Matthew T. Flavin

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Matthew T. Flavin

Assistant Professor
School of Electrical and Computer Engineering

I. Earned Degrees

Massachusetts Institute of Technology 2021
Ph.D. in Electrical Engineering
Advisors: Jongyoon Han, Charles Lissandrello
Dissertation title: *Electrochemical modulation of peripheral nerves using ion-selective electrodes*

Massachusetts Institute of Technology 2017
M.S. in Electrical Engineering
Advisors: Jongyoon Han, Charles Lissandrello

University of Illinois, Urbana–Champaign 2015
B.S. in Electrical Engineering
James Scholar (academic honors)

II. Employment History

Georgia Institute of Technology 2024 – Present
Assistant Professor
School of Electrical and Computer Engineering

Northwestern University 2021 – 2024
Post-doctoral Researcher
Advisor: John A. Rogers

Massachusetts Institute of Technology 2021 – 2021
Post-doctoral researcher
Advisor: Jongyoon Han

III. Honors and Awards

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

Draper Laboratory Fellowship 2021

IV. Research, Scholarship, and Creative Activities

Asterisk (*) indicates work performed at Georgia Tech.

A. Published Books, Book Chapters, and Edited Volumes

No data.

B. Refereed Publications and Submitted Articles

B1. Published and Accepted Journal Articles

1. **M. T. Flavin**, J. A. Foppiani, M. A. Paul, A. H. Alvarez, L. Foster, D. Gavlasova, H. Ma, J. A. Rogers, S. J. Lin, "Bioelectronics for targeted pain management," *Nature Reviews Electrical Engineering*, 2025.*
2. J. Shin,† J. Song,† **M. T. Flavin**,† S. Cho,† S. Li,† A. Tan, K. R. Pyun, **A. G. Huang**, H. Wang, S. Jeong, K. E. Madsen, J. Trueb, M. Kim, K. Nguyen, A. Yang, Y. Hsu, W. Sung, J. Lee, S. Phyo, J.-H. Kim, A. Banks, J.-K. Chang, A. S. Paller, Y. Huang, G. A. Ameer, J. A. Rogers (†equal contribution), "A non-contact wearable device for monitoring epidermal molecular flux," *Nature*, vol. 640, pp. 375–383, 2025.*
    - Featured in 24 news outlets, including *The Hindu*, *AAAS EurekAlert!,* and *Science Daily*
3. K.-H. Ha, J. Yoo, S. Li, Y. Mao, S. Xu, H. Qi, H. Wu, C. Fan, H. Yuan, J.-T. Kim, **M. T. Flavin**, S. Yoo, P. Shahir, S. Kim, H.-Y. Ahn, E. Colgate, Y. Huang, J. A. Rogers, "Full Freedom-of-Motion Actuators as Advanced Haptic Interfaces," *Science*, vol. 387, no. 6741, pp. 1383-1390, 2025.*
4. E. Flavin, M. Chung, S. Hwang, **M. T. Flavin**, "Augmented Reality for Area Measurement Reasoning of Elementary Students," *Educational Technology Research and Development*, 2025.*
5. E. Flavin, S. Hwang, **M. T. Flavin**, "The effects of augmented reality use on mathematics achievement of K–12 students: A meta-analysis," *International Journal of Science and Mathematics Education*, vol. 72, pp. 2989–3020, 2024.*
6. **M. T. 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, "Bioelastic state recovery for haptic sensory substitution," *Nature*, vol. 635, pp. 345–352, Nov. 2024.*
    - Featured in 30 news outlets, including *AAAS EurekAlert!* and *Science Daily*
7. E. Flavin, **M. T. Flavin**, "Black feminist thought as a guide for ethical integration of artificial intelligence in mathematics classroom," *Connections*, vol. 34, no. 1, Sep. 2024.*
8. **M. T. Flavin**, J. Fernandes, R. AlQabandi, E. Adams, J. Han, B. Al-Anzi, "Numerical modeling of plunging jets of brine: mass transport and implications for desalination plant outfalls," *Desalination*, vol. 568, 116996, Dec. 2023.
9. 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. T. 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.
10. **M. T. Flavin**, C. Lissandrello, J. Han, "Real-time, dynamic monitoring of selectively driven ion-concentration polarization," in *Electrochimica Acta*, vol. 426, 140770, Sep. 2022.
11. **M. T. 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.

