

Patrick Slade

Assistant Professor of Bioengineering at Harvard University

Slade Lab slade@seas.harvard.edu

ACADEMIC POSITIONS

- Assistant Professor of Bioengineering at Harvard University** July 2023 – current
Improving mobility through biomechanics, robotics, and data-science.
- Postdoctoral Scholar – Wu Tsai Human Performance Alliance** July 2021 – July 2023
Stanford Bioengineering – *Advisor: Scott Delp*
Improving human performance with biomechanics.

EDUCATION

- Stanford University**
Ph.D. Mechanical Engineering 2016 – 2021
Co-advisors: Mykel Kochenderfer, Steve Collins, Scott Delp
M.S. Mechanical Engineering 2017
- University of Illinois at Urbana-Champaign** 2013 – 2016
B.S. Mechanical Engineering

EXPERIENCE

- Technical Advisor at Voxel AI** August 2022 – July 2023
Developing ergonomic safety measures for reducing injuries during factory work.
- Stanford Intelligent Systems, Biomechatronics, & Human Performance Labs** 2016 – 2021
Graduate research assistant – Co-advisors: Mykel Kochenderfer, Steve Collins, Scott Delp
Data science for monitoring health, human-robot collaboration, and customizing wearable exoskeletons.
- AI Resident at Google** – Mountain View, CA July – December 2019
Developed AI/ML solutions for an early-stage Moonshot developing an assistive device.
- CHARM Lab** – Stanford, CA Fall 2017
Graduate research assistant – Co-advisors: Allison Okamura and Elliot Hawkes
Designed soft vine-like endoscope for surgical applications.
- Harvard REU, Biodesign Lab** – Cambridge, MA Summer 2015
Undergraduate research assistant – Advisor: Conor Walsh
Designed and manufactured active knee exosuit. Real-time, adaptive controller written in C.
- Co-founder of PSYONIC** – Champaign, IL 2014 – 2016
Startup for advanced and low-cost prosthetic hands with sensory feedback. Raised \$300k (NSF SBIR and I-CORPS, Cozad, Samsung Innovation). Ability Hand on sale in the US (psyonic.co).
- Bretl Research Group** – Champaign, IL 2013 – 2016
Undergraduate research assistant – Advisor: Timothy Bretl

JOURNAL PUBLICATIONS

1. Raymond Liu and **Patrick Slade**. Improving navigation for people with blindness using an ai-driven smartphone application and personalized audio guidance. *In Preparation*, 2025
2. Haedo Cho and **Patrick Slade**. A smartphone activity monitor that accurately estimates energy expenditure. *Under Review at Nature Computational Science*, 2025
3. **Patrick Slade**, Chris Atkeson, Max Donelan, Han Houdijk, Kim Ingraham, Myunghee Kim, Kyoungchul Kong, Katherine Poggensee, Robert Reiner, Martin Steinert, Juanjuan Zhang, and Steven H Collins. On human-in-the-loop optimization of human-robot interaction. *Nature*, 2024. 
4. **Patrick Slade**, Mykel J Kochenderfer, Scott L Delp, and Steven H Collins. Personalizing exoskeleton assistance while walking in the real world. *Nature*, 2022.  
5. **Patrick Slade**, Arjun Tambe, and Mykel Kochenderfer. Multimodal sensing and intuitive steering assistance improve navigation and mobility for people with impaired vision. *Science Robotics*, 6(59):eabg6594, 2021.   
6. **Patrick Slade**, Mykel Kochenderfer, Scott L Delp, and Steven H Collins. Sensing Leg Movement Enhances Wearable Monitoring of Energy Expenditure. *Nature Communications*, 12(1):1–11, 2021.   
7. **Patrick Slade**, Ayman Habib, Jennifer L Hicks, and Scott L Delp. An Open-source and Wearable System for Measuring Kinematics in Real-time. *IEEE Trans. on Biomedical Eng.*, 2021.   
8. **Patrick Slade**, Rachel Troutman, Mykel J Kochenderfer, Steven H Collins, and Scott L Delp. Rapid energy expenditure estimation for ankle assisted and inclined loaded walking. *Journal of Neuroengineering and Rehabilitation*, 16(1):1–10, 2019
9. **Patrick Slade**, Mykel Kochenderfer, and Zachary Sunberg. Estimation and Control Using Sampling-Based Bayesian Reinforcement Learning. *IET Cyber-Physical Systems: Theory & Applications*, 2019 **Best Paper Award**

