MATTHEW T. FLAVIN, PH.D.

Contact: mflavin@gatech.edu
Homepage: https://flavinlab.io

EDUCATION

Massachusetts Institute of Technology — Cambridge, MA
Ph.D. in Electrical Engineering — 2021
Committee: Jongyoon Han, Ph.D. (advisor); Charles Lissandrello, Ph.D.; Polina Anikeeva, Ph.D.; Dennis Freeman, Ph.D. — GPA: 5.00/5.00

Massachusetts Institute of Technology — Cambridge, MA
Master of Science in Electrical Engineering — 2017
GPA: 5.00/5.00

University of Illinois — Urbana–Champaign, IL
Bachelor of Science in Electrical Engineering — 2015
Minor in Bioengineering — GPA: 3.60/4.00
James Scholar (academic honors)

RESEARCH VISION

My aim is to develop powerful peripheral neural interfaces and mechatronic wearables that leverage advanced sensors and intelligent systems to address important and unresolved challenges in patient care.

RESEARCH POSITIONS

Georgia Institute of Technology — August 2024 **–** Present
Assistant Professor
Flavin Neuromachines Lab

Northwestern University — December 2021 – July 2024
Post-doctoral Researcher
John Rogers Research Group

Massachusetts Institute of Technology — June 2021 – December 2021
Post-doctoral researcher
Micro/nanofluidic and BioMEMS Research Group

Massachusetts Institute of Technology — August 2015 – May 2021
Doctoral researcher
Micro/nanofluidic and BioMEMS Research Group

GRANT ACTIVITY

Haptic Textiles for Patients with Motor and Sensory Disorders — 2024
Status: under review
Ralph E. Powe Junior Faculty Enhancement Award, Oak Ridge Associated Universities
Role: Principle Investigator

Brine Dispenser and Dilution Utilizing Novel Plunging Liquid Jet Reactor Incorporating Annular Riser 2024
Status: under review
Research Sector, Kuwait University
Role: Co-investigator

Full Freedom-of-Motion Haptic Actuators and Their Use in a Wireless System for VR Environments 2023
Status: awarded
Army (W911QY-20-R-0022)
Role: Co-investigator

Haptic neuro-prosthesis for spinocerebellar ataxia 2023
Status: awaiting site visit as a finalist
Raynor Cerebellum Project
Role: Co-investigator

High-frequency Electrical and Thermal Stimulation for Pain Management 2019
Draper Internal Research and Development Grant
Principle Investigator: Charles Lissandrello, Ph.D.
Role: Co-investigator

Focal Neuromodulation via Localized Ca^{2+} and Mg^{2+} depletion and enrichment 2016
BRAIN Initiative RFA-EY-16-001
Principle Investigator: Jongyoon Han, Ph.D.

Localized Modulation of Synaptic Activity Using Calcium Ion-selective Membrane Coated Electrodes 2015
Amar G. Bose research grant (MIT internal)
Principle Investigator: Jongyoon Han, Ph.D.
Role: Co-investigator

FELLOWSHIPS AND AWARDS

NIH Fellowship in Circadian and Sleep Research October 2023 – July 2024
Ruth L. Kirschstein Institutional National Research Service Award (T32)

Draper Laboratory Fellowship August 2015 – May 2021

NIH Brain Initiative Course on Models and Neurobiology July 2016

PEER-REVIEWED JOURNAL ARTICLES

M. Flavin,* K. Ha,* Z. Guo,* S. Li,* J. Kim,* T. Saxena, F. Al-Najjar, S. Bandapalli, C. Fan, D. Bai, Z. Zhang, J. Yoo, M. Park, J. Shin, A. Huang, H. Shin, Y. Huang, Z. Xie, H. Jiang, J. Rogers (*equal contribution), "Bioelastic state recovery for haptic sensory substitution," conditionally accepted in *Nature* as of August 2024.

J. Shin,* J. Song,* **M. Flavin**,* S. Cho,* S. Li,* A. Huang, J. Trueb, A. Yang, M. Kim, K. Nguyen, W. Sunng, H. Wang, A. Banks, J.-K. Chang, A. Paller, Y. Huang, G. Ameer, J. Rogers (*equal contribution), "An Approach for Continuous Monitoring of Molecular Flux Into and Out of The Skin," under first revision in *Nature* as of August 2024.

E. Flavin, S. Hwang, **M. Flavin**, "The effects of augmented reality use on mathematics achievement of K–12 students: A meta-analysis," under second revision in *International Journal of Science and Mathematics Education* as of August 2024.

E. Flavin, M. Chung, S. Hwang, **M. Flavin**, "Developing the area measurement reasoning of elementary students with augmented reality activities," under review in *Educational Technology Research and Development* as of August 2024.

E. Flavin, S. Hwang, **M. Flavin,** "Multi-dimensional engagement of Haitian immigrant parents in mathematics education," under review in *Educational Studies in Mathematics* as of August 2024.

E. Flavin, **M. Flavin**, "Developing augmented reality system for embodied mathematics learning," accepted in *Proceedings of the 46th Conference of the North American Chapter of the International Group for the Psychology of Mathematics Education (PME-NA)*, August 2024.

