

J.D. Peiffer

PhD Candidate in Biomedical Engineering

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Education

Northwestern University / Shirley Ryan AbilityLab

Chicago, IL

MS, PhD in Biomedical Engineering

Sept 2022 – Sept 2026

- GPA: 3.81 | Center for Bionic Medicine, Shirley Ryan AbilityLab
- NSF Graduate Research Fellowship (2022); NIH T32 Training Grant (2024)

Washington University in St. Louis

St. Louis, MO

Rotation Student in Biomedical Engineering

Aug 2021 – July 2022

- GPA: 3.58
- Rotations in cervical myelopathy motion characterization, EEG decoding, and spinal cord stimulation

University of Missouri

Columbia, MO

BS in Biomedical Engineering

Aug 2017 – May 2021

- GPA: 3.92 | Emphasis: Bioinformatics | Minor: Mathematics
- Honors Scholar; Dean's List (all semesters)

Experience

Research Scientist Intern

Redmond, WA

Meta Reality Labs

June 2025 – Feb 2026

- Implemented real-time C++ hand pose estimation and IK solver pipeline on the Glove Sensing and Tracking Team, achieving best-in-class accuracy and occlusion robustness for full dexterous hand pose capture.
- Led algorithm development resulting in first-author IROS submission on a fiber optic sensing glove for high-performance dexterous manipulation capture.

PhD Researcher

Chicago, IL

Center for Bionic Medicine, Shirley Ryan AbilityLab

Sept 2022 – present

- Designed and validated deep learning models for monocular biomechanical pose estimation and uncalibrated IMU–video sensor fusion, achieving joint angle errors $<3^\circ$ across neurological, prosthesis, and pediatric populations; 8 peer-reviewed publications. Developed OpenCV-based multi-camera calibration pipelines (intrinsic and extrinsic) for markerless motion capture deployment across clinical sites.
- Developed the Portable Biomechanics Laboratory — a cloud-enabled smartphone gait analysis system achieving ICC > 0.9 for gait metrics and greater sensitivity to decompression surgery outcome than standard mJOA patient-reported outcomes.
- Trained a contrastive learning + causal masking transformer on unannotated clinical gait data; demonstrated learned embeddings classify neurological diagnosis and track response to inpatient therapy.

Fulbright-Mitacs Globalink Intern

May 2020 – Aug 2020

Neuromuscular Control & Biomechanics Laboratory

- Computationally modeled seated human trunk biomechanics under Functional Electrical Stimulation (FES) and designed LQR and fuzzy inference (FIS) feedback controllers; validated closed-loop stability in simulation.

Undergraduate Researcher

MU Neural Engineering Laboratory

Columbia, MO

Aug 2020 – May 2021

- Developed and optimized a closed-loop gamma oscillation detection and modulation algorithm achieving <2 ms latency on embedded hardware; open-sourced on [GitHub](#).

Undergraduate Researcher

Pulmonary Imaging Research Laboratory, University of Missouri

Columbia, MO

Aug 2018 – May 2021

- Built a semi-automated image segmentation, registration, and quantification pipeline enabling large-cohort comparison of ¹²⁹Xe MRI vs. ^{99m}Tc SPECT; first-author publication in *Academic Radiology* (2024).
- Received Audience Choice Award for oral presentation at International Workshop on Pulmonary Functional Imaging (2019).

Teaching

Teaching Assistant — Biomedical Applications of Machine Learning

Northwestern University

Chicago, IL

Mar 2025 – June 2025

- Instructed graduate students in Python-based ML including data preprocessing, regression, tree-based methods, DNNs, and CNNs.

Teaching Assistant — Advanced Hydroinformatics

University of Missouri

Columbia, MO

Jan 2020 – May 2021

- Created curriculum introducing graduate students to scientific data manipulation and parallel computation job submission on HPC clusters.