PEER REVIEWED CONFERENCE PUBLICATIONS

1. Zoe Kutulakos and **Patrick Slade**. Simulating human-in-the-loop optimization of exoskeleton assistance to compare optimization algorithm performance. *Under Review*, 2025
2. Myles Cooper, Santiago Canete, Asa Eckert-Erdheim, Christopher Sivi, **Patrick Slade**, and Conor J Walsh. Design and systematic evaluation of power transmission efficiency of an ankle exoskeleton for walking post-stroke. *ICRA*, 2024
3. Nathan Kau, Aaron Schultz, Natalie Ferrante, and **Patrick Slade**. Stanford Doggo: An open-source, quasi-direct-drive quadruped. In *International Conference on Robotics and Automation (ICRA)*, pages 6309–6315, 2019.   
4. **Patrick Slade**, Preston Culbertson, Zachary Sunberg, and Mykel Kochenderfer. Simultaneous active parameter estimation and control using sampling-based Bayesian reinforcement learning. In *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 804–810, 2017
5. **Patrick Slade**, Alex Gruebele, Zachary Hammond, Michael Raitor, Allison M Okamura, and Elliot W Hawkes. Design of a soft catheter for low-force and constrained surgery. In *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 174–180, 2017. 
6. **Patrick Slade**, Aadeel Akhtar, Mary Nguyen, and Timothy Bretl. Tact: Design and performance of an open-source, affordable, myoelectric prosthetic hand. In *IEEE International Conference on Robotics and Automation (ICRA)*, pages 6451–6456, 2015. 

GRANTS

1. Amazon GBTC Award
Role: PI, Amount: \$50,000
2. Harvard Dean's Competetive Fund
Role: PI, Amount: \$50,000
3. NSF Phase 2: Convergence Accelerator Track H: Restoring Arm Function with Connected Assistance and Rehabilitation Systems
Role: Co-PI, Primary PI: Conor Walsh, Total Amount: \$2,000,000
4. Harvard Milton Generative AI Award
Role: PI, Amount: \$100,000
5. Kempner Institute Associate Faculty Award
Role: PI, Amount: \$450,000
6. NIH DP2 New Innovator Award Finalist (top 20%)

FELLOWSHIPS & AWARDS

- | | |
|--|-------------|
| 1. District 128 Illinois, Alumni Achievement Awards | 2023 |
| 2. STAT Wunderkind: National award for early stage scientists studying medicine | 2021 |
| 3. Human Performance Alliance Distinguished Postdoctoral Fellowship | 2021 – 2023 |
| 4. Stanford Graduate Fellowship: 3 year award, 100 awarded to graduate students | 2016 – 2021 |
| 5. NSF Graduate Research Fellowship | 2016 – 2021 |
| 6. AI Grant Winner (\$5,000) | 2017 |
| 7. Cozad Winner and Samsung Innovation Grant (\$30,000) | 2016 |
| 8. Forbes 30 under 30: young innovator in healthcare | 2016 |
| 9. Bronze Tablet: top 3% of graduating students in Engineering College (UIUC) | 2016 |
| 10. Goldwater Scholar: Awarded to 260 undergrads in the U.S. for research excellence | 2015 |
| 11. James Honors Scholar: Award for academic excellence (UIUC) | 2013 – 2016 |
| 12. MechSE Outstanding Scholar: Departmental merit award (UIUC) | 2013 – 16 |
| 13. James Newton Matthews Scholarship: Award for community service (UIUC) | 2013 – 16 |
| 14. Deans List: Top 20% of engineering students (UIUC) | 2013 – 2016 |
| 15. Illinois Scholar Undergrad Research: Research excellence program (UIUC) | 2014 – 2016 |

TEACHING

Biomechanics of Movement and Assistive Robotics (ES224 / BE 124) Fall 2023, Spring 2025
Harvard head instructor and course developer.

Harvard LInc Learning Fellow Fall 2024 – Spring 2025
Fellow in LInc community for redesigning BE 124 as core undergrad course, applying learning sciences to educational design and pedagogy, and enhancing teaching skills for active learning.

