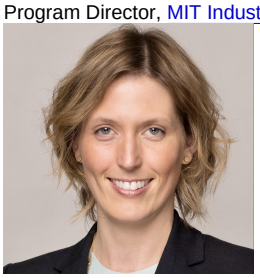
MIT Industrial Liaison Program Faculty Knowledgebase Report

Digital Health and Wellness

May 21, 2024 11:00 am - 1:00 pm

11:00 AM

Welcome & Introduction
Rebekah Miller
Program Director, MIT Industrial Liaison Program



Rebekah Miller
Program Director
MIT Industrial Liaison Program

Rebekah Miller joined the Office of Corporate Relations team as a Program Director in March 2022. Rebekah brings to the OCR expertise in the life sciences and chemical industries as well as in applications including sensors, consumer electronics, semiconductors and renewable energy.

Prior to joining the OCR, Rebekah worked for over a decade at Merck KGaA, most recently as a Global Key Account Manager in the Semiconductor division. Rebekah also served as Head of Business and Technology Development for the Semiconductor Specialty Accounts, during which time she led strategic planning and technology roadmapping.

While at Merck KGaA, Miller established a strong track record in industry-university partnerships, corporate entrepreneurship, and innovation management, with experience in roles spanning Technology Scouting, Alliance Management, and New Business Development. Early in her career, she led early phase R&D projects as a member of the Boston Concept Lab, which focused on technology transfer from academia.

Miller earned her B.A. in Chemistry and Biology from Swarthmore College and her Ph.D. in Chemistry, with a Designated Emphasis in Nanoscale Science and Engineering, from the University of California, Berkeley. She first joined MIT as a postdoctoral associate in the Bioengineering and Material Science Departments.

Miki Kato
Program Director, MIT Industrial Liaison Program

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Miki Kato joined the MIT Industrial Liaison Program as a Program Director in October 2021. Mr. Kato has over 20 years of experience in new business development, including various activities with MIT.

Prior to joining the ILP, Kato worked at FUJIFILM Corporation for 40 years in various new business development sectors. He was President of FUJIFILM Pharmaceuticals U.S.A., Inc., conducting the clinical trials of FUJIFILM pipeline drugs and leading the joint research project in drug delivery with MIT's Koch Institute. During his tenure, he also collaborated with the Department of Electrical Engineering at MIT for digital camera's CMOS image sensors and the Department of Materials Sciences and Engineering for high-speed photodetectors.

Kato has presented at several conferences at the Cambridge Innovation Center, including the 2018 Japan Innovation Forum with the Consulate General of Japan and the 60th-anniversary Kyoto-Boston sister city celebration Life Science Forum (2019) with the City of Boston, the Japan Society of Boston, and the Consulate General of Japan.

He holds an M.E. in Polymer Chemistry from Kyoto University and an M.S. in Management of Technology from MIT.

11:03 AM

Integrating Health Sensing, Device Fabrication and Human-Computer Interaction for Personal Health and Medical Devices

Junyi Zhu
Ph.D. Candidate
MIT Computer Science & Artificial Intelligence Laboratory (CSAIL)

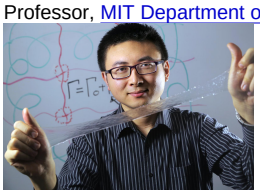
Doctors require biometric sensor data to improve diagnostic accuracy, monitor a patient's recovery progress, and make informed decisions about further treatment. Advances in electronics and sensing technologies have led to the development of remote monitoring devices, such as for ECG and blood pressure, which can collect biometric data outside of the clinic. However, these forms of systemic biometric signal monitoring only capture limited aspects of one's overall health, lacking detailed information on specific local body regions. In addition, individual patient health conditions are diverse and often complex. Thus, traditional sensing techniques, while effective for the broader population, often do not meet the unique needs of specific patient groups, especially for environments beyond clinic and home.

This presentation will highlight Dr. Zhu's advances in personalized health and medical monitoring systems that adapt to individual variance, focusing on the muscle engagement monitoring during unsupervised rehabilitation, with device and measurement setup customization based on the patient's regional body physique and use environment.

11:28 AM

Material Innovation for Ultrasound Patches

Xuanhe Zhao
Professor, MIT Department of Mechanical Engineering



Xuanhe Zhao
Professor
MIT Department of Mechanical Engineering

Xuanhe Zhao is a Professor of Mechanical Engineering at MIT. The mission of Zhao Lab is to advance science and technology between humans and machines to address grand societal challenges in health and sustainability. A major current focus is the study and development of soft materials and systems. Dr. Zhao has won early career awards from NSF, ONR, ASME, SES, AVS, Adhesion Society, JAM, EML, and Materials Today. He has been a Clarivate Highly Cited Researcher since 2018. Bioadhesive ultrasound, based on Zhao Lab's work published in Science, was named one of TIME Magazine's Best Inventions of the year in 2022. SanaHeal Inc., based on Zhao Lab's work published in Nature, was awarded the 2023 Nature Spinoff Prize. Over ten patents from Zhao Lab have been licensed by companies and have contributed to FDA-approved and widely-used medical devices.

