

MIT Industrial Liaison Program Faculty Knowledgebase Report

Health Science Technologies @MIT

March 23, 2021 10:00 am - 12:00
pm

10:00 AM

Welcome and Introduction
Sheryl Greenberg
Program Director, [MIT Industrial Liaison Program](#)



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Sheryl Greenberg initiates and promotes the interactions and development of relationships between academic and industrial entities to facilitate the transfer of new ideas and technologies between MIT and companies, and has created numerous successful partnerships. By understanding the business, technology, and commercial problems within a company, and understanding the technologies and expertise of MIT researchers, Greenberg identifies appropriate resources and expertise to foster new technology applications and collaborative opportunities.

Prior to MIT, Greenberg created and directed the Office of Technology Transfer at Brandeis University. In the process of managing intellectual property protection, marketing, and licensing, she has promoted the successful commercialization of technologies as diverse as new chemicals and manufacturing, biotechnology, food compositions, software, and medical devices. She facilitated the founding and funding of new companies, as well as creating a profitable technology transfer program. She also facilitated the patenting, marketing, and licensing of Massachusetts General Hospital technologies. In addition to her cellular, biochemical, and genetic research experience in academic and corporate environments, she has also created intellectual property for medical uses. Greenberg has been an independent intellectual property and business development consultant, is a U.S. Patent Agent, and has previously served the Juvenile Diabetes Research Foundation as Co-Chair of the Islet Research Program Advisory Committee and grant reviewer. She currently also mentors startup companies and facilitates partnering them with large life science and healthcare companies.

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10:05 AM

Teaching AI to cure the brain
Ernest Fraenkel
Professor, Biological Engineering
Associate Member, Broad Institute



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Ernest Fraenkel is a professor of biological engineering at MIT. His laboratory seeks to understand diseases from the perspective of systems biology. They develop computational and experimental approaches for finding new therapeutic strategies by analyzing molecular networks and clinical and behavioral data. Fraenkel received his PhD in biology from MIT after graduating summa cum laude from Harvard College with an AB in chemistry and physics.

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Rates of dementia and neurodegeneration are accelerating, with no therapies in sight despite record numbers of clinical trials. New approaches are desperately needed, built on radically different research paradigms. The convergence of new technologies at the interface of biological engineering and computer science create an opportunity for a fresh start. I'll describe a large-scale effort to understand and develop therapies for the neurodegenerative disease ALS. Our approach uses Artificial Intelligence to integrate clinical and molecular data, and can serve as a model for addressing other neurodegenerative diseases.

10:20 AM

A new paradigm for vaccine evaluation and design and its application to SARS-CoV-2

David Gifford

Professor, Electrical Engineering and Computer Science

Professor, Biological Engineering



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Professor, Electrical Engineering and Computer Science

Professor, Biological Engineering

David received his BS from MIT in 1976, and PhD from Stanford University in 1981. He joined the MIT faculty in 1982, where he is Professor of Computer Science and Engineering and Professor of Biological Engineering.

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We present combinatorial machine learning methods to evaluate and optimize peptide vaccine formulations using a solution to the maximum n-times coverage problem. We apply these new methods to design a peptide vaccine to induce cellular immunity to SARS-CoV-2, and show that our solution is superior to 29 other published COVID-19 peptide vaccine designs in predicted population coverage and the expected number of peptides displayed by each individual's HLA molecules. Our proposed SARS-CoV-2 MHC class I vaccine formulations provide 99.99% predicted population coverage with at least one vaccine peptide-HLA average hit per person with all vaccine peptides perfectly conserved across 4,690 geographically sampled SARS-CoV-2 genomes. Our proposed MHC class II vaccine formulations provide 95.62% predicted coverage with at least one vaccine peptide-HLA average hits per person with all peptides having an observed mutation probability of 0.001 . Our population coverage estimates integrate clinical data on peptide immunogenicity in convalescent COVID-19 patients and machine learning predictions. Our use of conserved viral sequences in vaccine designs is intended to make our vaccines effective against new viral strains. We are presently testing our vaccine designs in animal models.

