Gabrielle Leah Hoyer

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EDUCATION

University of California, San Francisco & UC Berkeley | San Francisco, CA
Ph.D. Candidate, Bioengineering | 2021 – Present

University of Utah | Salt Lake City, UT
B.S./M.S., Biomedical Engineering (Neural Interfaces) | May 2020

RESEARCH EXPERIENCE

Graduate Researcher | Musculoskeletal Quantitative Imaging Research (MQIR) Group | 2022 – Present

JointAI: A Sustainable Digital Twin for Predictive Knee Health and Clinical Research (Dissertation)
A modular research framework integrating dataset curation, biomarker discovery, and predictive modeling to enable personalized musculoskeletal care and inform preventive clinical strategy.

- **Scalable Dataset Innovation and Clinical Validation**
  - Developing thorough methods to evaluate clinical value, reliability, and practical impact of foundation AI models for musculoskeletal MRI.
  - Creating scalable, reproducible approaches to generate and curate diverse medical imaging datasets, ensuring consistent model generalizability, accuracy, and fairness.
- **Integrated MRI Biomarker Discovery and Statistical Validation**
  - Using cross-sectional analysis and hierarchical modeling to identify clinically meaningful MRI biomarkers predicting disease progression, osteoarthritis incidence, and knee replacement outcomes.
  - Establishing foundational datasets and analytical strategies that support advanced predictive modeling and clinical translation.
- **Digital Twin Development for Longitudinal Analysis and Predictive Medicine**
  - Advancing longitudinal modeling of MRI-derived biomarkers through causal inference, survival analysis, and scenario generation to capture patient-specific trajectories. [slide deck | demo]
  - Integrating imaging, clinical, biomechanical, and anatomical data into interactive digital twins that support risk assessment, intervention timing, and clinical decision planning.
- **Bias Evaluation and Fairness through Self-Supervised Learning (Collaborative Project)**
  - Examining how self-supervised learning methods influence MRI segmentation and fairness across diverse populations in large-scale musculoskeletal imaging.
  - Validating SSL as a scalable way to achieve equitable performance without increasing demographic biases in clinical AI applications.
- **Human-in-the-Loop Pipeline Optimization for Medical Image Annotation (Collaborative Lab Initiative)**
  - Contributing to the design and optimization of workflows that pair automated annotation algorithms with clinician oversight, elevating both speed and quality in large-scale dataset creation.

Graduate Researcher | Computer Vision in Anesthesiology Lab | 2018 – 2021

- Developed software for an augmented reality guidance system to improve clinician success rates during endotracheal intubation.
- Designed and evaluated deep learning-based real-time object detection models for clinical airway imaging applications.

- Developed an automated deep learning pipeline for large-scale VLS video processing, performing procedural frame trimming, sensitive object detection (persons, faces, IDs), and privacy-preserving blurring. [code]
- Awarded NSF I-Corps Seed Grant to advance the device toward clinical translation and commercialization.

Undergraduate Research Asst. | Mechanisms of Synaptic Functions Lab | 2016 – 2018

- Investigated calcium-dependent vesicle fusion mechanisms at neuromuscular junctions in C. elegans models.
- Performed TEM imaging of complexin- and synaptotagmin-protein mutant worm genotypes to assess synaptic neurotransmission models.
- Acquired technical expertise in C. elegans handling, neuromuscular preparation, and Transmission Electron Microscopy (Hitachi 7100 and JEOL JEM-1400). [poster]

Undergraduate Research Asst. | Neural Information Lab | 2014 – 2017

- Investigated behavioral and cortical oscillatory patterns in rodent models of Parkinson's disease.
- Collected and analyzed electrophysiological and behavioral datasets using MATLAB-driven pipelines.
- Identified motor signatures distinguishing healthy and Parkinsonian states, contributing to early-stage biomarker discovery.
- Acquired technical expertise in rodent EEG electrode implantation surgery, microinjections, transcardial perfusion, and histological preparation.

