Joshua H. Brake

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HMC Biophotonics Laboratory

Education

2019 **Ph.D., Electrical Engineering**, California Institute of Technology

2016 **M.S., Electrical Engineering**, California Institute of Technology

2014 **M.S., Engineering, Electrical Concentration**, LeTourneau University

2013 **B.S., Engineering, Electrical Concentration**, LeTourneau University

Academic Appointments

2025 – Present **Associate Professor of Engineering**, Harvey Mudd College

2019 – 2025 **Assistant Professor of Engineering**, Harvey Mudd College

Leadership Positions

2025 – Present **Director, Innovation Accelerator Lab for Imaginative Prototyping with AI (IPAI)**, Harvey Mudd College

Co-Director, AI Experimentation Laboratory (AXL), Harvey Mudd College
With Nancy Lape, Ken Fandell, and Julie Medero.

Professional Experience

2024 – Present **Venture Partner for AI**, Praxis, New York, NY

2021 – 2022 **Embedded systems development and testing**, Aquillius Corporation, San Diego, CA

2020 **Electrical engineering testing and support**, Jetpack Aviation, Chatsworth, CA

2016 **R&D Intern, Advanced Technology Development**, Instrumentation Laboratory

Publications

* Indicates shared first authorship.

JOURNAL PAPERS

2024 J. Branning, Jr., K. Faughnan, A. Tomson, G. Bell, S. Isbell, A. DeGroot, L. Jameson, K. Kilroy, M. Smith, R. Smith, L. Mottel, E. Branning, Z. Worrall, F. Anderson, A. Panditaradyula, W. Yang, J. Abdelmalek, **J. Brake**, K. Cash. "Multifunction Fluorescence Open-Source In Vivo/In Vitro Imaging System (openIVIS)." *PLOS ONE (2024).* doi:10.1371/journal.pone.0299875

2022 H. Ayaz, W. B. Baker [and 58 others, including **J. Brake**]. "Optical imaging and spectroscopy for the study of the human brain: status report." *Neurophotonics 9(S2), S24001 (2022).* doi:10.1117/1.NPh.9.S2.S24001

S. Gigan, O. Katz [and 43 others, including **J. Brake**]. "Roadmap on wavefront shaping and deep imaging in complex media." *Journal of Physics: Photonics (2022).* doi:10.1088/2515-7647/ac76f9

A. Abdelfattah, S. Ahuja [and 69 others, including **J. Brake**]. "Neurophotonic tools for microscopic measurements and manipulation: status report." *Neurophotonics 9(S1), 013001 (2022).* doi:10.1117/1.NPh.9.S1.013001

2020

J. Xu*, A. K. Jahromi*, **J. Brake***, J. E. Robinson, C. Yang. "Interferometric speckle visibility spectroscopy (ISVS) for human cerebral blood flow monitoring." *APL Photonics 5, 126102 (2020).* doi:10.1063/5.0021988

Y. Huang, M. Cua, **J. Brake**, Y. Liu, C. Yang. "Investigating ultrasound–light interaction in scattering media." *Journal of Biomedical Optics 25(2), 025002 (2020).* doi:10.1117/1.JBO.25.2.025002

2018

M. Jang*, Y. Horie*, A. Shibukawa*, **J. Brake**, Y. Liu, S. M. Kamali, A. Arbabi, H. Ruan, A. Faraon, C. Yang. "Complex wavefront shaping with disorder-engineered metasurfaces." *Nature Photonics 12(2), 84–91 (2018).* doi:10.1038/s41566-017-0078-z

2017

H. Ruan*, **J. Brake***, J. E. Robinson, Y. Liu, M. Jang, C. Xiao, C. Zhou, V. Gradinaru, C. Yang. "Deep tissue optical focusing for optogenetic applications with time-reversed ultrasonically encoded light." *Science Advances 3(12), eaao5520 (2017).* doi:10.1126/sciadv.aao5520

H. Ruan, T. Haber, Y. Liu, **J. Brake**, J. Kim, J. M. Berlin, C. Yang. "Focusing light inside scattering media with magnetic-particle-guided wavefront shaping." *Optica 4(11), 1337–1343 (2017).* doi:10.1364/OPTICA.4.001337

