MEGAN R. EBERS

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Postdoctoral Scholar in Applied Mathematics interested in data-driven modeling of complex systems to extract actionable insight from real-world data. Rather than focusing on just one application domain, I'm excited about applying my ML expertise to a wide variety of complex problems, such as human movement, pharmacology, electromagnetism, fluids, and climate.

RESEARCH INTERESTS

Machine learning/AI, hybrid (mechanism+data) modeling, deep learning, sparse sensing, data-driven engineering; application to engineering and physical sciences, complex systems, creative and challenging real-world problems

EDUCATION

PhD, Mechanical Engineering *August 2023*

University of Washington, Seattle, WA; Co-advisors: Katherine M Steele, J Nathan Kutz

Dissertation: Machine learning for dynamical models of human movement

- **NSF Graduate Research Fellow**
- **NSF AI Institute for Dynamic Systems member**

MS, Applied Mathematics *June 2022*

University of Washington, Seattle, WA

MS, Mechanical Engineering *June 2020*

University of Washington, Seattle, WA

BS, Mechanical Engineering, minor in Biomechanical Engineering *May 2018*

Colorado School of Mines, Golden, CO; Honors: magna cum laude

COMPUTATIONAL SKILLS

Python (numpy, PyTorch, pandas, TorchDiffEq, Altair, CUDA); MATLAB; HPC; LaTeX

RELEVANT EXPERIENCE

Postdoctoral Scholar, UW Department of Applied Mathematics *Sept 2023 – present*

Data-driven and reduced order modeling of complex dynamical systems

- Creating a reduced-order modeling framework for stable and robust uncertainty quantification
- Expanding applications of sparse sensing with mobile sensors for complex behavior (e.g., human movement, EM)
- Incorporating discrepancy modeling into established ML frameworks (e.g., reinforcement learning) for improved performance in real-world deployment

Research assistant, UW Department of Mechanical Engineering *Aug 2018 – Aug 2023*

Theoretical foundation of discrepancy modeling for dynamical systems

- Developed a data-driven framework to learn missing physics, model systematic residuals, and disambiguate between deterministic and random effects in dynamical systems
- Disseminated findings in a first author publication (P1), an invited minisymposium for SIAM's Conference on Applications of Dynamical Systems (T4), and an interview for Women in Data Science's Stanford conference (T2)

Quantification of individual gait responses to ankle exoskeletons during walking

- Integrated deep learning with discrepancy modeling to model dynamic changes in joint kinematics and electromyography in response to exoskeleton intervention in a nondisabled population
- Disseminated findings in a first author publication (P3), oral presentations at two academic conferences, and an interview for Women in Data Science's Stanford conference (T2)

Sparse sensing of complex dynamics with mobile sensors

- Leveraged mobile sensor trajectories with shallow recurrent decoder networks for full-state reconstruction (P4)
- Demonstrated sparse yet accurate monitoring of human movement "in-the-wild", turbulent flow, and global sea-surface temperature

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

- Investigated deep learning (DL) techniques to model preclinical pharmacokinetics
- Collaborated with the Translational Systems Pharmacology group to embed domain knowledge in DL framework

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 Science Advances: 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* (Under review in SIADS: arXiv:2203.05164)

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 **Dynamic Walking (virtual)**
Do in silico MTU dynamics improve predictions of AFO responses?

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

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*