Harvard LInc Learning Affiliate Fall 2023 – Spring 2024

Co-taught Biomechanics of Movement (Stanford ME281) Winter 2023
 Presented and supported all aspects of course. **Guest Lecturer in Decision Making Under Uncertainty (CS238)** 2020, 2021
 Presented hour lectures on belief planning and partially observable Markov decision processes.
Guest Lecturer in Engineering Design Optimization (CS361) 2020, 2021
 Presented hour lectures on sampling plans, surrogate models, and probabilistic surrogate modeling.
Teaching Assistant for Decision Making Under Uncertainty (CS238) Fall 2019
 Held weekly office hours and discussion section and gave a guest lecture on belief planning.

MENTORSHIP

Postdoctoral Candidates

Santiago Canete Riaza – Community Ankle Exoskeleton (joint w/ Conor Walsh) July 2023 – Current
 Jae-Ryeong Choi – Multi-exoskeleton optimization. Winter 2025 – Current
 Ava Lakmazaheri – Human adaptation to assistive devices. Fall 2025 – Current

PhD Students

Tara Kimiavi – Optimizing an ankle exoskeleton for post-stroke walking. Fall 2024 – Current
 Raymond Liu – Developing navigation aids for the visually impaired. Fall 2024 – Current
 Jordan Feldman – Understanding movement objectives during walking. Fall 2023 – Current
 Dominic Locurto – Exoskeleton for knee osteoarthritis. Fall 2023 – Current
 Chelsea Campillo-Rodriguez – Wearable diagnosis of musculoskeletal diseases. Fall 2023 – Current
 Haedo Cho – Personalized weight management. Spring 2023 – Current

Visiting Students

Yinkai Dong (SUSTech) – Optimizing exoskeleton assistance. Fall 2024 – Spring 2025
 David Morales (TUM) – Understanding movement objectives during walking. Fall 2024 – Winter 2025
 Nathan Irniger (ETH Zurich) – Optimizing assistance for a third-arm robot. Fall – Spring 2024
 Zoe Kutulakos (UToronto) – Development of a third-arm robot. Spring 2024
 Camille Guillaume (EPFL) – Simulating sit-to-stand motions. Spring – Summer 2024
 Estelle Richard (EPFL) – Learning effects for audio feedback training. Spring – Summer 2024
 Jae-Ryeong Choi (KAIST) – Multi-exoskeleton optimization. Fall 2023 – Winter 2025
 Xabier Irizar (TUM) – Human-robot-environment interaction. Summer – Winter 2023

Masters Students

Paige Lee Fall 2023
 Paula Stocco (MS) – Multi-modal obstacle localization. Spring 2022
 Nicholas Robles (MS) – Wearable robotic device to reduce knee contact force. Winter 2021 – Fall 2022
 Yasmine Kehnemouyi (PhD) – Sensing human movement and providing real-time feedback. Fall 2021
 Parker Ruth (PhD) – Estimating energy expenditure from video. Fall 2021
 Arec Jamgochian (PhD) – Personalizing haptic feedback with AI. Fall 2019
 Soyeon Jung (PhD) – Mobile SLAM implementation. Fall 2019
 Rose Meacham (MS) – Measuring human motion with wearable sensors. Fall 2018

Undergraduate Researchers

Ali Saffarini Spring 2024 – Winter 2025
 Alina Yu Fall 2024
 Sarah Erickson Fall 2024
 Dominic Young-Smith Fall 2024
 Justin Huang (Northeastern) Fall 2024 – Spring 2025

Sarah Li	Summer – Fall 2024
Eliana Bonbrest	Summer 2024
Prakash Palanivelu (U Queensland)	Summer 2024
Pooja Vegesna (U Chicago)	Summer 2024
David Picard	Summer 2024
Joey Bejjani	Summer 2024
Camilo Brown-Pinilla	Summer 2024
Waseem Ahmad	Summer 2024
Nico Fidalgo	Fall 2023
Kuma McCraw	Fall 2023
Sam Benabou	Summer 2022
Wesley Peische	Summer 2021
Max Harris	Summer 2021
Arjun Tambe – Co-author on Science Robotics paper	2019 – 2022
Edgar Guzman	Summer 2021
Kyle Hatch	Fall 2018
Ahmed Ahmed – Awarded NSF GRFP	Fall 2018

Harvard Undergraduate Thesis Advisor

David Picard	2025
Cooper Knarr	2025
Alex Dyer	2024

Harvard Undergraduate Thesis Reader

Ellie Shin	2025
Coby-Yahir Duran-Garcia	2025
Hildur Hakonardottir	2025
Daniel Mhrous	2024

