Cole Hurwitz

General Information

Affiliation *Postdoc, Zuckerman Institute, Columbia University*, supervised by Dr. Liam Paninski.

Contact ch3676@columbia.edu or colehurwitz@gmail.com

Education

2017–2022 **PhD**, ANC, Informatics Forum, University of Edinburgh, UK, Scalable software and models for large-scale extracellular recordings, supervised by Dr. Matthias Hennig.

2013–2017 **BA, Logic, Information, and Computation**, University of Pennsylvania, Philadelphia, Minor in Mathematics and Computer Science, *summa cum laude*.

Experience

2022–present **Postdoctoral Research Scientist**, Columbia University, International Brain Laboratory, and the NSF AI Institute for Artificial and Natural Intelligence.

- Led the development of brain-wide foundation models that generalize across animals, brain regions, and tasks, with resulting publications at top venues (e.g., NeurIPS, ICLR, ICML) in collaboration with institutes across the U.S. and Canada.
- Developed algorithms to improve electrophysiological and behavioral analyses, leading to multiple software packages and publications in top venues (e.g., NeurIPS, Nature Methods).
- Co-organizer of two major workshops in 2025: *Cosyne: Building a Foundation Model for the Brain*, which brought together experimentalists, theoreticians, and model builders to explore brain-wide modeling paradigms; and *NeurIPS: Foundation Models for the Brain and Body*, which brings together neuroscientists, biomedical engineers, wearable tech researchers, and ML experts to advance foundation model approaches across domains.

2021 **Research Intern**, Facebook Reality Labs.

- Enhanced the accuracy and robustness of spike sorting algorithms and evaluation pipelines for EMG-based neural interfaces.

2020 **Research Intern**, MIT-IBM Watson AI Lab.

- Developed deep generative models (VAEs, GANs) for image and scene understanding, with emphasis on image generation and disentangled representation learning (preprints on arXiv).

2016–2021 **PhD Researcher**, University of Edinburgh, School of Informatics.

- Conducted research on deep generative models for neural population activity and electrophysiological data, with publications at top venues (e.g., NeurIPS).
- Co-developed *SpikeInterface* and *SpikeForest*, widely used Python packages for standardized spike sorting pipelines, in collaboration with labs across Europe and the U.S. (e.g., Oslo, CRNL, Flatiron, Allen Institute). These software packages are now published in eLife.
- Co-organized the Spike Sorting and Reproducibility for Next-Generation Electrophysiology workshop focused on scalable and reproducible analysis of extracellular recordings.

Technical Skills

Programming Python (PyTorch, NumPy, SciPy, scikit-learn, pandas, Jupyter), CUDA, Bash, Git.

Machine Learning Transformers, RNNs, CNNs, and MLPs; sequence and time-series modeling; latent variable models; self- and semi-supervised learning; contrastive and generative modeling; multimodal representation learning; domain adaptation and transfer learning.

Data & Infrastructure Distributed training; HPC/SLURM job scheduling; reproducible ML pipelines (conda/mamba, Docker); experiment tracking (TensorBoard/Wandb).

Neuroscience Neural decoding/encoding, neurofoundation models, spike sorting, electrophysiology, electromyography (EMG), cell-type and brain-region classification, behavioral analysis.

