term collaboration with the National Taipei University of Technology with a workshop focusing on smart mobility in urban environments.

Open Leadership Conference (November 28–December 1, 2017). This was a professional development program for senior leaders of nonprofit and public sector organizations which aimed to apply principles of open source, open innovation, and the decentralized nature of the Web to the way some of the most crucial social sector organizations work.

CivilServant Summit (January 27, 2018). Civic Media group alumnus and CivilServant founder J. Nathan Matias held the nonprofit's first community research summit on creating a safer, more understanding Internet through citizen behavioral science.

Here be Dragons (February 26–27, 2018). The Open Ocean initiative, in collaboration with the National Geographic Society, convened explorers, innovators, artists, scientists, storytellers, and students to identify the uncharted territories that still exist in ocean exploration and storytelling.

The Future of Wearables (February 28, 2018). Co-hosted by the Media Lab with member companies BP and IDEO, this workshop explored the possibilities and applications of technologies for augmenting and upgrading human capabilities over the next decade.

Beyond the Cradle (March 10, 2018). The Space Exploration Initiative's second annual event on envisioning a new space age.

Business of Blockchain (April 23, 2018). The Digital Currency Initiative, in collaboration with *MIT Technology Review*, hosted a one-day conference examining the technology, ethics, and impact of blockchains.

Make the Breast Pump Not Suck (April 27–29, 2018). The second installment of the Make the Breast Pump Not Suck Hackathon focused on equity and inclusive innovation in breastfeeding, and also included discussions related to family-leave policy.

Scratch Day took place on May 12, 2018 as part of the global network of events celebrating the Scratch programming language.

In/visible Health (June 6, 2018) was a day-long, hands-on workshop with the MIT Media Lab, IDEO, and the Robert Wood Johnson Foundation dedicated to exploring the future of health in complex systems.

Selection of Talks, Exhibits, and Performances

The Advancing Wellbeing Initiative hosted Justine Cassell (July 10), David Williams (September 6), Tam Vu (September 13), Mel Slater (November 16), Don Norman (November 17), and Robert Waldinger (December 11).

At a town hall meeting in Nantucket, MA (August 17, 2017) on preventing tick-borne diseases, Kevin Esvelt presented his research, asking for residents' questions and opinions to guide researchers in a plan to combat diseases such as Lyme disease using genetically engineered mice.

As a part of the AI Artificial Intelligence "The Other I" exhibition at the Ars Electronica Festival 2017, graduate student Xin Liu and postdoc Katia Vega demonstrated the DermalAbyss project in September 2017.

The Tangible Media group's latest programmable materials were on display at the Radical Atoms Exhibition at the Ars Electronica Center in Linz, Austria.

In January 2018, the Space Exploration Initiative presented research results from the 14 projects that flew on the inaugural zero gravity flight in fall 2017.

In February 2018, Canan Dagdeviren spoke on the panel "Women in Science and Diplomacy for Sustaining Peace and Development" as a part of the Equality and Parity in Science for Peace Development program at the United Nations Headquarters in New York City.

Tod Machover's *Philadelphia Voices* premiered on April 5, 2018 with The Philadelphia Orchestra (with subsequent performances April 6 and 7), led by its music director Yannick Nézet-Séguin, with four choirs representing Philadelphia-area choruses. The final performance of *Philadelphia Voices* took place in New York at Carnegie Hall on April 10, 2018, marking the first City Symphony presentation outside the city for which it was written.

In collaboration with the Department of Nuclear Science and Engineering and the MIT Media Lab, the MIT Program in Art, Culture and Technology presented Resynthesizer, a performance, installation, and public tour series of MIT Media Lab Professor Joe Paradiso's modular synthesizer, temporarily installed within MIT's internationally known Plasma Science and Fusion Center.