View full bio

Continuous imaging of internal organs over days could provide unprecedented information about one's health and diseases and shed new insights into developmental biology. However, this is unattainable with existing wearable devices. Here, we report a bioadhesive ultrasound (BAUS) device, which consists of a thin and rigid ultrasound probe robustly adhered to the skin via a soft, tough, anti-dehydrating, and bioadhesive couplant. The BAUS device provides 48-hour continuous and simultaneous imaging of multiple organs including blood vessels, muscle, heart, gastrointestinal tract, diaphragm, and lung for the first time. The BAUS device could enable diagnostic and monitoring tools for various diseases, including hyper/hypotension, neuromuscular disorders, cardiac diseases, digestive diseases, and COVID-19. The long-term time-series imaging data of multi-organ correlations could provide a new system-level insight into human physiology. I will conclude the talk by proposing two challenges in science, technology, and medicine:

- Can we continuously image the full human body over days to months?
- Can we make ultrasound imaging an affordable wearable commodity for global health?

11:53 AM

Wearables and AI for Better Biomarkers and Health
Rosalind Picard

Professor of Media Arts and Sciences, MIT Media Lab
Director, Affective Computing Research, MIT Media Lab
Faculty Chair, MIT Mind+Hand+Heart
Co-founder, Empatica, Inc.
Co-founder Affectiva, Inc.

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Rosalind Picard, Sc.D., is a scientist, inventor, entrepreneur, author, professor and engineer. She is best-known for her book, Affective Computing, which proposed and described how to give skills of emotional intelligence to computers -- including voice assistants, robots, agents, and many kinds of interactive technologies. While trying to create ways to objectively measure data related to emotion, she pioneered wearable technologies to monitor and analyze physiological data in daily life, giving rise to new research and inventions at the intersection of wearables, physiology, and physical and mental health.

Picard is a named inventor on over a hundred patents, with impact that earned her recognition as both a member of the National Academy of Engineering and as a Fellow of the National Academy of Inventors. Her contributions include wearable and non-contact sensors, algorithms, and systems for sensing, recognizing, and responding respectfully to human affective information. Her inventions have applications in autism, epilepsy, depression, PTSD, sleep, stress, dementia, autonomic nervous system disorders, human and machine learning, health behavior change, market research, customer service, and human-computer interaction, and are in use by thousands of research teams worldwide as well as in many products and services.

She is founder and director of the MIT Media Lab's Affective Computing Research Group, where she teaches and mentors students in research. Her research and engineering contributions have been recognized internationally, also with election as a fellow to the IEEE, the ACM, the AAAC and the APA. Picard is the recipient of the 2022 International Lombardy Prize for Computer Science Research, which is described by many as the "Nobel prize in computer science". The Lombardy prize includes an award of a million euros, which Picard donated to research.

Picard has co-founded two successful businesses, Empatica providing FDA-cleared biomarkers, a platform for clinical trial data collection from wearables, and the first FDA-cleared smartwatch to detect seizures, and Affectiva, providing Emotion-AI technologies (now part of Smart Eye, AB). She serves on the Board of Directors of Empatica.

Picard interacts regularly with industry and has consulted for many companies including Apple, AT&T, BT, Harman, HP, i.Robot, Merck, Motorola, and Samsung. Her group's achievements have been featured in forums for the general public such as The New York Times, The London Independent, National Public Radio, Scientific American Frontiers, ABC's Nightline and World News Tonight, Time, Vogue, Wired, Forbes, Voice of America Radio, New Scientist, and BBC programs such as "Hard Talk" and BBC Horizon with Michael Mosley.

View full bio

This talk will highlight advances in digital health, including running AI on wearable data that captures physiological patterns in real life (e.g., with autonomic stress and sleep-activity rhythms) and accurately modeling changes related to brain states (e.g., mood changes, depression, and seizures). These advances are today enabling important health monitoring and alerting, and in the future, forecasting and prevention. This talk is informed by a combination of science and real-world trials leading to five FDA clearances, including an FDA-cleared AI algorithm *not* using generative AI, as the latter does not preserve truth or trustworthiness, two qualities we require. This talk will overview recent findings and platform developments, as well as ongoing work to apply objective data from daily patient life to improve healthcare, clinical trials, and personalized medicine.

12:18 PM

Development of an EEG Neurobiomarker Platform for Neurological and Psychiatric Disease

Jacob Donoghue
CEO & Co-Founder
Beacon Biosignals

12:28 PM

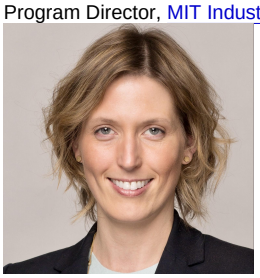
Continuous and Accurate Monitoring of Vital Functions for Patient Monitoring, Consumer Wellness, and Disease Prevention

Mohan Thanikachalam
Founder and CEO
Dynocardia Inc.

Dynocardia, Inc. is developing an innovative wearable device for continuous, accurate monitoring of blood pressure and heart function, with applications across healthcare markets.

12:38 PM

Panel Discussion: The Commercialization of Wearables
Rebekah Miller
Program Director, MIT Industrial Liaison Program



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1:00 PM	Closing Remarks and Adjournment