M. M. Qureshi*, **J. Brake***, H.-J. Jeon, H. Ruan, Y. Liu, A. M. Safi, T. J. Eom, C. Yang, E. Chung. "In vivo study of optical speckle decorrelation time across depths in the mouse brain." *Biomedical Optics Express 8(11), 4855–4864 (2017).* doi:10.1364/BOE.8.004855

2016

E. H. Zhou, A. Shibukawa, **J. Brake**, H. Ruan, C. Yang. "Glare suppression by coherence gated negation." *Optica 3(10), 1107–1113 (2016).* doi:10.1364/OPTICA.3.001107

J. Brake*, M. Jang*, C. Yang. "Analyzing the relationship between decorrelation time and tissue thickness in acute rat brain slices using multispeckle diffusing wave spectroscopy." *Journal of the Optical Society of America A 33(2), 270–275 (2016).* doi:10.1364/JOSAA.33.000270

2015

D. Wang, E. H. Zhou, **J. Brake**, H. Ruan, M. Jang, C. Yang. "Focusing through dynamic tissue with millisecond digital optical phase conjugation." *Optica 2(8), 728–735 (2015).* doi:10.1364/OPTICA.2.000728

CONFERENCE PAPERS

2022

A. Vercruysse, M. W. Miller, **J. Brake**, D. Harris. "A Tutorial-style Single-cycle Fast Fourier Transform Processor." *Proceedings of the 2022 Great Lakes Symposium on VLSI (GLSVLSI '22), Irvine, CA.* doi:10.1145/3526241.3530329

2021

D. Harris, **J. Brake**, S. L. Harris. "A Digital Design and Computer Architecture MOOC." *ACM/IEEE Workshop on Computer Architecture Education (WCAE) (2021).* doi:10.1109/WCAE53984.2021.9707613

2020

K. Pezeshki, C. Norfleet, E. Meike, T. Jenrungrot, M. Spencer, **J. Brake**, D. Harris. "A Board and Projects for an FPGA/Microcontroller-Based Embedded Systems Lab." *Proceedings of the 2020 Great Lakes Symposium on VLSI (GLSVLSI '20), virtual.* doi:10.1145/3386263.3406930

BOOKS AND BOOK CHAPTERS

2021 **J. Brake**, D. Harris, S. Harris. "Chapter 9: Embedded I/O Systems." *Digital Design and Computer Architecture: RISC-V Edition. Morgan Kaufmann, 2021.*

2012 **J. Brake**. "The Engineer's Guide to Introductory Circuit Analysis." *New York: McGraw-Hill, 2012.*

PATENTS

2024 **Interferometric speckle visibility spectroscopy**
US11867505B2. Granted January 9, 2024.

2022 **Interferometric speckle visibility spectroscopy**
US20200386535A1. Granted May 31, 2022.

2019 **Glare suppression through fog by optical phase conjugation assisted active cancellation**
US10194100B2. Granted January 29, 2019.

Invited Talks

2026 **The Metaphor is the Message**, Baylor Institute for Faith and Learning Symposium

Cooking with Claude

2025 **What Is a Better Future?**, Harvey Mudd College Convocation

Cultivating a Convivial Classroom in the Age of AI, MIT Teaching + Learning Lab

What Happens When You Try To Out-Shovel God, Biola University Chapel

Cultivating Socio-Technical Thinkers, Octet Collaborative

Artificial Intelligence and Christian Education, Taylor University Board of Trustees

Christian Education in the Age of AI, Vancouver College

2024 **AI and Human Flourishing**, LeTourneau University Faith, Science, and Technology Initiative

He's Got A Bigger Shovel, LeTourneau University Chapel

2023 **The Power of the Prototyping Mindset**, Harvey Mudd College, Mudd Talks

Talking Teaching: ChatGPT (with W. Menefee-Libey), Harvey Mudd College

Conference Presentations and Posters

2022 **J. Brake**. "Teaching Optics with 3D-printed Microscopes." *Gordon Research Conference: Image Science. Newry, ME, July 2022.*