10:35 AM

Fast modular manufacturing for protein biologics
J. Christopher Love

Raymond A. (1921) and Helen E. St. Laurent Professor, [MIT Department of Chemical Engineering](#),
Member, [Koch Institute for Integrative Cancer Research at MIT](#),
Associate Member, [Broad Institute of MIT and Harvard](#),
Associate Member, [Ragon Institute of MGH, MIT, and Harvard](#)



J. Christopher Love

Raymond A. (1921) and Helen E. St. Laurent Professor, [MIT Department of Chemical Engineering](#),
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J. Christopher Love is Professor of Chemical Engineering and a member of the Koch Institute for Integrative Cancer Research at MIT. He is also an Associate Member of the Broad Institute, and an Associate Member at the Ragon Institute of MGH, MIT, and Harvard. Love earned a BS in chemistry from the University of Virginia and a PhD in physical chemistry at Harvard University under the supervision of George Whitesides. Following completion of his doctoral studies, he extended his research into immunology at Harvard Medical School with Hidde Ploegh from 2004-2005, and at the Immune Disease Institute from 2005-2007. Dr. Love has been named a W.M. Keck Distinguished Young Scholar for Medical Research (2009), a Dana Scholar for Human Immunology (2009), and a Camille Dreyfus Teacher-Scholar. Prof. Love served as a Distinguished Engineer in Residence at Biogen from 2015-2016. He has co-authored more than 100 manuscripts and is an inventor on multiple patents.

Professor Love is co-founder of OneCyte Biotechnologies, HoneyComb Biotechnologies, and Sunflower Therapeutics. He serves as an advisor to SQZ Biotechnologies, Repligen, QuantrumCyte, and other companies.

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This talk will address how the intersection of biology-driven molecular and cell engineering with intensified integrated bioprocessing can address both speed and costs in protein-based biopharmaceutical and vaccine production. Strategies for next-generation biomanufacturing that rely on holistic design and implementation of production and purification will be discussed. A new model for shared development and advancement of the transformative biological systems will be presented.

10:50 AM

MIT Startup Exchange Lightning Talk

[Resolute Bio](#): Discovery platform optimizing peptide therapeutics

Allison Ackerman
CEO
[Resolute Bio](#)

MIT Startup Exchange Lightning Talk

[Vaxess](#): Novel vaccine patches for COVID-19 & more

Michael Schrader
Co-Founder and CEO, [Vaxess](#)

MIT Startup Exchange Lightning Talk

[LifeCanvas Technologies](#): End-to-end solution in 3D histology for research, drug discovery and anatomical pathology.

Rhie-young Lim
Co-founder & COO
[LifeCanvas Technologies](#)

MIT Startup Exchange Lightning Talk

[Volta Labs](#): Exponentially scaling genomic and genetic engineering

Udayan Umapathi
Co-founder & CEO
[Volta Labs](#)

Digital Transformation of Healthcare with Scalable Medicine
Zen Chu

Co-Founder and Faculty Director, [MIT Hacking Medicine](#)
Senior Lecturer, [MIT Sloan School of Management](#)



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Zen Chu serves as Faculty Director of MIT's [Hacking Medicine Initiative](#), and is a Senior Lecturer in Healthcare Innovation for both the MIT Sloan School of Management and Harvard-MIT Health Sciences & Technology program.

In partnership with Professors Martha Gray and Bill Aulet, Zen created and directs HST.978 MIT Healthcare Ventures, a graduate course that teaches entrepreneurship, business models, and venture creation around technology that can transform healthcare. Zen actively consults companies in pharma, health tech, and healthcare systems struggling to adapt to global digital healthcare transformation and emerging markets.

As managing director of [Accelerated Medical Ventures](#), Zen specializes in building early-stage medical technology and healthcare service companies, usually serving as cofounder and first investor. AMV's portfolio spans Boston, Silicon Valley, and China, including [PillPack.com](#), [Call9.com](#), [Figure1.com](#), [NuRx.com](#), [3D-Matrix Medical](#) [NASDAQ: 7777], [Sofi.com](#), Curoverse Genomics (acq Veritas Genomics), [BitGym.com](#), [DirectDermatology.com](#), and a few companies still in stealth mode.

Alongside MIT professors Shuguang Zhang, Alex Rich, Alan Grodzinsky, and Bob Langer, Zen cofounded and served as ceo for [3D-Matrix Medical Inc.](#), a venture-backed MIT regenerative medicine company with a successful IPO in 2011. 3D-Matrix has wound-healing and drug-delivery products on the market outside of the US and multiple human clinical trials in process.

He has managed and led new ventures for Harvard Medical School, Harvard's Wyss Institute for Bioengineering, NetVentures, and Hewlett-Packard. Zen earned a BS in biomedical/electrical engineering from Southern Methodist University and an MBA from Yale University. He is married to Katie Rae, a serial entrepreneur and CEO of MIT's Engine Fund. They are raising three aspiring entrepreneurs in Brookline, MA.