12. J. Yoon, **M. T. 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.
13. **M. T. 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.
14. **M. T. 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.
15. 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. T. 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.
16. S. Xu, Z. Yan, K. Jang, W. Huang, H. Fu, J. Kim, Z. Wei, **M. T. 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.
    - Featured in 11 news outlets, including *BBC News* and *News Week Japan*
    - Cover image
17. 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. T. 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.
    - Featured in 10 news outlets, including the *Huffington Post* and *CBS News*

B2. Conference Presentations with Proceedings (Refereed)

18. E. Flavin, **M. T. Flavin**, "Developing augmented reality system for embodied mathematics learning," in press in *Proceedings of the 46th Conference of the North American Chapter of the International Group for the Psychology of Mathematics Education (PME-NA)*, Cleveland, Ohio, Aug. 2024.*
19. **A. G. Huang**, J. Shin, S. H. Cho, J. A. Rogers, **M. T. Flavin**, "Wireless, Wearable System for the Continuous Monitoring of Epidermal Water Flux," in *IEEE-EMBS International Conference on Body Sensor Networks*, Chicago, IL, Oct. 2024.*

B3. Other Refereed Material

No data

B4. Submitted Journal Articles

20. K. E. Madsen,† **M. T. Flavin**,† J. A. Rogers (†equal contribution), "Materials Advances Supporting Massively Distributed Networks of Environmental Sensors," invited and under revision in *Nature Reviews Materials*, submitted 2024.

21. E. Flavin, S. Hwang, **M. T. Flavin,** “Lekòl, Legliz, Lakay: Haitian immigrant parental engagement in mathematics education,” under review in *Educational Studies in Mathematics*, submitted 2024.*

C. Other Publications and Creative Products

C1. Patents

C3.a. Patents Awarded

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

C3.b. Provisional Patents, Applications, and Invention Disclosures

M. T. Flavin, J. A. Rogers, K.-H. Ha, U.S. Provisional Patent Application 63/713,733. “Advanced Haptic Actuators and Systems,” 2024.

D. Presentations

D1. Invited Conference and Workshop Oral Presentations

Forthcoming* 2025
MRS-K Global Conference on Innovation Materials
Jeju Island, Korea

Haptic Sensory Augmentation for Patient Care 2025
InterfaceNeuro
Atlanta, GA

Workshop: Innovations in Sustainable Devices for Healthcare 2025
WISH X SUSMED conference 2025

Forceful haptics for information delivery, extended reality, and patient care* 2025
SPIE Soft Mechatronics and Wearable Systems
Vancouver, Canada

Workshop: Equity Driven Design Through Phantom Validation* 2024
IEEE-EMBS International Conference on Body Sensor Networks
Chicago, IL

D2. Invited Seminar Presentations

Neural Mechatronics and Mixed Reality for Patient Care 2024
Invited talk, University of Pennsylvania, ESE department

Neural Mechatronics and Mixed Reality for Patient Care 2024
Invited talk, Georgia Institute of Technology, School of ECE

Neural Mechatronics and Mixed Reality for Patient Care 2024
Invited talk, John Hopkins University, ECE Department

Neural Mechatronics and Mixed Reality for Patient Care 2024
Invited talk, University of Colorado, Boulder, ECEE Department

Neural Mechatronics and Mixed Reality for Patient Care 2024
Invited talk, Rensselaer Polytechnic Institute, ECSE and BME Departments

D3. Conference and Workshop Oral Presentations

Multimodal Augmented Reality 2023
Sustainable Laboratory Showcase, Chicago, Illinois.

Focal Manipulation of Neural Interstitial Ion Concentration Using Ion-Selective Membrane Electrodes 2017
Fall meeting of the Material Research Society, Boston, Massachusetts.

Mathematical Modeling of Ion Selective Membrane Systems Subject to Electrical Polarization 2017
232nd Electrochemical Society Meeting, New Orleans, Louisiana.

D4. Conference Posters and Demos

M. T. Flavin, K. Ha, Z. Guo, S. Li, J. Kim, Y. Huang, Z. Xie, H. Jiang, J. A. Rogers, "Neural mechatronics and mixed reality for patient healthcare," at *Gordon Robotics*, Ventura, California, 2024.

M. T. 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," at *Gordon Bioelectronics*, Andover, New Hampshire, 2019.

M. T. Flavin, D. Freeman, J. Han, "Electrochemical neuromodulation using cuff electrodes modified with ion-selective membrane electrodes," at *Neuroscience*, Washington D.C., 2017.