Ski Instructor

Vail Resorts

Dec 2018 – present

Publications

Probabilistic Monocular Biomechanical Reconstruction via Guided Flow Matching

R. James Cotton, *J.D. Peiffer*, Fabian Sinz
(ECCV, In Review)

Fiber Optic Sensing Glove for High Performance Dexterous Manipulation Capture

J.D. Peiffer, Taylor Niehues, Li Guan, Ziyi Kou, Ergys Ristani
(IROS, In Review)

Monocular Markerless Motion Capture Enables Quantitative Assessment of Upper Extremity Reachable Workspace

Feb 2026

Seth Donahue, *J.D. Peiffer*, R. Tyler Richardson, Yishan Zhong, Shaun Q. Y. Tan, Benoit Marteau, Stephanie R. Russo, May D. Wang, R. James Cotton, Ross Chafetz
[10.48550/arXiv.2602.13176](https://arxiv.org/abs/10.48550/arXiv.2602.13176) (arXiv)

Differentiable Biomechanics for Markerless Motion Capture in Upper Limb Stroke Rehabilitation: A Comparison With Optical Motion Capture

Feb 2026

Tim Unger, Arash Sal Moslehian, *J.D. Peiffer*, Johann Ullrich, Roger Gassert, Olivier Lambercy, R. James Cotton, Chris Awai Easthope
[10.1109/TMRB.2025.3605962](https://doi.org/10.1109/TMRB.2025.3605962) (IEEE Transactions on Medical Robotics and Bionics | 2nd Place Best Student Paper, ICORR 2025)

- Portable Biomechanics Laboratory: Clinically Accessible Movement Analysis from a Handheld Smartphone** July 2025
J.D. Peiffer, Kunal Shah, Irina Djuraskovic, Shawana Anarwala, Kayan Abdou, Rujvee Patel, Prakash Jayabalan, Brenton Pennicooke, R. James Cotton
[10.48550/arXiv.2507.08268](https://doi.org/10.48550/arXiv.2507.08268) (npj Digital Medicine, In Review)
- Efficacy and feasibility of synergy-based multichannel functional electrical stimulation for chronic stroke gait rehabilitation: a pilot study** May 2025
Jackson T. Levine, Xin S. Yu, Rebecca Munoz, Alaina Fiorenza, Tyler Smith, Irina Djuraskovic, *J.D. Peiffer*, Emilia Ambrosini, Simona Ferrante, Rebecca Webster
www.medrxiv.org/content/10.1101/2025.05.21.25328035v2 (medRxiv, In Review)
- Fusing Uncalibrated IMUs and Handheld Smartphone Video to Reconstruct Knee Kinematics** Sept 2024
J.D. Peiffer, Kunal Shah, Shawana Anarwala, Kayan Abdou, R. James Cotton
[10.1109/BioRob60516.2024.10719724](https://doi.org/10.1109/BioRob60516.2024.10719724) (BioRob 2024)
- Biomechanical Arm and Hand Tracking with Multiview Markerless Motion Capture** Sept 2024
Pouyan Firouzabadi, Wendy Murray, Anton R Sobinov, *J.D. Peiffer*, Kunal Shah, Lee E Miller, R. James Cotton
[10.1109/BioRob60516.2024.10719940](https://doi.org/10.1109/BioRob60516.2024.10719940) (BioRob 2024)
- Hyperpolarized ^{129}Xe MRI, $^{99\text{m}}\text{Tc}$ scintigraphy, and SPECT in lung ventilation imaging: a quantitative comparison** Apr 2024
J.D. Peiffer, Talissa Altes, Iulian C. Ruset, F. W. Hersman, John P. Mugler, Craig H. Meyer, Jamie Mata, Kun Qing, Robert Thomen
[10.1016/j.acra.2023.10.038](https://doi.org/10.1016/j.acra.2023.10.038) (Academic Radiology)
- Optimizing Trajectories and Inverse Kinematics for Biomechanical Analysis of Markerless Motion Capture Data** Sept 2023
R. James Cotton, Allison DeLillo, Anthony Cimorelli, Kunal Shah, *J.D. Peiffer*, Shawana Anarwala, Kayan Abdou, Tasos Karakostas
[10.1109/ICORR58425.2023.10304683](https://doi.org/10.1109/ICORR58425.2023.10304683) (ICORR 2023)
- Self-Supervised Learning of Gait-Based Biomarkers** Sept 2023
R. James Cotton, *J.D. Peiffer*, Kunal Shah, Allison DeLillo, Anthony Cimorelli, Shawana Anarwala, Kayan Abdou, Tasos Karakostas
[10.1007/978-3-031-46005-0_24](https://doi.org/10.1007/978-3-031-46005-0_24) (Predictive Intelligence in Medicine (Springer))
- Enhanced selectivity of transcutaneous spinal cord stimulation by multielectrode configuration** Aug 2023
Noah Bryson, Lorenzo Lombardi, Rachel Hawthorn, Jie Fei, Rodolfo Keeseey, *J.D. Peiffer*, Ismael Seáñez
[10.1088/1741-2552/ace552](https://doi.org/10.1088/1741-2552/ace552) (Journal of Neural Engineering)
- Markerless Motion Capture and Biomechanical Analysis Pipeline** Mar 2023
R. James Cotton, Allison DeLillo, Anthony Cimorelli, Kunal Shah, *J.D. Peiffer*, Shawana Anarwala, Kayan Abdou, Tasos Karakostas
[10.48550/arXiv.2303.10654](https://doi.org/10.48550/arXiv.2303.10654) (arXiv)