PUBLICATIONS & PRESENTATIONS

1. **Hoyer, G.**, Tong, M.W., Bhattacharjee, R. et al. Scalable Evaluation Framework for Foundation Models in Musculoskeletal MRI Bridging Computational Innovation with Clinical Utility. *arXiv* (2025). https://arxiv.org/abs/2501.13376. (under review at *Nat. Commun.*). [code | supplement | poster]
2. **Hoyer, G.**, Gao, K.T., Gassert, F.G. et al. Foundations of a knee joint digital twin from qMRI biomarkers for osteoarthritis and knee replacement. *npj Digit. Med.* 8, 118 (2025). https://doi.org/10.1038/s41746-025-01507-3. [code | code | supplement]
3. Huang, H., **Hoyer, G.**, Hess, M. et al. Does Demographic Bias Always Affect Model Fairness? An Evaluation with Musculoskeletal Imaging. (2025). (under review at *Conference on Health, Inference, and Learning* (CHIL)). [preprint | code]
4. Liu, F., **Hoyer, G.**, Ziegeler K. et al. Validation of a Fully Automized Volumetric Thigh Muscle Segmentation Pipeline Using Segment Anything. In *Proceedings of the OARSI World Congress*, Incheon, South Korea, (2025).
5. **Hoyer, G.** & Tong, M.W. et al. Towards a Generalizable Foundation Model for Multi-Tissue Musculoskeletal MRI Segmentation. In *Proceedings of the 32nd Annual Meeting of ISMRM*, Session: The Future of AI in MRI: Emerging Technologies & Directions, Singapore, (2024), 8045. (Awarded Magna Cum Laude). [abstract]
6. **Hoyer, G.**, Gao, K.T., et al. Quantitative MRI Interpretable 100D Feature Space of Knee Osteoarthritis. In *Proceedings of the 31st Annual Meeting of ISMRM*, Session: ML/AI New Ideas, Toronto, Ontario, Canada, (2023), 993. [slide deck]
7. **Hoyer, G.**, Runnels, S. et al. Comparison of Procedural Distancing of Primary and Advanced Intubation Techniques. In *Proceedings of the Difficult Airway Society Annual Meeting*, UK (2020).
8. **Hoyer, G.**, Runnels, S., Kuck, K. et al. Automatic Video Laryngoscope Archiving System, First Pass Rates in Archived Intubations. In *Proceedings of the Society for Technology in Anesthesia Annual Meeting*, Austin, TX (2020). [demo]
9. Dorval, A., Polar, C. & **Hoyer, G**. Cortico-Subthalamic Beta-Coherence Suppression During High-Intensity, Self-Directed Motion in a Parkinsonian Rat Model. In *Proceedings of the 9th International IEEE/EMBS*

Conference on Neural Engineering (NER), IEEE Engineering in Medicine and Biology Society, San Francisco, CA, (2019), 491. [poster]

10. Sudabattula, M. & **Hoyer, G**. Towards the Provision of Sustainable Medical Materials to Low and Middle-Income Countries: A Non-Profit Case Study. In *Proceedings of the 2017 International Health Conference*, Session: Health Inequalities and Big Data, St. Hugh's College, Oxford, UK, (2017), 178.

AWARDS & FELLOWSHIPS

Fletcher Jones Fellowship Nominee | UCSF | 2025
Nominated for a competitive research fellowship recognizing outstanding dissertation research and potential for significant contributions to health sciences.

UCSF Discovery Fellowship | 2023 – Present
Awarded for leadership potential, research excellence, community engagement, and communication skills. Fellows advocate for UCSF's foundational biomedical sciences and healthcare research initiatives.

NIH T32 Bioengineering Training Grant | 2021 – 2022
Competitive NIH-funded training grant supporting interdisciplinary biomedical engineering research.

NSF National I-Corps Program Grant | 2021
Experiential entrepreneurship training from the National Science Foundation's Innovation Corps (I-Corps™), fostering skills to accelerate technology commercialization from research laboratories to industry.

NASA Space Grant Fellowship | 2019 – 2021
Nationally competitive fellowship supporting research aligned with NASA's aeronautics and space exploration missions, aimed at advancing scientific understanding and public engagement in aerospace.

Chevron Scholarship for Women in STEM | 2018 – 2019
Award recognizing academic excellence among self-identified women pursuing STEM disciplines, created to support and encourage women's careers in science, technology, engineering, and mathematics.

Bioscience Undergraduate Research Scholar | University of Utah | 2015 – 2017
Recognition and funding from the Department of Biology awarded to exceptional undergraduate students conducting advanced bioscience research.

NSF Research Experiences for Undergraduates (REU) Grant | 2015 – 2016
National Science Foundation-funded program supporting undergraduate research participation in neural engineering and computational neuroscience, under Dr. Chuck Alan Dorval in the Neural Information Lab.

ACCESS Program for Women in STEM Scholar | University of Utah | 2014 – 2015
Selective scholarship and mentorship program dedicated to first-year women demonstrating exceptional potential and interest in science, technology, engineering, and mathematics.