Publications

- Improved calibration-free multi-view pose estimation with the variance-inflated Ensemble Kalman Smoother. Lenny Aharon, Keemin Lee, . . . , **Cole Hurwitz**, Liam Paninski, Matthew R Whiteway. CVPR 2025 Workshop: CV4Animals (Oral).
- Neural Encoding and Decoding at Scale. Yizi Zhang*, Yanchen Wang*, Mehdi Azabou, . . . , Liam Paninski, **Cole Hurwitz**. ICML (spotlight) 2025. *equal contribution.
- Reproducibility of in-vivo electrophysiological measurements in mice. International Brain Laboratory, . . . , **Cole Hurwitz**, . . . *eLife* 2025.
- In vivo cell-type and brain region classification via multimodal contrastive learning. Han Yu, Hanrui Lyu, Ethan YiXun Xu, Charlie Windolf, Eric Kenji Lee, Fan Yang, Andrew M. Shelton, . . . , Liam Paninski, **Cole Hurwitz**. ICLR (spotlight) 2025.
- Towards a "universal translator" for neural dynamics at single-cell, single-spike resolution. Yizi Zhang, Yanchen Wang, Donato Jiménez Benetó, Zixuan Wang, Mehdi Azabou, Blake Richards, Olivier Winter, Eva Dyer, Liam Paninski, **Cole Hurwitz**. NeurIPS 2024.
- Lightning Pose: improved animal pose estimation via semi-supervised learning, Bayesian ensembling and cloud-native open-source tools . Dan Biderman, Matthew R Whiteway, **Cole Hurwitz**, . . . , John P Cunningham, Nathaniel Sawtell, Liam Paninski. $*$ - Equal Contribution., *Nature Methods* 2024.
- Towards robust and generalizable representations of extracellular data using contrastive learning. Ankit Vishnu*, Charlotte Loh*, Julien Boussard, Akash Srivastava, Liam Paninski, **Cole Hurwitz**. $*$ - Equal Contribution. NeurIPS 2023.
- Density-based neural decoding of electrophysiological data. Yizi Zhang*, Tianxiao He*, Julien Boussard, **Cole Hurwitz**, Erdem Varol, Charlie Windolf, Olivier Winter, Matt Whiteway, The International Brain Laboratory, Liam Paninski. $*$ - Equal Contribution. NeurIPS 2023.
- Spike sorting pipeline for the International Brain Laboratory. International Brain Laboratory, . . . , **Cole Hurwitz**, ... 2022
- Targeted Neural Dynamical Modeling. **Cole Hurwitz**, Akash Srivastava, Kai Xu, Justin Jude, Matthew Perich, Lee Miller, Matthias Hennig *Advances in Neural Information Processing Systems 34 (NeurIPS)*. 2021
- Building population models for large-scale neural recordings: opportunities and pitfalls. **Cole Hurwitz***, Nina Kudryashova*, Arno Onken, Matthias H. Hennig. $*$ - Equal Contribution, *Current Opinion in Neurobiology 70, Pages 64-73*. 2021
- SpikeInterface, a unified framework for spike sorting. Alessio Buccino*, **Cole Hurwitz***, Jeremy Magland, Samuel Garcia, Joshua Siegle, Roger Hurwitz, and Matthias Hennig. $*$ - Equal Contribution, *eLife*. 2020
- SpikeForest, reproducible web-facing ground-truth validation of automated neural spike sorters. Jeremy Magland, James Jun, Elizabeth Lovero, Alexander J Morley, **Cole Hurwitz**, Alessio Buccino, Samuel Garcia, Alex Barnett. *eLife*. 2020
- Scalable Spike Source Localization in Extracellular Recordings using Amortized Variational Inference. **Cole Hurwitz**, Kai Xu, Akash Srivastava, Alessio Buccino, and Matthias Hennig. *Advances in Neural Information Processing Systems 32 (NeurIPS)*. 2019

- Scaling Spike Detection and Sorting for Next Generation Electrophysiology. Matthias Hennig, **Cole Hurwitz**, and Martino Sorbaro. In press. *In Vitro Neuronal Networks - From Culturing Methods to Neuro-Technological Applications*. 2019

