# Daniel Ames Messenger                    December, 2022

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Google Scholar: https://scholar.google.com/citations?user=bg1DXK0AAAAJ&hl=en&oi=ao

## Education

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| August 2022 | **PhD** Applied Mathematics | University of Colorado Boulder (UCB) |
| July 2019 | **MSc** Applied Mathematics | Simon Fraser University (SFU) |
| May 2015 | **BSc** Mathematics, **BA** Physics | University of Puget Sound (UPS) |

## Research Interests

- Robust and efficient machine learning algorithms for automated discovery of mathematical models from data

- Emergent phenomena in large systems of autonomous agents (e.g. financial markets, autonomous vehicles, biological swarms, plasma physics)

## Research Experience

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| Summer 2022 - (current) | **Postdoctoral Research Associate**, Dept. of Applied Mathematics, UCB; Supervisor: David Bortz |
| Summer 2020 - Summer 2022 | **Research Assistant**, Department of Applied Mathematics, UCB; Supervisor: David Bortz |
| Summer 2019 | **Research Assistant**, Department of Mathematics, SFU; Supervisors: Razvan Fetecau, Ralf Wittenberg |
| Summer 2018 | **Research Assistant**, Department of Mathematics, SFU; Supervisors: Razvan Fetecau, Ralf Wittenberg |
| Summer 2014 | **Research Intern**, Visiting Faculty Program, U.S. Department of Energy, Pacific Northwest National Lab (PNNL); Supervisors: Amanda Mifflin (UPS), P. El-Khoury (PNNL) |

## Preprints

1. Daniel A Messenger and David M Bortz. Asymptotic consistency of the WSINDy algorithm in the limit of continuum data. arXiv preprint arXiv:2211.16000, 2022

## Publications

1. Daniel A Messenger, Graycen E Wheeler, Xuedong Liu, and David M Bortz. Learning anisotropic interaction rules from individual trajectories in a heterogeneous cellular population. Journal of the Royal Society Interface, 19, October 2022

2. Daniel A. Messenger, Emiliano Dall'Anese, and David Bortz. Online weak-form sparse identification of partial differential equations. In Bin Dong, Qianxiao Li, Lei Wang, and Zhi-Qin John Xu, editors, Proceedings of Mathematical and Scientific Machine Learning, volume 190 of Proceedings of Machine Learning Research, pages 241–256. PMLR, 15–17 Aug 2022

3. Daniel A. Messenger and David M. Bortz. Learning mean-field equations from particle data using wsindy. Physica D: Nonlinear Phenomena, page 133406, July 2022

4. Daniel A. Messenger and David M. Bortz. Weak SINDy For Partial Differential Equations. Journal of Computational Physics, 443:110525, October 2021

5. Daniel A. Messenger and David M. Bortz. Weak SINDy: Galerkin-Based Data-Driven Model Selection. SIAM Multiscale Modeling & Simulation, 19(3):1474–1497, Sept. 2021

6. Daniel Messenger and Razvan C. Fetecau. Equilibria of an aggregation model with linear diffusion in domains with boundaries. Mathematical Models and Methods in Applied Sciences, 30(04):805–845, April 2020

7. Razvan C. Fetecau, Hui Huang, Daniel Messenger, and Weiran Sun. Zero-diffusion limit for aggregation equations over bounded domains. Discrete and Continuous Dynamical Systems, Oct. 2022

## Posters & Presentations

[1] **Normal and Enhanced Vibrational Spectroscopy**. Summer Intern Research Symposium, Pacific Northwest National Laboratory, Richland, WA. July 28, 2014.

[2] **Normal and Enhanced Vibrational Spectroscopy**. Fall Physics Research Symposium, University of Puget Sound, Tacoma, WA. Oct. 17, 2014.

[3] **Self-Organization in Domains with Boundaries**. Math Graduate Seminar, Simon Fraser University, Burnaby, BC. July 12, 2018.

[4] **Interacting Particle Systems: Numerics for the Zero-Diffusion Limit**. Canadian Mathematical Society (CAS), Winter Meeting, Vancouver, BC. Dec. 7, 2018.

[5] **Aggregation-Diffusion Phenomena in Domains with Boundaries**. Canadian Applied and Industrial Mathematics Society (CAIMS), Annual Meeting, Whistler, BC. June 10, 2019.

[6] **Aggregation-Diffusion Phenomena in Domains with Boundaries**. Mathematical Biology Seminar, University of Colorado, Boulder, CO. Dec. 10, 2019.

[7] **Aggregation-Diffusion Phenomena in Domains with Boundaries**. SIAM Front Range Student Conference, University of Colorado, Denver, CO. March 7, 2020.

[8] **Weak SINDy: Galerkin-Based Data-Driven Model Selection**. SAMM 2020, Max Planck Institute for Dynamics of Complex Systems, Magdeburg, GE. July 27, 2020.