E. Grants and Contracts

E1. As Principal Investigator

Air pollution and inflammation: Empowering patients with real-time exposome tools Aug. 2025 – Aug. 2026
HERCULES Center, Emory University
Role: Principal Investigator
Collaborators: Aniruddh Sarkar (PI), Jeremy Sarnat (co-I)
$30,000 (share: 50%)

Mechatronics and Motivation VIP Seed Grant* Jan. 2025 – June 2026
Georgia Tech Vertically Integrated Projects
Role: Principal Investigator
Collaborators: Eunhye Flavin (co-PI)
$5,000 (share: 50%)

Faculty Support Funds Sep. 2024 – May 2025
Georgia Tech, School of Electrical and Computer Engineering
Role: Principal Investigator
$3,000 (share: 100%)

E2. As Co-Principal Investigator

No data

E3. As Senior Personnel or Contributor

Brine Dispenser and Dilution Utilizing Novel Plunging Liquid Jet Reactor Incorporating Annular Riser* Aug. 2025 – Aug. 2026
Research Sector, Kuwait University
Role: Consultant
Collaborators: Bader Shafaqa Al-Anzi (PI)
$25,500 (share: 0%)

Full Freedom-of-Motion Haptic Actuators and Their Use in a Wireless System for VR Environments Jan. 2025 – Jan. 2026
U.S. Army DEVCOM
Role: Co-investigator
Collaborators: John A. Rogers (PI)
$230,000 (share: 0%)

E4. Pending Proposals

Augmented Touch at a Distance: Intelligent, Impairment Body-Scale Haptics for Vision* Jan. 2026 – Jan. 2029
National Science Foundation
Role: Principal Investigator
Collaborators: Bruce Walker (co-PI)
$900,000 (share: 50%)

Sustainable Thermoregulation Strategies for Climate Change Resilience July 2025 – April 2027
Georgia Tech, Institute for Matter and Systems
Role: Co-Principal Investigator
Collaborators: Noura Howell (PI), Joe Bozeman (co-PI)
$80,000 (share: 33%)

Distant perceptual augmentation with intelligent body-scale haptics June 2025 – June 2028
Defense Advanced Research Projects Agency
Role: Principal Investigator
$1,000,000 (share 100%)

Bioelectronics for augmenting children's awareness of environmental hazards* Aug. 2025 – Aug. 2026
Emory University
Role: Principal Investigator
$12,000 (share: 100%)

E5. Proposals Submitted but Not Funded (Last Two Years)

A Pressing Need: Smart Haptic Clothing for Affective STEM Learning* June 2025 – June 2028
National Science Foundation
Role: Principal Investigator
Collaborators: Bruce Walker (co-PI), Eunhye Flavin (co-PI)
$900,000 (share: 50%)

Targeted pain management using an intelligent augmentative system of haptic wearables July 2025 – July 2026
Role: Principal Investigator
Collaborators: Anna Woodbury (co-I)
$50,000 (share: 80%)

Neural Mechatronic Interfaces for Regeneration 2024
The Curci Foundation
Role: Principal Investigator

Regenerative Neural Mechatronics 2024
Keck Foundation Research Program
Role: Principal Investigator

Haptic Textiles for Patients with Motor and Sensory Disorders 2024
Oak Ridge Associated Universities
Role: Principal Investigator

Haptic neuro-prosthesis for spinocerebellar ataxia 2023
Raynor Cerebellum Project
Role: Co-investigator
Collaborators: John A. Rogers (PI)

F. Other Scholarly and Creative Accomplishments

F1. Clinical Trials

Multimodal haptic feedback for plantar sensory substitution April 2023 – July 2024
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. 2023 – July 2024
Northwestern IRB # STU0021480
Role: Investigator

G. Societal and Policy Impacts

No data

H. Other Professional Activities

No Data

V. Education

A. Courses Taught

A1. Taught as Course Instructor

Semester, Year	Course Number	Course Title	Number of Students
Spring 2025	ECE2020	Fundamentals of digital design	75
Spring 2025	ECE4014	ECE Culminating Design	5

A2. Guest Lectures

Georgia Institute of Technology
Biomedical Sensing Systems (ECE 6781) Fall 2024

Northwestern University
Wearable Electronics (COMP_ENG 395, 495) Spring 2023
Designing Product Interactions (DSGN 495-21) Fall 2022