2019 **J. Brake**, J. Xu, A. K. Jahromi, C. Yang. "Interferometric speckle visibility spectroscopy for improved measurement of blood flow dynamics." *Engineering Conferences International: Advances in Optics for Biotechnology, Medicine and Surgery XVI. Mont Tremblant, Quebec, June 2019.*

J. Brake, C. Yang. "Optical Scattering in Biomedicine: Friend and Foe?" *Physics of Quantum Electronics. Snowbird, UT, January 2019.*

2018 **J. Brake**, H. Ruan, J. E. Robinson, Y. Liu, V. Gradinaru, C. Yang. "Deep-Tissue Optical Focusing for Optogenetics Using Wavefront Shaping." *Gordon Research Seminar: Image Science. Easton, MA, June 2018.*

J. Brake, H. Ruan, J. E. Robinson, Y. Liu, V. Gradinaru, C. Yang. "Time-reversed ultrasonically encoded (TRUE) focusing for deep-tissue optogenetic modulation." *SPIE Photonics West, BiOS. San Francisco, CA, January 2018.*

2017 **J. Brake**. "Wavefront shaping in living tissue." *Engineering Conferences International: Advances in Optics for Biotechnology, Medicine and Surgery XV. Aspen, CO, July 2017.*

2016 **J. Brake**, M. Jang, C. Yang. "The relationship between decorrelation time and sample thickness in acute rat brain tissue slices." *SPIE Photonics West, BiOS. San Francisco, CA, February 2016.*

2015 S. Cho, **J. Brake**, C. Joy, S. Kim. "Refractive index measurement using an optical cavity based biosensor with a differential detection." *SPIE Photonics West, BiOS. San Francisco, CA, February 2015.*

2014 **J. Brake**, S. Kim. "An optical cavity based biosensor with chained differential detection to improve sensitivity and fabrication tolerance." *SPIE Photonics West, BiOS. San Francisco, CA, February 2014.*

Public Writing

Weekly ***The Absent-Minded Professor***
Substack newsletter on technology, education, and human flourishing.

2024 **Experience and Extend**, *Virtues & Vocations*, Fall 2024

Grants

CURRENT

2026 **Planning grant**, Lilly Endowment Inc. — $75,000
Role: PI (Co-PI, Esther Chung-Kim)

2025 – 2026 **Innovation Accelerator Lab for Imaginative Prototyping with AI (IPAI)**, Harvey Mudd College Innovation Accelerator, seed-stage grant — $30,000
Role: Director

AI Experimentation Laboratory (AXL), Harvey Mudd College Innovation Accelerator, seed-stage grant — $30,000
Role: Co-Director, with Nancy Lape, Ken Fandell, and Julie Medero

2023 – 2028 **CAREER: Next-generation Rhizosphere Monitoring — Non-invasive Plant Phenotyping and Health Monitoring Using the Light-piping Properties of Plant Stems**, NSF CAREER — $560,428
Role: PI

2023 – 2025 **ERI: RUI: Wavefront shaping through flexible multicore fiber bundles for coherent light focusing and imaging in neurophotonics**, NSF Engineering Research Initiation — $173,904
Role: PI

2022 – 2024 **openIVIS: Democratizing Access to Macroscopic Bioimaging**, Chan Zuckerberg Initiative (CZI) Scialog Advancing BioImaging Award — $57,500
Role: PI

COMPLETED

2015 – 2017 **Improved Light Delivery for Optogenetics via Digital TRUE**, NIH F31 NRSA
Role: PI

Teaching

HARVEY MUDD COLLEGE

E155 Microprocessor-based Systems
FA24, FA23, FA22, FA21, FA20, FA19

E85 Digital Design and Computer Architecture
FA23, SP21, SP20

E80 Experimental Engineering
SP25, SP24, SP23, SP22

E79 Practicum
FA22

E190BD Introduction to Optical Engineering
SP22

ENGINEERING CLINIC (FACULTY ADVISOR)

Fall 2025 — Translucence Biosystems
Fall semester only.