Preprints

- Self-supervised pretraining of vision transformers for animal behavioral analysis and neural encoding . Yanchen Wang, Han Yu, Ari Blau, Yizi Zhang, The International Brain Laboratory, Liam Paninski, **Cole Hurwitz**, Matt Whiteway. *arXiv*. 2025
- BAND: Behavior-Aligned Neural Dynamics is all you need to capture motor corrections. Nina Kudryashova, **Cole Hurwitz**, Matthew Perich, Matthias Hennig. *bioRxiv*. 2025
- Exploiting correlations across trials and behavioral sessions to improve neural decoding. Yizi Zhang*, Hanrui Lyu*, **Cole Hurwitz**, Shuqi Wang, Charles Findling, Felix Hubert, Alexandre Pouget; International Brain Laboratory, Erdem Varol, Liam Paninski. $*$ - Equal Contribution., *bioRxiv*. 2024
- Ultra-high density electrodes improve detection, yield, and cell type identification in neuronal recordings. Zhiwen Ye*, Andrew M Shelton*, Jordan R Shaker, . . . , **Cole Hurwitz** . . . , Nicholas A Steinmetz. $*$ - Equal Contribution., *bioRxiv*. 2024
- DARTsort: A modular drift tracking spike sorter for high-density multi-electrode probes. Charlie Windolf*, Julien Boussard*, **Cole Hurwitz***, Hyun Dong Lee, Liam Paninski. $*$ - Equal Contribution., *bioRxiv*. 2023
- not-so-BigGAN: Generating High-Fidelity Images on Small Compute with Wavelet-based Super-Resolution. Seungwook Han*, Akash Srivastava*, **Cole Hurwitz***, Prasanna Sattigeri, David D. Cox. $*$ - Equal Contribution. *arXiv*. 2020
- Improving the Reconstruction of Disentangled Representation Learners via Multi-Stage Modelling. Akash Srivastava*, Yamini Bansal*, Yukun Ding*, **Cole Hurwitz***, Kai Xu, Bernhard Egger, Prasanna Sattigeri, Josh Tenenbaum, David D. Cox, Dan Gutfreund. $*$ - Equal Contribution. *arXiv*. 2020

Software

- SpikeInterface: Developed a unified framework for spike sorting (now widely used).
- EKS: Developed an ensembling and Kalman smoothing framework for pose estimation.
- TNDM: Developed a nonlinear state-space model, Targeted Neural Dynamical Modeling (TNDM), that jointly models neural activity and behavior
- NEDS: Supervised the development of model that can perform neural encoding and decoding across multiple animals.
- MtM: Supervised the development of a self-supervised modeling approach which learns to predict across different time steps, neurons, and brain regions.
- NEMO: Supervised the development of a multimodal contrastive learning method for cell-type and brain region classification.
- CEED: Supervised the development of a novel contrastive learning framework, CEED, for improving analysis of high-density extracellular recordings.
- Lightning Pose: Contributed to a pose estimation package that utilizes semi-supervised learning, Bayesian ensembling, and cloud-native open-source tools.
- SpikeForest: Contributed to the development of a standardized, web-based benchmarking platform for spike sorting algorithms.

- DARTsort: Contributed to the development of a modular drift tracking spike sorter for high-density probes.
- HS2: Contributed to the development of a spike sorting algorithm for dense multielectrode arrays. Real-time speeds for datasets from >4000 electrodes.

Invited Talks

2025 **Washington University in St. Louis** , *Building towards a brain-wide foundation model at single-cell, single-spike resolution*, 2025 Next Gen Symposium.

2025 **Bernstein Conference**, *Modeling neural activity and behavior at scale*, Workshop: Toward a joint definition of neural-behavioral states.

2025 **University College London**, *Building towards a brain-wide foundation model at single-cell, single-spike resolution*, Gatsby Tri-Center Annual Meeting.

2025 **Flatiron Institute**, *Building towards a brain-wide foundation model at single-cell, single-spike resolution*, International Brain Laboratory Annual Meeting.

2024 **University of Edinburgh**, *Drift-aware electrophysiology with DREDge and DARTsort*, Workshop: Tools and Methods for Next Generation Electrophysiology.

2024 **Cosyne**, *A simple deep ensembling and Kalman smoothing approach to pose tracking*, Workshop: I Can't Believe It's Not Better!.

2023 **Columbia University**, *Towards robust and generalizable representations of extracellular data using contrastive learning*, ZIPS - Zuckerman Institute Postdoctoral Seminar Series.