Communications

Traditional Press and Media Coverage

Media Lab projects and people continued to garner positive media coverage in national and international markets. Of particular note are a feature on the Media Lab on CBS's prime-time newsmagazine *60 Minutes*; a double-page spread in *The New York Times* on Joy Buolamwini's (Civic Media group) Gender Shades project; and a BBC News item on the Norman project (Scalable Cooperation group), which led to more than 100 global syndications. Other media outlets covering the lab include ABC News Online, *The Atlantic*, BBC News Online, BBC World, *The Boston Globe, Boston Herald, Business Insider*, CBC News, CNBC online, CNET, CNN Online, *CoinDesk, Deutsche Welle, Die Welt, Digital Trends, The Economist, El Mundo, El Pais, Engadget, Financial Times, Forbes, Gizmodo, The Guardian, Handelsblatt, Huffington Post, International Business Times, La Razon, La Vanguardia, Les Echos, MIT Technology Review, National Geographic, New Scientist, New York Post, The New York Times*, NPR, *The Observer, Politico*, RTE, *Scientific American*, Sky News, *Stuff, TechCrunch, The Telegraph, VentureBeat, The Washington Post, WIRED,* and *WirtschaftsWoche*.

Web Analytics

Website traffic more than doubled from FY2017. In FY17, the site had 2,370,260 pageviews and 1,802,875 unique pageviews. In FY 2018, the site had 5,550,716 pageviews and 4,296,052 unique pageviews. (A "pageview" is a view of a page on a site, as tracked by analytics tools. A "unique pageview" is the number of sessions during which that page was viewed once or more.) The communications group's new strategic plan to announce peer-reviewed research likely contributed to this substantial increase, as did interest generated by the *60 Minutes* feature and the Disobedience Award.

Social Analytics

The Media Lab gained more than 40,000 new Twitter followers and has a potential reach of 412,795,970 users. Top activity included several tweets with over 65,000 impressions. Facebook reach is approximately 200,000 users per month and Instagram reach is approximately 30,000 per month. The Media Lab had 2,186,236 total views on YouTube. Top videos were AlterEgo (556,518 views), Net Neutrality with Andy Lippman (146,918 views), and Programmable Droplets (31,893 views).

Finance

The Media Lab's annual operating budget of approximately $75 million represents an increase of approximately 3% over FY2017. With surpluses from prior years, the net asset balance is $27 million ($12 million of this with the lab director and $15 million with the research groups). Roughly 40% of funding came from the consortium ($31 million), which brought in a net annual membership revenue increase of $890,000. Sponsored project funding was $13 million and accounted for 17%of the FY2018 budget. Gift income came in at $23.6 million, an increase of $6.3 million or 37% over the previous fiscal year. The lab wrote off two members in FY2018 and after these write-offs holds a bad-debt reserve balance of $577,000 to protect from any downside risk. In all, FY2018 was a year of financial growth and one in which the lab has continued to automate business systems.

Members

In FY2018, the Media Lab welcomed 19 new member companies and organizations: MetLife; POLA Chemical Industries, Inc.; Agility; Ford Motor Company; Zoshinkai Holdings Inc.; Standard Industries; OMRON Corporation; Monetary Authority of Singapore; PMP Tech, Inc.; ATB Financial; PTC; Honeywell SPS; AT Kearney; Yokogawa Electric Corporation; Honda Research Institute Japan Co., Ltd.; American Express; Salesforce; and two additional anonymous companies.

Patents

In FY2018, the Media Lab filed 70 patent applications (Provisional, Ordinary, PCT [filed under the Patent Cooperation Treaty], and divisional) and 22 patents have been issued since July 1, 2017.

Directed Research

In FY2018, the Media Lab submitted 98 proposals for new or continuing directed research projects, including postdoctoral fellowships and no-cost collaborations. Approximately 38% of these proposals were for subawards in collaboration with other research institutions. Seventy proposals remain under consideration and 18 have resulted in awards. Sixty-three percent of the proposals submitted were in response to government solicitations, while the others were submitted to foundations and non-governmental sponsors. The new awards ranged up to $2.9 million, and spanned from one month to three years.

Human Resources

Morgan Binswanger joined the Media Lab this year as chief of program staff, managing new research initiatives. Ryan McCarthy was promoted to director of member relations, and Kelly Gavin has become the lab's point person for donors and alumni. Marissa Marcoux, contracts and intellectual property administrator, was recognized by the School of Architecture and Planning with an Infinite Mile Award this spring.

Joi Ito
Director

Media Lab Members

Consortium Research Lab Members

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Digital Garage

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Burroughs Wellcome Fund

Cold Spring Harbor Laboratory / NIH

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Harvard Medical School / NIH

Harvard University / Ford Foundation, US Department of the Interior

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