

Michael Hess

(he/him)

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Curious, rigorous, and results-oriented researcher with more than six years of experience integrating machine learning, statistical inference, and large-scale computation to address questions in the natural sciences. First published while still in high school for a summer project in environmental science, and has barely been outside of a laboratory team since then. Originally trained as an experimentalist, he has since transitioned to computational and theoretical work in neuroscience and biomechanics.

Education

PhD - Neuroscience

Emory University, Atlanta, GA

Expected 05/2026

Berman Laboratory IT/hardware administrator

Investigating neural pathways that coordinate dynamical locomotor stability.

Creating a data-driven framework to accurately quantify dynamical stability metrics of physical systems.

Bachelor of Arts - Neuroscience

Minor - Scientific Modeling

Claremont McKenna College, Claremont, CA

05/2021

Relevant Coursework: Data Structures and Algorithms, Computational Neuroscience, Machine Learning with Neural Signals, Computational Physics and Engineering, Computational Partial Differential Equations, Advanced Projects in Data Science (Internship with FlexFit LLC)

Thesis: Neurons as Learners - Time-Series Forecasting and Classification using Linear Reservoir Computers Subjected to Recurrent Time-Delayed Feedback

Technical Skills

Programming Languages

Python
→ Keras
→ Torch
→ JAX
Julia
SQL
MATLAB
Bash
C/C++

Frameworks

- Bayesian Inference
- Machine/Deep Learning
- Reinforcement Learning
- Scientific Machine Learning
- Physics-Informed Modeling
- Differentiable Programming

Relevant Skills & Interests

- High-Performance Computing
- Software engineering
- Hardware engineering
- 3D modeling and printing
- Nonlinear dynamics
- Biophysics

Publications & Conference Abstracts

Hess, M., Kang, S., & Berman, G. (2024) *Robust gait stability analyses using dynamical machine learning*. Bulletin of the American Physical Society. APS March Meeting 2024.
<https://meetings.aps.org/Meeting/MAR24/Session/M36.5>

Huang, J.-Y., Hess, M., Bajpai, A., Barton, S. J., Li, X., Hobson, L. N., & Lu, H.-C. (2022). *Sex- and GABAergic-modulated neuronal subnetwork assemblies in the developing somatosensory cortex* (p. 2022.10.23.513371). bioRxiv. <https://doi.org/10.1101/2022.10.23.513371>

Lamberti, M., Hess, M., Dias, I., van Putten, M., le Feber, J., & Marzen, S. (2022). Maximum entropy models provide functional connectivity estimates in neural networks. *Scientific Reports*, 12(1), 9656.

<https://doi.org/10.1038/s41598-022-13674-4>

Marzen, S., Lamberti, M., **Hess, M.**, Mehlman, J., Hernandez, D., & la Feber, J. (2020) *Inference of functional connectivity in living neural networks*. 29th Annual Computational Neuroscience Meeting. <https://doi.org/10.1186/s12868-020-00593-1>

Matheus, T. J., Maxwell, J. T., Oliver, J., Thornton, M., **Hess, M.**, & Harley, G. L. (2017). A dendrochronological evaluation of three historic pioneer cabins at Spring Mill Village, Indiana. *Dendrochronologia*, 43, 12–19. <https://doi.org/10.1016/j.dendro.2016.11.004>

Honors and Awards

Emory/Georgia Institute of Technology's
Computational Neural Engineering Training Program (T32)

10/2023

Scholar (No funding)

Simons-Emory International Consortium
on Motor Control Microaccelerator Grant

10/2023

One year of project support + travel funds

Marty Sunak Quantitative and Computing Laboratory Fellowship

01/2020-05/2021

Selected to lead data science workshops and mentor computational students

Claremont McKenna College Sponsored Internships
and Experiences Program

Summer 2018-2020

Grant for summer living expenses while conducting research

Eli Lilly Community Endowment Scholarship

12/2016

Full Tuition anywhere in Indiana

Room/Board at select colleges

QuestBridge National College Match Scholarship

12/2016

Full Tuition to Claremont McKenna College

Room/Board

Low-income scholarship

Experience

Doctoral Researcher

Emory University, Atlanta, GA

06/2022 - Present

Berman Laboratory

Research

- Leveraging scientific machine learning to learn individual-specific dynamical models of locomotion (in humans, mice, flies, etc.) and using information-theoretic approaches to sample from these models and estimate Floquet multipliers accurately, which historically has been plagued by finite-size bias and extreme susceptibility to noise.

