

MELISSA BUTLER

mbutle15@uwyo.edu | butlerm0405.github.io | 307-705-3184 | Laramie, WY

RESEARCH INTERESTS

Computational and Applied Mathematics, Data Science, Scientific Computing, Machine Learning, Network Science, Anomaly Detection, Modeling, Random Matrix Theory, Human Mobility Patterns

EDUCATION

PhD in Mathematics University of Wyoming	Anticipated Graduation May 2026
* Dissertation: Anomaly detection algorithms for human mobility and other complex networks	
* Committee: Dr. Dane Taylor (Chair/Advisor), Dr. Victor Ginting, Dr. Bryan Shader, Dr. Long Lee, Dr. Chen Xu	
MS in Mathematics University of Wyoming	December 2022
* Concentration: Numerical Methods and Mathematical Modeling	
BS in Mathematics University of Wyoming	May 2019
* Minor: Computer Science	

PUBLICATIONS

- * M. Butler, A. Khan, F. Afrifa, Y. Hu, and D. Taylor (2026) *Multilayer networks characterize human-mobility patterns by industry sector for the 2021 Texas winter storm*. Accepted to NPJ Complexity. <https://arxiv.org/abs/2509.03642>
- * M. Butler, D. Taylor *Detecting small anomalous communities in networks with background structure*. In preparation.
- * M. Sejunti, M. Butler, Y. Hu, and D. Taylor *Predictability of human movement in multilayer mobility networks*. In preparation.
- * M. Butler, V. Ginting *Uncertainty in boundary values of Richards Equation*. In preparation.

RESEARCH AND PROJECTS

PhD Research | University of Wyoming

Detecting Anomalous Temporal and Community Structures in Complex Networks. I developed methods for detecting and quantifying the impact of anomalous temporal and community structures within complex networks using spectral methods and statistical analysis. I applied this to human mobility data.

MS Research | University of Wyoming

Uncertainty in Boundary Values of Richards Equation. I applied a finite volume method to derive a numerical solution of Richards Equation, governing semi-saturated fluid dynamics, and incorporated stochastic boundary conditions to quantify precipitation uncertainty.

Graduate Course Projects | University of Wyoming

Metalearning for Machine Learning Optimization. I created machine learning algorithms to optimize selection of ML learner, data preparation, and hyperparameter selection.

Physics Informed Neural Networks for Initial Value Problems. I adapted code to create a PINN for solving initial value problems and research current literature for PINN's.

Finite Element Method for Solving Two-point Boundary Value Problems. I worked in collaborative group to create objected oriented software in MATLAB for solving BVP's.

Conjugate Gradient Method. I implemented the conjugate gradient method using C++ and applied it to differential equations.

MELISSA BUTLER

mbutle15@uwyo.edu | butlerm0405.github.io | 307-705-3184 | Laramie, WY

PRESENTATIONS

September 25, 2025	<i>Multilayer networks characterize human-mobility patterns by industry sector for a Texas winter storm.</i> Wyoming Computing Symposium: AI For WY Industries, Laramie, WY
June 24, 2025	<i>Multilayer networks characterize human-mobility patterns by industry sector for a Texas winter storm.</i> 2025 UCGIS Symposium, Navigating the Geospatial Frontier: Future Directions for Academia and Its Partners, Laramie, WY
October 15, 2024	<i>Characterizing anomalous human mobility patterns during the 2021 Texas winter storm.</i> I-GUIDE Forum 2024, Convergence Science and Geospatial AI for Environmental Sustainability, Jackson, WY
March 12, 2022	<i>Quantifying uncertainty in Richards equation through Brownian Motion.</i> SIAM 18 th Front Range Applied Mathematics Student Conference, Denver, CO (virtual participation)

SOFTWARE AND COMPUTING EXPERTISE

Languages

Python	Anomaly Detection in Networks, Machine Learning, Data Science
C++	Finite Volume Method, Stochastic Gradient Decent, Iterative Techniques
MATLAB	Finite Element Method, Scientific Computing Techniques
OpenMP	Parallel Computing, Decentralized Computing Network
Mathematica	Mathematical Modeling

Professional Development Workshops

2022	<i>Fundamentals of Accelerated Computing with CUDA C/C++</i> NVIDIA DLI
2022	<i>Fundamentals of Deep Learning</i> NVIDIA DLI
2022	<i>Parallel Computing Workshop</i> MATLAB

GRADUATE COURSEWORK

2023 - 2024	Random Matrix Theory for Anomaly Detection, Combinatorial Matrix Theory, Advanced Topics in AI, Computational Methods III, Practical Applications of Machine Learning, Machine Learning for Fluid Dynamics
2021 – 2022	Multiscale Modeling, Permutation Groups, Introduction to Machine Learning, Advanced High-Performance Computing, Computational Methods II, Functional Analysis, Bayesian Numerical Analysis, Real Variables
2019 – 2020	Stochastic Processes, Advanced Partial Differential Equations, Computational Methods I, Introduction to High Performance Computing, Abstract Algebra, Advanced Linear Algebra, Methods of Applied Mathematics, Complex Variable

TEACHING EXPERIENCE

2024-2025	Undergraduate Research Mentor University of Wyoming Topic: Network science for human mobility patterns
2020-2023	Instructor of Record University of Wyoming Courses: Differential Equations, Calculus I, Math Apps for Business, Trigonometry
2018-2023	Teaching Assistant University of Wyoming Courses: Scientific Computing, Calculus II, College Algebra
2017-2023	Tutor University of Wyoming Center for Assistance in Statistics and Mathematics