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Healthcare's tectonic shifts are forcing fundamental business model change to every one of it's players, both in the United States and globally. Medical and health technology — for decades derided as the driver of increased health costs — are now the key enabler of new products, re-imagined services and new business models to extend the reach and impact of healthcare. Digital tech and the telemedicine enabled by it have proven that health systems can bend the cost curve and accomplish the "Triple Aim" of increased access, better outcomes and lower costs with:

- New sensors and biometrics
- Connected medical devices
- Companion apps to therapeutics
- Re-designed care delivery models
- New business models
- Digiceuticals + Electroceuticals that compliment or replace traditional pharmaceuticals

11:25 AM

Mammalian synthetic biology and therapeutic applications

Ron Weiss

Professor, Biological Engineering

Director, MIT Synthetic Biology Center



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Professor, Biological Engineering

Director, MIT Synthetic Biology Center

Ron Weiss is Professor in the Department of Biological Engineering and in the Department of Electrical Engineering and Computer Science at the Massachusetts Institute of Technology, and is the Director of the Synthetic Biology Center at MIT. Professor Weiss is one of the pioneers of synthetic biology. He has been engaged in synthetic biology research since 1996 when he was a graduate student at MIT and where he helped set up a wet-lab in the Electrical Engineering and Computer Science Department. After completion of his PhD, Weiss joined the faculty at Princeton University, and then returned to MIT in 2009 to take on a faculty position in the Department of Biological Engineering and the Department of Electrical Engineering and Computer Science. The research pursued by Weiss since those early days has placed him in a position of leadership in the field, as evidenced both by publications from his lab as well as a variety of awards and other forms of recognition. He pursued several aspects of synthetic biology, including synthesis of gene networks engineered to perform *in vivo* analog and digital logic computation. The Weiss lab also published seminal papers in synthetic biology focused on programming cell aggregates to perform coordinated tasks using engineered cell-cell communication with chemical diffusion mechanisms such as quorum sensing. Several of these manuscripts were featured in a recent Nature special collection of a select number of synthetic biology papers reflecting on the first 10 years of synthetic biology. While work in the Weiss lab began mostly with prokaryotes, during the last 5 years a majority of the research in the lab shifted to mammalian synthetic biology. The lab focuses both on foundational research, e.g. creating general methods to improve our ability to engineering biological systems, as well as pursuing specific health related applications where synthetic biology provides unique capabilities.

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11:40 AM

Unveiling the mechanistic basis of human disease by combining computational and experimental techniques

Manolis Kellis

Member, Broad Institute of MIT and Harvard

Professor, [MIT Computer Science and Artificial Intelligence Lab](#)



Manolis Kellis

Member, Broad Institute of MIT and Harvard

Professor

[MIT Computer Science and Artificial Intelligence Lab](#)

Manolis Kellis is a professor of computer science at MIT, a member of the Broad Institute of MIT and Harvard, a principal investigator of the Computer Science and Artificial Intelligence Lab at MIT, and head of the MIT Computational Biology Group (compbio.mit.edu). His research includes disease circuitry, genetics, genomics, epigenomics, coding genes, non-coding RNAs, regulatory genomics, and comparative genomics, applied to Alzheimer's Disease, Obesity, Schizophrenia, Cardiac Disorders, Cancer, and Immune Disorders, and multiple other disorders. He has helped lead several large-scale genomics projects, including the Roadmap Epigenomics project, the ENCODE project, the Genotype Tissue-Expression (GTEx) project, and comparative genomics projects in mammals, flies, and yeasts. He received the US Presidential Early Career Award in Science and Engineering (PECASE) by US President Barack Obama, the Mendel Medal for Outstanding Achievements in Science, the NIH Director's Transformative Research Award, the Boston Patent Law Association award, the NSF CAREER award, the Alfred P. Sloan Fellowship, the Technology Review TR35 recognition, the AIT Niki Award, and the Sprowls award for the best Ph.D. thesis in computer science at MIT. He has authored over 280 journal publications cited more than 148,000 times. He has obtained more than 20 multi-year grants from the NIH, and his trainees hold faculty positions at Stanford, Harvard, CMU, McGill, Johns Hopkins, UCLA, and other top universities. He lived in Greece and France before moving to the US, and he studied and conducted research at MIT, the Xerox Palo Alto Research Center, and the Cold Spring Harbor Lab. For more info, see: compbio.mit.edu

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When combined, computational and experimental techniques can allow for the systematic discovery and characterization of functional elements in the human genome, the discovery and validation of the gene-regulatory circuitry controlling these elements, and the use of epigenomic information for annotating regulatory regions and their activity across different cell types. The progress of this approach, together with its impact on health science, will be discussed.

11:55 AM

Closing Remarks