MEGAN R. EBERS

mebers@uw.edu | linkedin.com/in/meganebers | meganebers.github.io

Postdoctoral scholar in Applied Mathematics interested in physics-informed machine learning for engineering and scientific discovery. My interdisciplinary experience has equipped me to bridge the gap between theoretical modeling and practical applications for complex physical systems.

RESEARCH INTERESTS

- Machine learning, reduced-order models, data-driven model discovery, dynamical systems, time series, sensing
- Applications in engineering and natural sciences, complex systems, domain-specific algorithms

SKILLS

Python (numpy, scipy, pandas, scikit-learn), PyTorch, CUDA, HPC, MATLAB, Github, LaTeX, data visualization, data preparation, machine learning, mathematical modeling and simulation, pattern recognition, reduced-order modeling

EDUCATION

University of Washington, Seattle, WA
PhD, Mechanical Engineering — *August 2023*
MS, Applied Mathematics — *June 2022*
MS, Mechanical Engineering — *June 2020*

Colorado School of Mines, Golden, CO — *May 2018*
BS, Mechanical Engineering, minor in Biomechanical Engineering, magna cum laude

PROFESSIONAL EXPERIENCE

Postdoctoral Scholar, University of Washington Department of Applied Mathematics — *Sept 2023 – present*
Supported by the National Science Foundation's AI Institute in Dynamic Systems

Data-driven and reduced order modeling of complex dynamical and physical systems

- Data expansion to improve accuracy and availability of digital biomarkers for human health and performance
- Expanding and expediting sparse mobile sensing for large-scale natural disaster modeling and acoustic object detection using low-rank embedding
- Real-time low-rank framework for modeling dynamic systems with control in the low-data regime, while providing stable and robust uncertainty quantification

Graduate research assistant, University of Washington Department of Mechanical Engineering — *Aug 2018 – Aug 2023*
Co-advised by Dr. Katherine M. Steele and Dr. J. Nathan Kutz

Theoretical foundation of discrepancy modeling for dynamical systems

- Developed a hybrid (mechanism + data) modeling framework to learn missing physics, model systematic residuals, and disambiguate between deterministic and random effects in dynamical systems
- Automated the process of learning better models using data-driven model discovery (SINDy, DMD, Gaussian processes, feed-forward neural networks) for digital twins, improved control algorithms, and scientific discovery

Scientific machine learning to isolate individual responses to assistive technology

- Enabled researchers and engineers to personalize device design using an individual's physiological data (N=15)
- Applied neural network-based discrepancy modeling to isolate the response dynamics governing biomechanical changes in walking with ankle exoskeletons

Sparse sensing of complex dynamical systems with mobile sensors

- Multimodal reconstruction of high-dimensional complex systems that require mobile sensing, such as for personalized human movement tracking, fluid dynamics, and climate modeling
- Leveraged the time histories of mobile sensor for full-state estimation using time-delay embedded sensor trajectories with GPU-based shallow recurrent (LSTM) decoder networks

Machine learning and systems pharmacology intern, Genentech Research & Early Development — *June 2022 – Oct 2022*

- Collaborated with Translational Systems Pharmacology to recommend which preclinical drugs may succeed in clinical trials
- Developed a domain-specific GPU-based deep learning framework combining neural ODEs and shallow decoders to model sparse and irregular time series in low data regime

AWARDS AND HONORS

A2. National Science Foundation Graduate Research Fellow. *Sept 2019 – Aug 2022*
A1. University of Washington Graduate School Research Top Scholar Fellowship. *Sept 2018 – June 2019*

PEER-REVIEWED JOURNAL ARTICLES

P4. **Ebers MR**, Williams JP, Steele KM, Kutz JN. *Leveraging arbitrary mobile sensor trajectories with shallow recurrent decoder networks for full-state reconstruction.* (Submitted to IEEE Sensors: arXiv:2307.11793)
P3. **Ebers MR**, Rosenberg MC, Kutz JN, Steele KM. *A machine learning approach to quantify complex changes in gait with ankle exoskeletons.* (Published in the Journal of Biomechanics)
P2. Kutz JN, Bramburger J, **Ebers MR**, Koch J, Rahman A. *Universal Dynamics of Damped-Driven Systems: The Logistic Map as a Normal Form for Energy Balance.* (Submitted to Reviews of Modern Physics: arXiv:2211.11748)
P1. **Ebers MR**, Steele KM, Kutz JN. *Discrepancy Modeling Framework: Learning missing physics, modeling systematic errors, and disambiguating between deterministic and random effects* (Published in the SIAM Journal on Applied Dynamical Systems)

INVITED TALKS

T7. American Society of Biomechanics, Minisymposium. Can machine learning reveal the next generation of neural and biomechanical processes governing human movement?. *upcoming August 2024*
T6. Women in Data Science, Seattle University, Data expansion for improving accuracy and accessibility of digital biomarkers of health and performance. *upcoming May 2024*
T5. UW eScience Data Science Seminar series, Mobile Sensing with Shallow Recurrent Decoder Networks. *January 2024 (video)*
T4. SIAM Conference on Applications of Dynamical Systems, Minisymposium on Hybrid Modeling. *May 2023*
T3. Institute for Human and Machine Cognition, Machine Learning for Dynamical Models of Human Movement. *April 2023*
T2. Women in Data Science, Stanford University. *March 2023*
T1. Colorado School of Mines Computational Biomechanics lecture, virtual. *April 2021*

PEER-REVIEWED CONFERENCE ABSTRACTS

C9. SIAM Conference on Applications of Dynamical Systems. *Discrepancy Modeling Framework: Learning missing physics, modeling systematic residuals, and disambiguating between deterministic and random effects.* 2023
C8. Northwest Biomechanics Symposium. *Do in silico MTU dynamics improve predictions of AFO responses?* 2022.
C7. AI for Dynamic Systems workshop. *Discrepancy Modeling Framework: Learning missing physics, modeling systematic residuals, and disambiguating between deterministic and random effects.* 2022
C6. Dynamic Walking (virtual). *Discrepancy Modeling of Ankle Exoskeleton Walking Can Improve Response Predictions.* 2021
C5. American Society of Biomechanics (virtual). *Biomechanically-Constrained Machine Learning for the Identification of Mechanistic Discrepancies.* 2020
C4. Dynamic Walking (virtual). *Discrepancy Modeling in Bipedal Dynamics.* 2020
C3. International Society of Biomechanics. *Do Simulated Synergies Accurately Represent Muscle Coordination?* 2018
C2. Northwest Biomechanics Symposium. *Evaluating Altered Muscle Synergies Following Surgical Intervention in Cerebral Palsy Using Matrix Factorization Algorithms.* 2018
C1. Rocky Mountain American Society of Biomechanics. *The Design and Validation of a Passive Foot Prosthesis with Adjustable Plantarflexion.* 2017