2019 **Allen Institute for Brain Science**, *SpikeInterface, a unified framework for spike sorting*.

2019 **University of Edinburgh**, *SpikeInterface, a unified framework for spike sorting*, Workshop: Spike Sorting and Reproducibility for Next Generation Electrophysiology.

2018 **Flatiron Institute**, *Scalable Spike Localization in Extracellular Recordings using Amortized Variational Inference*.

Community leadership

2025 **Workshop organizer**, *NeurIPS*, Foundation Models for the Brain and Body. A 1-day workshop to catalyze the next generation of AI models that can capture the complexity of the brain, body, and behavior at scale.

2025-present **Researchers Representative**, International Brain Laboratory (IBL).

2025 **Workshop organizer**, *Cosyne*, Building a foundation model for the brain: datasets, theory, and models. A 2-day workshop on how foundation models can be built for the brain.

2024 **Co-chair**, Zuckerman Institute Postdoctoral Seminar (ZIPS).

2023 **Seminar Organizer**, Zuckerman Institute Postdoctoral Seminar (ZIPS).

2019 **Workshop Organizer**, University of Edinburgh, Edinburgh.
Workshop: Spike Sorting and Reproducibility for Next Generation Electrophysiology

Teaching

2025 **Guest Lecture**, *CAJAL Summer School on Neuroscience and AI*.
Introduced neurofoundation models: large-scale models trained on data from many animals and brain regions. Discussed how the International Brain Laboratory is developing these approaches.

2025 **Tutorial**, *Cosyne*, Foundations of Transformers in Neuroscience.
Helped participants with code and questions during the session as a teaching assistant.

2025 **Guest Lecture**, *NYU*, Neuroinformatics .
Presented slides for a lecture on neural decoding, encoding, and self-prediction. Introduced neurofoundation models: large-scale models trained on data from many animals and brain regions.

2024 **Guest Lecture**, *Columbia*, Statistical analysis of neural data.
Created slides for a lecture on neural decoding, encoding, and self-prediction. Introduced neurofoundation models: large-scale models trained on data from many animals and brain regions.

2016 **Teaching Assistant**, University of Pennsylvania, Philadelphia.
Taught recitations and graded assignments/tests for an introductory calculus course.

2014–2016 **Athlete Tutor**, University of Pennsylvania, Philadelphia.
Tutored student-athletes in introductory calculus and physics.

Mentoring

2024 **Renee Tung (with Liam Paninski)**.
MD-PhD student - Medical Scientist Training Program, Columbia University

2024 **Hanrui Lyu (with Liam Paninski)**.
Research Assistant, Columbia University

2024 **Ethan Yixun Xu (with Liam Paninski)**.
Research Assistant, Columbia University

2024 **Yanchen Wang (with Liam Paninski)**.
Research Engineer, Stanford

2024 **Zixuan Wang (with Liam Paninski)**.
Undergraduate student, Columbia University

2023–present **Yizi Zhang (with Liam Paninski)**.
Ph.D. student - Dept. of Statistics, Columbia University

2023–present **Han Yu (with Liam Paninski)**.
Ph.D. student - Fu Foundation School of Engineering and Applied Science, Columbia University

2023 **Ankit Vishnubhotla (with Liam Paninski)**.
Masters student - Dept. of Computer Science, Columbia University

Awards and Honors

PhD NeurIPS travel award (£1400)
PhD OCNC: OIST Computational Neuroscience Course travel award (£500)
PhD Machine Learning Summer School (MLSS) Travel Award
BA Thouron Award – Two year UK postgraduate study fellowship
BA Summa Cum Laude
BA Major Flag Bearer, Logic Information and Computation
BA Phi Beta Kappa
BA USA Swimming Olympic Trials Qualifier
BA CSCAA Scholar All-American
BA 2016 USA Swimming Olympic Trials Qualifier
BA 2013-2017 Ivy League Championship Swimming Finalist