E. Flavin, **M. Flavin**, "Black feminist thought as a guide for ethical integration of artificial intelligence in mathematics classroom," accepted in *Connections*, August 2024.

M. Flavin,* J. Fernandes,* R. AlQabandi, E. Adams, J. Han, B. Al-Anzi (*equal contribution), “Numerical modeling of plunging jets of brine: mass transport and implications for desalination plant outfalls,” *Desalination*, vol. 568, 116996, Dec. 2023.

M. Park, J.-Y. Yoo, T. Yang, Y. Hwan Jung, A. Vázquez-Guardado, S. Li, J.-H. Kim, J. Shin, W.-Y. Maeng, G. Lee, S. Yoo, H. Luan, J.-T. Kim, H.-S. Shin, **M. Flavin**, H.-J. Yoon, N. Miljkovic, Y. Huang, W. King, and J. Rogers, “Skin-integrated systems for power efficient, programmable thermal sensations across large body areas,” in *Proceedings from the National Academy of Sciences of the United States of America*, vol. 120, no. 6, e2217828120, Jan. 2023.

M. Flavin, C. Lissandrello, J. Han, “Real-time, dynamic monitoring of selectively driven ion-concentration polarization,” in *Electrochimica Acta*, vol. 426, 140770, Sep. 2022.

M. Flavin, M. Paul, X. Lim, C. Lissandrello, R. Ajemian, S. Lin, J. Han, “Electrochemical modulation enhances the selectivity of peripheral neurostimulation in vivo,” in *Proceedings from the National Academy of Sciences of the United States of America*, vol. 119, no. 23, e2117764119, June 2022.

J. Yoon, **M. Flavin**, J. Han, “Current efficiency and selectivity reduction caused by co-ion leakage in electro-membrane processes,” in *Water Research,* vol. 201, 117351, Aug. 2021.

M. Flavin, M. Paul, X. Lim, S. Abdulhamed, C. Lissandrello, R. Ajemian, S. Lin, J. Han, “Rapid and low cost manufacturing of cuff electrodes,” in *Frontiers in Neuroscience*, vol. 16, 628778, Feb. 2021.

M. Flavin, D. Freeman, J. Han, “Interfacial ion transfer and current limiting in neutral-carrier ion-selective membranes: A detailed numerical model,” in *Journal of Membrane Science*, vol. 572, pp. 374-381, Feb. 2019.

K. I. Jang, H. U. Chung, S. Xu, C. H. Lee, H. Luan, J. Jeong, H. Cheng, G. T. Kim, S. Y. Han, J. W. Lee, J. Kim, M. Cho, F. Miao, Y. Yang, H. N. Jung, **M. Flavin**, H. Liu, G. W. Kong, K. J. Yu, S. I. Rhee, J. Chung, B. Kim, M. H. Yun, J. Y. Kim, Y. M. Song, U. Paik, Y. Zhang, Y. Huang, J. A. Rogers, “Soft network composite materials with deterministic, bio-Inspired designs,” in *Nature Communications*, vol. 18, no. 6, 6566, Mar. 2015.

S. Xu,* Z. Yan,* K. Jang, W. Huang, H. Fu, J. Kim, Z. Wei, **M. Flavin**, J. McCracken, R. Wang, A. Badea, H. Liu, D. Xiao, G. Zhou, J. Lee, H. U. Chung, H. Cheng, W. Ren, A. Banks, X. Li, U. Paik, R. G. Nuzzo, Y. Huang, Y. Zhang, J. A. Rogers, “Assembly of micro/nanomaterials into complex, three-dimensional architectures by compressive buckling,” in *Science*, vol. 347, no. 6218, pp. 154-159, Jan. 2015. (Cover Figure)

S. Xu,* Y. Zhang,* L. Jia,* K. E. Mattewson,* K. Jang, J. Kim, H. Fu, X. Huang, P. Chava, R. Wang, S. Bhole, L. Wang, Y. J. Na, Y. Guan, **M. Flavin**, Z. Han, Y. Huang, J. A. Rogers, “Soft microfluidic assemblies of sensors, circuits, and radios for the skin,” in *Science,* vol. 344, no. 6179, pp. 70-74, Apr. 2014.

PATENTS

J. Han, D. Freeman, **M. Flavin**, U.S. Patent Application 17/741,921, “Architectures and Methods for Electrochemical Neuromodulation,” 2022.

CLINICAL TRIALS

Multimodal haptic feedback for plantar sensory substitution April 20 – Present
Northwestern IRB # STU00218277
https://clinicaltrials.gov/study/NCT06232512
Role: Investigator

Evaluation of haptic feedback in a novel acoustomechanic device for behavioral scratch modification in atopic dermatitis Feb. 6 – Present
Northwestern IRB # STU0021480
Role: Investigator

CONFERENCE AND SEMINAR

E. Flavin, **M. Flavin**, "Developing an augmented reality system for embodied mathematics learning," under review in the North American Chapter of the International Group for the Psychology of Mathematics Education, 2024, Cleveland, Ohio.

