# Joshua H. Brake

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## Education

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| **2019** | **California Institute of Technology**, Ph.D. Electrical Engineering |
| **2016** | **California Institute of Technology**, M.S. Electrical Engineering |
| **2014** | **LeTourneau University**, M.S. Engineering, Electrical Concentration |
| **2013** | **LeTourneau University**, B.S. Engineering, Electrical Concentration |

## Academic Appointments

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| **2019 - Present** | **Harvey Mudd College**<br>Dept. of Engineering, Assistant Professor of Engineering |

## Consulting Experience

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| **2024 - Present** | **Praxis**, New York, NY. Venture Partner for Studio Seminars. |
| **2021 - 2022** | **Aquillius Corporation**, San Diego, CA. Embedded systems development and testing. |
| **2020** | **Jetpack Aviation**, Chatsworth, CA. Electrical engineering testing and support. |

## Publications

### 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, and 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, and 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, and 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*, and 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), 270-75 (2016). doi:10.1364/JOSAA.33.000270.

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

## Books and Book Chapters

**2021** **J. Brake**, D. Harris, and S. Harris. Chapter 9: Embedded I/O Systems. In *Digital Design and Computer Architecture: RISC-V Edition*, 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 01/09/24)

**2022** Interferometric speckle visibility spectroscopy. US20200386535A1. (Granted 05/31/22)

**2019** Glare suppression through fog by optical phase conjugation assisted active cancellation. US10194100B2. (Granted 01/29/21)

## Conference Papers

**2022** A. Vercruysse, M. W. Miller, **J. Brake**, D. Harris. "A Tutorial-style Single-cycle Fast Fourier Transform Processor." In Proceedings of 2022 Great Lakes Symposium on VLSI (GLSVLSI'22), June 6–8, 2022, Irvine, CA. ACM, New York, NY, USA (2022). 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." In Proceedings of Great Lakes Symposium on VLSI (GLSVLSI'20), September 7–9, 2020, Virtual Event, China. ACM, New York, NY, USA (2020). doi:10.1145/3386263.3406930.

## 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, and 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, Canada, June 2019.

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

**2018** **J. Brake**, H. Ruan, J. E. Robinson, Y. Liu, V. Gradinaru, and 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, and 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, and 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, and 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.

## Talks

**2023** **J. Brake**, W. Menefee-Libey. "Talking Teaching: ChatGPT." Harvey Mudd College Internal Talking Teaching talk.

## Public Writing

Weekly Substack Newsletter, *The Absent-Minded Professor*, writing about technology, education, and human flourishing.

**J. Brake.** "Experience and Extend." Virtues & Vocations Magazine, Fall 2024. [in press]

# Grants

## Current Research

NSF CAREER 05/2023-04/2028
CAREER: Next-generation Rhizosphere Monitoring - Non-invasive Plant Phenotyping and Health Monitoring Using the Light-piping Properties of Plant Stems
Role: PI $560,428

NSF Engineering Research Initiation 06/2023-05/2025
ERI: RUI: Wavefront shaping through flexible multicore fiber bundles for coherent light focusing and imaging in neurophotonics
Role: PI $173,904

Chan Zuckerberg Initiative (CZI) Scialog Advancing BioImaging Award 10/2022-09/2024
openIVIS: Democratizing Access to Macroscopic Bioimaging
Role: PI $57,500

## Completed Research

NIH F31 NRSA
Improved Light Delivery for Optogenetics via Digital TRUE
Role: PI

# Teaching Experience

### Harvey Mudd College

**Courses**

E155 Microprocessor-based Systems: FA24, FA23, FA22, FA21, FA20, FA19
E85 Digital Design and Computer Architecture: FA23, SP21, SP20
E80 Experimental Engineering: SP24, SP23, SP22
E79 Practicum: FA22
E190BD: Introduction to Optical Engineering: SP22

**Engineering Clinic (Faculty Advisor)**

**2023-2024** Auburn University & United State Department of Agriculture
**2022-2023** Silvus Technologies
**2020-2021** Millennium Space Systems
**2019-2020** Leidos

### Caltech

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, & 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 Recipient 2018
**2015-2017** NIH F31 NRSA Fellow 2015-2017
**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** LeTourneau University R.G. LeTourneau Outstanding Senior Engineering Student
**2013** 2nd Place, IEEE Region 5 Circuit Design Competition
**2013** LeTourneau University Gold Key Society Member
**2013** LeTourneau University Outstanding Junior Engineering Student
**2011-2014** LeTourneau University Engineering Honor Society Member

# Research Advising

**2024** Audrey Gruian, Ben Hartley, Erin Wang, Hailey Knolton, Ruby Peterman, Zoe Worrall, Fred Kim

**2023** Jose Guerrero, Ellie Sindler, Fred Kim, Ashrit Panditaradyula, Zoe Worrall, William Yang, Frances Anderson
**2022** Katrina Nelson, Ashrit Panditaradyula, Erina Iwasa, Ellie Sindler, Rohan Huang, 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

# Work Experience

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

# Research Experience

## Caltech

**2014-2019** **Research Assistant**
Developed optical methods in wavefront shaping and time-reversal for suppressing the scattering of light in biological tissue.

## LeTourneau University

**2012-2014** **Research Assistant**
Built and tested new photonic biosensor architecture to sense refractive index changes.

# Leadership, Service, & Workshops

## Professional Service

Reviewer for: Optica, Applied Optics, Optics Express, Optics Letters, and Biomedical Optics Express, Scientific Reports

## College Service

**2024-2025** Nelson Lecture Series Committee
**2023-2024** Research, Presentation Days, and Institutional Review Board Committee (FA23 only)
**2022-2023** Research, Presentation Days, and Institutional Review Board Committee
**2021-2022** Research, Presentation Days, and Institutional Review Board Committee
**2020-2021** Watson Fellowship Committee

## Department Service

**2024-2025** Engineering Student Experience Coordinator
**2022-2023** Honors Committee Chair
**2021-2022** 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
**2021** NSF CAREER Workshop
**2021** Stanford Life-Design Studio