Selected Talks

- **Deployable motion capture for in-clinic and in-the-wild biomechanical measurement**, Computerized Motion Analysis Laboratory Visiting Professor Program, Chicago, IL (2026)
- **Leveraging AI for Real-World Biomechanical Reconstruction from a Single Moving Camera**, European Society of Biomechanics, Zurich, Switzerland (2025)
- **Differentiable Biomechanics for Markerless Motion Capture in Upper Limb Stroke Rehabilitation**, International Consortium for Rehabilitation Robotics, Chicago, IL (2025)
- **Accurate Lower Body Kinematics Using a Handheld Smartphone**, American Society of Biomechanics Annual Meeting, Madison, WI (2024)

Selected Honors

- **NSF Graduate Research Fellowship**, National Science Foundation (2022)
- **Fulbright-Mitacs Globalink Internship** (2020)
- NIH T32 Training Grant (2024)
- 2nd Place Best Student Paper, ICORR (2025)
- Barry M. Goldwater Scholarship Campus Nomination (2019)
- Audience Choice Award, International Workshop on Pulmonary Functional Imaging (2019)
- 2 x Boston Marathon Qualifier (2024, 2025)
- Cherng Summer Scholar, University of Missouri (2019)

Skills

Languages: Python, C++, R

ML Frameworks: JAX (Jaxlie), PyTorch (Pytorch3D), TensorFlow, MuJoCo/MJX, OpenCV

Infrastructure: Docker, Kubernetes, Git, SQL, Datajoint, W&B

Research Areas: Computer Vision, Sensor Fusion, Biomechanics, Wearables, Self-Supervised Learning, Generative Models

Service

Speaker

Apr 2023 – Apr 2025

National Biomechanics Day

Developed interactive sessions for high school students on biomechanics, prosthetics, computer vision, and AI for medical image analysis.

Peer Reviewer

Apr 2022 – present

BioRob, IROS, iScience, CMBBE — Imaging & Visualization

Site Leader

Nov 2018 – Aug 2020

Mizzou Alternative Breaks

- Organized a week-long adaptive sports service trip (Ski Apache, NM) for 12 participants; assisted in instruction of students with visual, cognitive, and physical disabilities.