MEGAN R. EBERS

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Postdoctoral scholar in Applied Mathematics interested in machine learning for extracting actionable insight from real-world data. My unique interdisciplinary experience has equipped me to bridge the gap between theoretical modeling and practical applications for personalized health technologies.

RESEARCH INTERESTS

- Machine learning, sparse sensing, data-driven model discovery, dynamical systems, time series, signal processing
- Applications in engineering and physical sciences; human mobility, health, and accessibility; wearable technology

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 2022*

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

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AWARDS AND HONORS

National Science Foundation Graduate Research Fellow — *Sept 2019 – Aug 2022*

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)

PEER-REVIEWED CONFERENCE ABSTRACTS

2023 **SIAM Conference on Applications of Dynamical Systems**
Discrepancy Modeling Framework: Learning missing physics, modeling systematic residuals, and disambiguating between deterministic and random effects

2022 **Northwest Biomechanics Symposium**
Do in silico MTU dynamics improve predictions of AFO responses?

2022 **AI for Dynamic Systems workshop**
Discrepancy Modeling Framework: Learning missing physics, modeling systematic residuals, and disambiguating between deterministic and random effects

2021 **Dynamic Walking (virtual)**
Discrepancy Modeling of Ankle Exoskeleton Walking Can Improve Response Predictions

2020 **American Society of Biomechanics (virtual)**
Biomechanically-Constrained Machine Learning for the Identification of Mechanistic Discrepancies

2020 **Dynamic Walking (virtual)**
Discrepancy Modeling in Bipedal Dynamics

2018 **International Society of Biomechanics**
Do Simulated Synergies Accurately Represent Muscle Coordination?

2018 **Northwest Biomechanics Symposium**
Evaluating Altered Muscle Synergies Following Surgical Intervention in Cerebral Palsy Using Matrix Factorization Algorithms

2017 **Rocky Mountain American Society of Biomechanics**
The Design and Validation of a Passive Foot Prosthesis with Adjustable Plantarflexion

INVITED TALKS

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 conference, Stanford University. *March 2023*
T1. Colorado School of Mines Computational Biomechanics lecture, virtual. *April 2021*