M. Flavin, K. Ha, Z. Guo, S. Li, J. Kim, Y. Huang, Z. Xie, H. Jiang, J. Rogers, "Neural mechatronics and mixed reality for patient healthcare," presented (as a poster) at Gordon Robotics 2024, Ventura, California.

M. Flavin, J. Rogers, "Multimodal augmented reality," presented (orally) at Sustainable Laboratory Showcase 2023, Chicago, Illinois.

M. Flavin, M. Paul, X. Lim, S. Abdulhamed, C. Lissandrello, R. Ajemian, S. Lin, J. Han. "Selective nerve conduction block via focal delivery of high-frequency alternating current from a radial electrode array," presented (as a poster) at Gordon Bioelectronics 2019, Andover, New Hampshire.

M. Flavin, M. Paul, X. Lim, R. Ajemian, S. Lin, D. Freeman, J. Han, "Focal Manipulation of Neural Interstitial Ion Concentration Using Ion-Selective Membrane Electrodes," presented (orally) at the Fall meeting of the Material Research Society, 2017, Boston, Massachusetts.

M. Flavin, D. Freeman, J. Han, "Electrochemical neuromodulation using cuff electrodes modified with ion-selective membrane electrodes," presented (as a poster) at Neuroscience 2017, Washington D.C.

M. Flavin, D. Freeman, J. Han, "Mathematical Modeling of Ion Selective Membrane Systems Subject to Electrical Polarization," presented (orally) at the 232nd Electrochemical Society Meeting, 2017, New Orleans, Louisiana.

PROFESSIONAL AND EDITORIAL SERVICE

IEEE-EMBS BSN 2024 October 2024
Publications Co-chair, Organizing committee,

Kellog-Q residency February 2024 – July 2024
Mentoring two MBA students

PNAS Journal Club Panelist October 2022 – July 2024
Contributed to selections for PNAS's journal club segment
See: https://www.pnas.org/journal-club/journal-club-panelists

Peer review June 2022 – Present
Reviewed articles for *npj Digital Medicine* and *Science Advances*

Ph.D. advisor (Georgia Institute of Technology) August 2024 – Present
Led and trained two current students

Undergraduate student mentor (Georgia Institute of Technology) August 2024 – Present
Led and trained threee current students

Undergraduate student mentor (Northwestern University) December 2021 – July 2024
Led and trained six undergraduate students

Undergraduate student mentor (MIT) August 2015 – May 2021
Hired, trained, and mentored two undergraduate students

TEACHING ACTIVITY

Northwestern Teaching Assistant
Bioelectronics Lab (BME 354) Spring 2024

Outreach
Fairview Elementary Third Grade Class (https://twitter.com/dist57/status/1722418763155263993) Nov. 8, 2023
STEM for ALL Brockton Math education program Spring 2023

Guest Lecturer (Northwestern) Evanston, IL
Designing Product Interactions (DSGN 495-21) Fall 2022
Wearable Electronics (COMP_ENG 395, 495) Spring 2023

MIT Teaching Assistant Cambridge, MA
Biological Systems Modeling (20.334) Fall 2021
Cellular Neurophysiology and Computing (9.21) Fall 2020
Biological Systems Modeling (20.334) Fall 2017

MIT BE Data Lab Cambridge, MA
Fellow March 2020 – May 2021

TECHNICAL SKILLS

- Clean-room fabrication: photolithography, thin-film deposition, reactive-ion and wet etching
- Electrochemical characterization: electrochemical impedance spectroscopy (EIS), cyclic voltammetry (CV), ion-selective electrode (ISE) potentiometry, inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
- Fluorescence microscopy: widefield, confocal, two-photon, fluorescence lifetime imaging microscopy (FLIM)
- Biological wet-lab: microarray fabrication, cell culturing, EDC/NHS protein functionalization, plasmid amplification and transfection
- Rapid prototyping: CNC milling, 3D printing (FDM and SLA)
- Animal preparations: *ex vivo* bullfrog sciatic nerve, acute *in vivo* rat sciatic nerve, rat hippocampal neuron culture, rat dorsal root ganglion culture
- Embedded electronics design: fPCB design and fabrication, Bluetooth Low-energy (BLE) embedded software, mobile integration
- Numerical simulation: COMSOL Multiphysics, NEURON
- Programming languages (see https://github.com/mflav): Python, C, C++, Java, SystemVerilog, Haskell, Julia, Swift
- Mathematical packages: Mathematica, Matlab
- DAQ control: Labview, TDT RPvdsEx/Synapse
- CAD: SolidWorks, AutoCAD, Adobe Illustrator, EAGLE, Blender, Unity
- Other: fabrication and operation of microfluidic devices, GNU/Linux software development, statistical/machine learning

ADDITIONAL INFORMATION

Google scholar: https://scholar.google.com/citations?user=3VgPQZoAAAAJ
LinkedIn: https://www.linkedin.com/in/matthew-flavin-a6b52250/
Github: https://github.com/mflav
ORCiD: https://orcid.org/0000-0001-6636-0445
Homepage: https://flavinlab.io

REFERENCES

References available upon request