2023 – 2024 — Auburn University & United States Department of Agriculture

2022 – 2023 — Silvus Technologies

2020 – 2021 — Millennium Space Systems

2019 – 2020 — Leidos

CALTECH (GRADUATE TEACHING ASSISTANT)

EE166 Optical Methods for Biomedical Imaging and Diagnosis
SP17

EE151 Electromagnetic Engineering
SP16, SP15

LETOURNEAU UNIVERSITY

Head Supplemental Instructor
FA12

Electric Circuits 1, Lead Supplemental Instructor
SP14, FA13, SP13, FA12, SP12, FA11, SP11

Electric Circuits 1, Lab Assistant
FA13, SP11

TEACHING PROFESSIONAL DEVELOPMENT

2020 — Stanford Life Design Virtual Studio

2017 — Caltech E110: Principles of University Teaching & Learning in STEM

2016 — Caltech Center for Teaching, Learning, and Outreach — ABCs of Course Design Short Course

Awards, Honors, and Fellowships

2023 – 2024 — **AI Faculty Fellow**, Claremont Colleges Center for Teaching and Learning

2021 – 2023 — **Scialog® Advancing Bioimaging Fellow**

2015 – 2019	**Caltech Biotechnology Leadership Program Fellow**
2018	**SPIE Photonics West Student Travel Grant**
2015 – 2017	**NIH F31 NRSA Fellow**
2017	**2nd Place Poster Award**, Engineering Conferences International: Advances in Optics for Biotechnology, Medicine and Surgery XV
2015	**NSF Graduate Research Fellowship Program, Honorable Mention**
2014	**R. G. LeTourneau Outstanding Senior Engineering Student**, LeTourneau University
2013	**2nd Place, IEEE Region 5 Circuit Design Competition**
	Gold Key Society Member, LeTourneau University
	Outstanding Junior Engineering Student, LeTourneau University
2011 – 2014	**Engineering Honor Society Member**, LeTourneau University

Research Advising

2026	Leena Ansari, Broderick Bownds, Cooper Giles, Tyler Holman
2025	Brock Bownds, Broderick Bownds, Hailey Knolton, Natalie Ko, Grey Seymour, Megan Tran, Erin Wang
2024	Audrey Gruian, Ben Hartley, Fred Kim, Hailey Knolton, Ruby Peterman, Erin Wang, Zoe Worrall
2023	Frances Anderson, Jose Guerrero, Fred Kim, Ashrit Panditaradyula, Ellie Sindler, Zoe Worrall, William Yang
2022	Rohan Huang, Erina Iwasa, Katrina Nelson, Ashrit Panditaradyula, Ellie Sindler, Max de Somma
2021	Sathvika Anand, Kevin Kim, Kanthi Pandhigunta, George Wang
2020	Christina Dong, Erin Obermayer, Samuel Perales, Rosey Sams, Shreya Sanghai, Alec Vercruysse, Xingzi Xu

Research Experience

2014 – 2019	**Graduate Research Assistant**, Caltech Developed optical methods in wavefront shaping and time-reversal for suppressing the scattering of light in biological tissue.
2012 – 2014	**Research Assistant**, LeTourneau University Built and tested a new photonic biosensor architecture to sense refractive index changes.

Service

PROFESSIONAL

2026 – Present	**Editorial Board**, *Virtues & Vocations* magazine
	Reviewer Optica, Applied Optics, Optics Express, Optics Letters, Biomedical Optics Express, Scientific Reports

COLLEGE

2024 – 2025	**Nelson Lecture Series Committee**

2021 – 2024	Research, Presentation Days, and Institutional Review Board Committee Fall semester only in 2023–24.
2020 – 2021	Watson Fellowship Committee

DEPARTMENT

2024 – 2025	Engineering Student Experience Coordinator
2021 – 2023	Honors Committee Chair
2020 – 2021	Prototyping Mindset – Student Experience Committee

Workshops

2024	Praxis Forum on Redemptive Applications of Artificial Intelligence
2022	NSF CAREER Workshop and Mock Panel
2021	ASEE DELTA Junior Faculty Institute
	NSF CAREER Workshop
	Stanford Life Design Studio