TEACHING & MENTORSHIP

Graduate and Undergraduate Research Mentoring | UCSF, UC Berkeley, NYU | 2024 – Present

Mentor to:

- Howard Huang (NYU MS): Self-supervised learning for musculoskeletal MRI segmentation, including data prep, training, and fairness analysis.
- Aniket Pratapneni (UCSF MD): Shoulder MRI dataset assembly and AI-based shape modeling for surgical planning.

- Rahil Shaik (UC Berkeley undergrad): MRI biomarker extraction and ML methods for musculoskeletal disease.

Teaching Assistant | BioSystems Analysis (BIOEN 4101) | University of Utah | 2019 – 2020

Led lab instruction and provided technical support in biomedical instrumentation, systems modeling (mechanical, electrical, physiological), and programming (LabVIEW, MATLAB).

Mentor and Assistant | GREAT Robotics & Graphics Summer Camp | University of Utah | 2018

Taught programming and robotics to students (K–12) using Scratch, Alice 3D, and LEGO Mindstorms; supported hands-on design and coding activities.

LEADERSHIP & SERVICE

Chief Development Officer | Project Embrace nonprofit | 2018 – 2022

- Built and scaled an operational system that delivered medical devices to over 1000 individuals across nine countries.
- Directed Patient Impact and Patient Resources teams, launching impact-driven initiatives that improved educational outreach and resource delivery to community partners.
- Developed and deployed a customized inventory management platform using Python, SQL, and Django to track medical resources and partner needs.
- Secured multi-source grant funding from Intermountain Healthcare, the Utah Division of Multicultural Affairs, SelectHealth, and others, strengthening the organization's operational sustainability.

Technical Lead, A.I. Healthcare Venture | NSF National I-Corps Program | 2021

- Conducted a market analysis on A.I. integration into the clinical workflow and the potential strategic and tactical uses of video airway data. [demo]
- Interviewed 100+ industry stakeholders – including hospital administration, insurance groups, I.T., supply chain, end-users, and competitors.
- Acquired hands-on experience with the chaos and uncertainty of commercializing innovations and creating ventures.

Director of Research + Project Development | Project Embrace nonprofit | 2016 – 2018

- Researched, organized, and executed medical resource campaigns to the Navajo Nation of Utah, Arizona, and New Mexico, as well as to Tijuana, Mexico, Seattle, Washington, redirecting 500+ medical devices to vulnerable communities.
- Established sustainable partnerships with clinics and community distribution centers in the Navajo Nation of Utah through the Navajo Health System Inc.

Volunteer Lab Technician | Shriners Hospital for Children | 2014 – 2016

- Engaged actively with various prosthetic and orthotic-based services inclusive of upper and lower extremity prosthetic care, scoliosis bracing and muscular dystrophy bracing.
- Utilized 3-D scanning technology, computer-aided design (CAD), and computer-aided manufacturing (CAM) to assist in the design and fabrication of prosthetic and orthotic devices.
- Aided clinical staff in their appointments with patients and fit orthotic and/or prosthetics to patients for measurements.

TECHNICAL & INDUSTRY EXPERIENCE

Software Development Intern | Compassion International | 2020

- Built user interfaces and chat applications using ReactJS and AWS Lambda RESTful APIs to support organizational communication and outreach.
- Designed, coded, and integrated application components within a collaborative Agile development environment.

Data Science Impact Fellow | Sorenson Impact Center | 2018

- Supported custom data diagnostics and statistical analyses for public and private sector clients using R and Python.
- Contributed to the design of interactive data visualizations and dashboards for client reporting and decision-making.
- Wrote secure, modular code consistent with data governance and confidentiality standards.
- Assisted in developing and operationalizing impact measurement strategies to evaluate social and financial outcomes across diverse initiatives.

Product Development Engineering Intern | Ortho Development | 2017 – 2018

- Analyzed morphological changes in Direct Metal Laser Sintering (DMLS)-printed titanium orthopedic implants designed for bone ingrowth using SEM imaging techniques.
- Differentiated residual stress-induced cracking from incomplete build defects in porous superstructures through SEM-based failure analysis.
- Quantified SEM and photographic images of DMLS-printed titanium and bone-implant histological cross-sections using specialized image analysis software.
- Maintained FDA-compliant technical documentation and engineering drawings with Creo Parametric CAD to support product validation and regulatory submissions.