A3. Taught as Teaching Assistant

Semester, Year	Course Number	Course Title	Number of Students
Spring 2024	BME 354 (NU)	Bioelectronics Lab	20
Fall 2021	20.334 (MIT)	Biological Systems Modeling	15
Fall 2020	9.21 (MIT)	Cellular Neurophysiology and Computing	30
Fall 2017	20.334 (MIT)	Biological Systems Modeling	15

B. Individual Student Guidance

B1. Ph.D. Students **Start – Graduation**

B1.a. In Process Ph.D. Students

Aaron G. Huang Sep. 2024 – May 2028
School of Electrical and Computer Engineering
Awards: 2024 Presidential Fellowship

Dulani N. Wijayarathne Sep. 2024 – May 2028
School of Electrical and Computer Engineering

B2. M.S. Students **Start – Graduation**

B2.a. In Process M.S. Students

Fengyuan Shen Sep. 2024 – May 2026
School of Electrical and Computer Engineering
Non-thesis

Timothy Weigman Jan. 2025 – May 2026
School of Electrical and Computer Engineering
Thesis

Myong H. Chung Jan. 2025 – May 2026
School of Electrical and Computer Engineering
Non-thesis

B3. Undergraduate Students **Start – Departure**

Ethan Huang June 2025 – Present
Georgia Tech, ECE

Sarvesh Senthilkumar June 2025 – Present
Georgia Tech, ECE

Sam Allahverdi June 2025 – Present
Georgia Tech, ECE

Andrew Liu Sep. 2024 – Present
Georgia Tech, ECE

Amogh Kashyap Sep. 2024 – Present
Georgia Tech, ECE

Chinmay Bandapalli Jan. 2025 – Present
Georgia Tech, ECE

Nicholas Candello Jan. 2025 – Present
Georgia Tech, ECE

Tara Saxena Jan. 2022 – July 2024
Northwestern University, ME

Shishir Bandapalli June 2022 – Dec. 2023
Northwestern University, ME

Aaron G. Huang Sep. 2022 – July 2024
Northwestern University, ME

Winnie Sung June 2022 – Dec. 2023
Northwestern University, BME

Fatimah Al-Najjar Sep. 2022 – July 2024
Northwestern University, BME

Claire Lin Sep. 2017 – May 2018
Massachusetts Institute of Technology, EECS

Pedro La Rotta Sep. 2018 – May 2020
Massachusetts Institute of Technology, BE

B4. Service on Thesis or Dissertation Committees

B4.a. Internal

Student name	School	Advisor	Graduation
John A. Berkebile	ECE	Omer T. Inan	Spring 2025

B5. Mentorship of Postdoctoral Fellows or Visiting Scholars

No data.

C. Educational Innovations and Other Contributions

Vertically Integrated Projects (VIP) Jan. 2025 – Present
Teams: Mechatronics and Motivation (15 students)

Kellog-Q residency February 2024 – July 2024
Mentor for two MBA students

MIT BE Data Lab March 2020 – May 2021
Fellow

VI. Service

A. Professional Contributions

A1. Editorial Board Service

PNAS Journal Club Panelist October 2022 – July 2024
Contributed to selections for PNAS's journal club segment

A3. Organization and Chairing of Technical Sessions, Workshops, and Conferences

IEEE-EMBS BSN 2024 October 2024
Publications Co-chair, Organizing committee.
- Recognized for outstanding service

A4. Technical Journal or Conference Referee Activities

npj Digital Medicine 2024 – Present
1–2 reviews per year

Science Advances 2024 – Present
1–2 reviews per year

Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (PACM IMWUT) 2024 – Present
1–2 reviews per year

B. Public and Community Service

Fairview Elementary Third Grade Class Nov. 2023
Role: Lecture for students
See: https://twitter.com/dist57/status/1722418763155263993

***STEM for ALL Brockton* Math education program** Spring 2023
Role: Organizer and supervisor

C. Institute Contributions

C1. School Committee Service

Graduate Student Recruitment Committee Spring 2025
Bioengineering Technical Interest Group Representative

C2. Program Development: Research

Neuro IRI Fall 2024 – Present
Faculty
Hiring committee for IDEaS/INNS Research Engagement Manager

Petit Institute for Bioengineering and Bioscience IRI Fall 2024 – Present
Faculty

Institute for Robotics and Intelligent Machines IRI Fall 2024 – Present
Faculty

WISH Center Fall 2024 – Present
Faculty