Harvard Graduate Qualifications Committee

Sarah Cavanagh, Philipp Arens, James Arnold, Elizabeth Sutor, Haedo Cho	2024
---	------

Harvard Graduate Thesis Defense Committee

Jennifer Shum	2024
---------------	------

CONFERENCE PRESENTATIONS

1. **Best abstract finalist (3/700)**, Chelsey Campillo. Estimating active energy expenditure across the menstrual cycle using at-home wearable sensing. *American Society of Biomechanics* 2024
2. Spotlight talk: Monitoring energy expenditure, *Bay Area Robotics Symposium* 2021
3. Invited speaker: Symposium on Recent Advances in Wearable Sensing and Machine Learning for Biomechanics, *IEEE Engineering in Medicine and Biology Society* 2021
4. Selected podium presentation: An open-source and wearable system for measuring 3D human motion in real-time, *American Society of Biomechanics* 2021
5. An open-source and wearable system for measuring 3D human motion in real-time, *Ambulatory Monitoring of Physical Activity and Movement*, **Poster award** 2021
6. Presentation by collaborator Julie Walker: User-adapting Haptic Interaction from Holdable Kinesthetic Devices, *SCIEN Industry Affiliates*, **Prize winner** 2019

7. Design of a soft catheter for low-force and constrained surgery, *International Conference on Intelligent Robots and Systems (IROS)* 2017
8. Simultaneous active parameter estimation and control using sampling-based Bayesian reinforcement learning, *Intelligent Robots and Systems (IROS)* 2017
9. Design of a soft catheter for low-force and constrained surgery, *International Conference on Robotics and Automation (ICRA)* 2015

INVITED TALKS AND PRESENTATIONS

1. ICRA 2025 workshop speaker: Multi-modal sensing and shared control: the future of wearable robotics. "Using wearable sensing for personalizing human-robot interaction" 2025
2. ICRA 2025 workshop speaker: State of the Art in Lower-Limb Exoskeletons."Performing human-in-the-loop optimization beyond the laboratory" 2025
3. United Nations, AI For Good (ITU): Assistive Robotics 2025
4. North Arizona University Mech. Eng. Seminar 2025
5. United Nations, AI For Good (ITU): Rehabilitation Robotics 2024
6. Northeastern Univ. Action Club Seminar: Towards assistive robotics in the real world 2023
7. United Nations, AI For Good (ITU): Rehabilitation Robotics 2023
8. Univ. of Michigan Robotics Institute Seminar: Optimizing wearable robotic devices 2023
9. Caltech Medical Engineering Seminar: Personalizing assistive devices in the real-world 2023
10. Univ. of Nebraska at Omaha Biomechanics Seminar: Data-driven biomechanics modeling 2023
11. UNC Applied Biomechanics Lab Seminar: Data-driven biomechanics modeling 2022
12. Wu Tsai Human Performance Alliance: Performance enhancing exoskeletons 2022
13. Harvard SEAS Seminar: Improving health with biomechanics and assistive devices 2022
14. Harvard Biomedical Informatics: Democratizing biomedicine for mobility 2022
15. Princeton Robotics Seminar: Improving health with human-centered robotics 2022
16. CMU Robotics Institute Seminar: Improving health with human-centered robotics and AI 2022
17. Stanford eWear Seminar: Improving navigation for people with impaired vision 2022
18. Stanford Human-Robot Salon: Optimizing exoskeleton assistance in the real-world 2022
19. Mobilize Center Webinar: Monitoring physical activity with a DIY calorie counter 2022
20. Stanford MediaX Industry Alliance: Human-robot systems for improving mobility 2021
21. Google X Technical Talk: Estimating energy expenditure from movement 2019
22. Highlight talk: Rapidly estimating energy expenditure, *Dynamic Walking* 2019
23. TEDxUIUC: How to have real world impact as a student 2016
24. Illinois Project Lead the Way Organization: Keynote presentation to 400 STEM educators 2015
25. Plenary Speaker: Low-cost prosthetic hands, *UIUC Research Symposium* 2016
26. Low-cost prosthetic hands, *UIUC Mechanical Engineering Seminar* 2015
27. Highlight talk: Active knee exosuit to assist uphill and stairs, *Harvard REU Conference* 2015