[9] **Data-Driven Model Selection using Weak SINDy**. Mathematical Biology Seminar, University of Colorado, Boulder, CO. Sept. 21, 2020.

[10] **Data-Driven Model Selection using Weak SINDy**. APPM Recruitment Symposium, University of Colorado, Boulder, CO. March 5, 2021.

[11] **Data-Driven Model Selection using Weak SINDy**. T-5 Reading Group, Theoretical Division, Los Alamos National Laboratory, NM. Aug. 6, 2021.

[12] **Data-Driven Model Selection using Weak SINDy**. APPM Recruitment Symposium, University of Colorado, Boulder, CO. March. 11, 2022.

[13] **Data-Driven Model Selection using Weak SINDy**. AI Institute in Dynamics, University of Washington, Seattle, WA. March. 16, 2022.

[14] **WSINDy MATLAB tutorial: ODEs & PDEs**. Guest lecture and workshop, APPM 4720 Data-Driven Modeling, UCB. April 5 & 7, 2022.

[15] **Online Weak-form Sparse Identification of Partial Differential Equations**. Mathematical and Scientific Machine Learning 2022 (MSML2022), Beijing, China. Aug. 16, 2022.

[16] **Using WSINDy to Learn Anisotropic Interaction Rules from Individual Trajectories in a Heterogeneous Cellular Population**. SIAM Conference on Mathematics of Data Science (MDS22), San Diego, CA. Sept. 28, 2022.

[17] **Weak-form sparse identification of differential equations from noisy measurements**. SFU Applied and Computational Math Seminar, Burnaby, BC. Oct. 7, 2022.

## Press

[1] "New study shows how to learn the equations of cell migration", Daniel Strain. Oct 26, 2022. CU Boulder Today. `https://www.colorado.edu/today/2022/10/26/new-study-shows-how-learn-equations-cell-migration`.

[2] "CU Boulder joins national effort to advance nuclear fusion research". Oct 19, 2022. University of Colorado Boulder Arts & Sciences Magazine. `https://www.colorado.edu/asmagazine/2022/10/19/cu-boulder-joins-national-effort-advance-nuclear-fusion-research`.

## Teaching

| 2020–2021 | **Co-Instructor**, Department of Applied Mathematics, UCB |
| | APPM 7400 Teaching Excellend (Fall 2020) |

| 2019– 2020 | **Teaching Assistant**, Department of Applied Mathematics, UCB |
| | APPM 1350 Calculus I (Fall 2020) |
| | APPM 2360 Differential Equations (Spring 2020) |
| | APPM 2350 Calculus III (Fall 2019) |

| 2017–2019 | **Teaching Assistant**, Department of Mathematics, SFU |
| | MACM 316 Numerical Analysis (Spring 2019) |
| | MATH 303 Set Theory and Logic (Fall 2018) |
| | Math 310 Differential Equations (Spring 2018) |
| | Calculus I,II,III (Fall 2017) |

| 2015 | **Lab Assistant**, Physics Department, UPS |
| | PHYS 110 College Physics 2 (Spring 2015) |

## Professional Service

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| - | **Reviewer**, Phys. D, JCP, SIADS |
| Dec. 9$^{th}$, 2022 | **Calculus workshop leader**, Peak to Peak High School, Colorado |
| Fall 2021 - Spring 2022 | **President**, SIAM graduate student chapter, UCB |
| Fall 2021 - Spring 2022 | **Peer mentor**, Department of Applied Mathematics, UCB |
| Fall 2021 | **Organizer, Co-creator**, APPM Graduate Student Seminar, Department of Applied Mathematics, UCB |
| Summer 2020 - Spring 2021 | **Lead Teaching Assistant**, Center for Teaching and Learning & Department of Applied Mathematics, UCB |
| Spring 2020, Spring 2021, Spring 2022 | **Organizer**, SIAM Front Range Student Conference |
| Fall 2019 | **Secretary**, SIAM graduate student chapter, UCB |
| Fall 2018 - Summer 2019 | **Vice President**, grill master, ski-trip organizer, Math Graduate Caucus, SFU |
| Spring 2019 | **Councilor**, Graduate Student Society, SFU |
| Fall 2019 - Spring 2019 | **Committee Member**, Internal Relations Committee, Teacher and Support Staff Union, SFU |

## Awards & Scholarships

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| 2022 | Graduate Student Travel Award (MDS22) | SIAM |
| 2019 | Special Entrance Scholarship | UCB |
| 2019 | MSc Thesis Certificate with Distinction | SFU |
| 2018 | Best Poster Award | SFU Summer Research Symposium |
| 2018 | Graduate Fellowship | SFU |
| 2017 | Special Entrance Scholarship | SFU |
| 2015 | Successful Participant | Mathematical Contest in Modeling |
| 2011-2015 | Dean's Scholarship | UPS |
| 2012-2014 | Hoffman Construction Scholarship | UPS |

## Programming Languages

MATLAB, LaTeX, Git, Unix, Python, Mathematica