Other

- TA for multiple courses at Emory, regular workshop leader for data science topics both on and off campus
- Volunteer guest teacher at local K-12 schools, focused on increasing interest in STEM in minoritized communities
- IT administrator for lab server hardware, responsible for training new students to use servers and program
- Frequent presenter and attendant at various journal clubs focused on computational science and theoretical physics

Tools Used Python (JAX, Equinox, Diffrax, Brax, Torch), Julia (DifferentialEquations.jl, Flux.jl), Bash, Git

Research Engineer

Indiana University, Bloomington, IN

04/2021 - 09/2021

Lu Laboratory

Research

- Helped turn a qualitative observation of changing sub-network dynamics through neural development in mice into quantitative results about sub-network clustering and connectivity.
- Implemented code to test our hypothesis, massively parallelized the processing (within processes), and created scripts to further parallelize processing using many high-performance computing nodes in parallel.
- Converted a legacy codebase that required lots of manual intervention/supervision to an automated data analysis pipeline, bringing analysis time down *from weeks to hours*.
- Helped with manuscript writing, and still helping with edits requested by reviewers as they arise.

Tools Used Slurm, Python, MATLAB, Bash

Research Assistant

Dell Medical School, Austin, TX

Clayton Biotechnologies Foundation, Austin, TX

04/2021 - 08/2021

Paydarfar Laboratory

Research

- Used Echo State Networks to predict extreme events like neural spiking, earthquakes, and stick-balancing with a goal of using these networks to predict neonatal asphyxiation before it occurs
- Worked both independently and collaboratively in a fast-paced laboratory environment.

Tools Used Python, MATLAB, Git

Research Assistant

W.M. Keck Science Center, Claremont, CA

01/2019 - 05/2021

Marzen Laboratory

Research

- Developed a tool to infer functional connectivity in neural networks using maximum entropy models, which enable identification of both excitatory and inhibitory connections
- Created multiple simulations of network activity to test the framework, applied the analysis to data from cultured neurons and made accurate predictions about network responses to unseen stimuli.
- Created and maintained all code for the project, debugging problems that arose from multiple collaborators.

Tools Used Python, Git

Teacher's Assistant

Claremont McKenna College, Claremont, CA

01/2019 - 05/2021

Introduction to Computational Neuroscience

Research

- Delivered pre-lab lectures, helped students complete laboratory assignments, helped grade assignments and exams, and held weekly office hours.

Tools Used Python, XPPAUT

Research Assistant

Indiana University, Bloomington, IN

05/2019 - 08/2019

Brain Networks and Behavior Laboratory

Research

- Converted diffusion tensor imaging of human brain scans into coarse-grained network models and evaluated the optimal control energy required to transition between brain states. Investigated whether transitioning between specific sub-networks required more energy for individuals of higher age with and without cognitive deficits.

- Created a MATLAB toolbox to streamline the data analysis and assess optimal control energy for arbitrary transitions between network states.

Tools Used MATLAB

Research Assistant

University of Washington, Seattle, WA

05/2018 - 08/2018

Fetz Laboratory

Research

- Worked with local field potential data collected from an implanted NeuroChip3 in non-human primates to determine phase-locking and coherence between multiple brain regions before and after various Vagus nerve stimulation protocols. Created an analysis script that automatically evaluates the data and saves the outputs for downstream processing.

Tools Used MATLAB

Research Assistant

Indiana University, Bloomington, IN

07/2016 - 08/2017

Lu Laboratory

Research

- Studied the effects of transgenic knockdown of NMNAT2, a neuronal maintenance on increased presence of genetic markers frequently associated with Alzheimer's Disease.
- Used techniques like whole-brain perfusion and fixation, brain-tissue cryogenic slicing, gel electrophoresis, immunohistochemical staining, and confocal imaging.
- Mentored, guided, and aided in project creation for two undergraduate students also studying NMNAT2.

Tools Used Excel

Research Assistant

Indiana University, Bloomington, IN

05/2016 - 09/2016

Environmental Tree Ring Laboratory

Research

- Collaborated with 6 laboratory members to extract, prepare, and evaluate the tree rings of 40+ log samples from pioneer cabins at Spring Mill State Park, some of which were hundreds of years old when felled
- Used statistical comparisons of tree ring growth to determine the age of the trees used in the pioneer cabins, providing an extension of environmental tree ring knowledge for southern-central Indiana almost 100 years further into history than any other published data
- Discovered erroneous historical records claiming construction dates of pioneer structures 40+ years before logs had even been cut down and aided in the process of writing up our results.

Tools Used Excel

Additional activities

Vice President, Workshop Leader

*Data Visualization and Analysis subcommittee of the Division
Student Advisory Council for the Graduate Division of Biological
and Biomedical Sciences*

08/2023 - Present

Teacher's Assistant

QTM 385

Analyzing Data in Many Dimensions

Fall 2024

Teacher's Assistant/Workshop Leader

*Jackson Laboratory's Short Course on the Application of Machine Learning
for Automated Quantification of Animal Behavior*

10/2023, 10/2024

Attendant

Les Houches Theoretical

Biophysics Summer School

Summer 2023

Teacher's Assistant

NBB 480

Applied Neuroethics

Spring 2023

Co-founder and Kaggle Team Leader

Vector Data Analytics (Data science club at Claremont McKenna College)

04/2019 - 05/2021

Technology and Innovations Chair

Associated Students of Claremont McKenna College

04/2018 - 06/2019