28. Highlight talk: Prosthetic hands for developing nations, *UIUC Research Symposium* 2014

PEDAGOGICAL TRAINING

- | | |
|--|------|
| 1. Harvard Learning Incubator Fellow | 2024 |
| 2. TIGRR: Rehabilitation Robotics Grant Writing Workshop | 2024 |
| 3. Harvard Learning Incubator Affiliate | 2023 |
| 4. Stanford Grant Writing Boot Camp | 2022 |
| 5. Accessibility 101: STEM Edition | 2021 |
| 6. Mechanical Engineering Department Training on Diversity and Inclusion | 2020 |
| 7. Stanford Graduate Summer Institute: Preparing for a Faculty Career | 2020 |

SERVICE & OUTREACH

Kempner Institute Seminar host, KRANIUM grad fellowship reviewer, etc	AY 2024-25
Harvard Robotics Community Council Faculty Liason	2025 – Current
Harvard Graduate Admissions Committee	AY 2024-25
Harvard Graduate Admissions Scholarships Subcommittee	AY 2024-25
Harvard SEAS AI Working Group	AY 2023-24
Harvard National Biomechanics Day Event	2024-current

Our lab co-organizes (with Walsh Lab) the Harvard outreach event to introduce biomechanics topics to underrepresented high school students through hands-on demos and activities.

Harvard Robotics Seminar Organizer	2024
Workshop Organizer BioRob 2024: AI-Based Estimation and Control of Wearable Robotic Systems for Enhancing Human Mobility	2024
Scientific Advisory Board for ICRA 2024 Workshop: Wearable Intelligence for Healthcare Robotics (WIHR): From Brain Minds to Body Movements	2024
Amazon Robotics Fellowship Mentor	AY 2023-24
Harvard CHD Committee	AY 2023-24
Mentor for Stanford Robotics Club	2017 – 2019

Research mentor for 6 Stanford undergrad students interested legged robotics. Taught the research process, assisted technical work, and was principle investigator for an all-student publication in ICRA 2019.

Mentor for Stanford Undergraduate Research Fellowship (SURF) Summer 2019, 2020, 2021
 Research mentor for 8 week program for underrepresented undergraduates. Taught background material, the research process, and advised research. Students: Patrick Babb, Edgar Campbell, and Oscar.

Mentor for Raising Interest in Science and Engineering (RISE) Summer 2018
 Research mentor for Ivan Morales during a seven-week Stanford STEM program for underrepresented high school students.

Instructor for AI4ALL Summer 2018, 2021
 Research mentor and instructor for Stanford Artificial Intelligence program for underrepresented high school students. Prepared lecture material, homework, and open-ended research project.

Assorted smaller outreach / mentorship roles:

- | | |
|---|------|
| 1. URM student mentor for Delaware Valley Science Fairs | 2024 |
| 2. Palo Alto Vision Support Group: Demonstration and training with 'smart' cane | 2022 |

3. GRAMS: Research demo and volunteer session with seniors 2021
4. NMBL Lab Outreach Committee: Biomechanics outreach in communities near Stanford 2021
5. AI Mentor (CS Dept.): Meetings with female undergrads to make AI and research accessible 2019
6. High School STEM Outreach: Prosthetics presentations in low-income schools 2016 – 2018
7. Engineering Open House: Prosthetics research demos to gradeschoolers in Urbana 2014 – 2016
8. Engineering Information Bureau: STEM orientations for highschool students (UIUC) 2014 – 2016
9. Volunteer Bike Mechanic: Annually repaired 50 bikes for low-income families 2009 – 2015

REVIEW EXPERIENCE

Nature
 npj Digital Health
 Science Advances
 Science Robotics
 IEEE Transactions on Automatic Control
 IEEE Transactions on Neural Systems and Rehabilitation Engineering
 Journal of Biomechanics
 Journal of Machine Learning Research
 IEEE International Conference on Robotics and Automation
 IEEE International Conference on Intelligent Robotics and Systems
 MDPI Sensors

PATENTS

1. **P. Slade**, M. J. Kochenderfer, S. L. Delp, S. H. Collins, “Sensing leg movement for wearable monitoring of energy expenditure”, *Full patent*, 2021.
2. **P. Slade**, S. H. Collins, “Customizing exoskeleton assistance from movement”, *Full patent*, 2021.