# Amanda A. Howard, Ph.D.

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| CONTACT INFORMATION | 3914 SW Brandon Street<br>Seattle, WA 98136 | amanda.howard@pnnl.gov<br>+1 (650) 906-2232 |

RESEARCH INTERESTS

Multiphase flows, physics-informed machine learning, suspension flows, computational fluid mechanics, high performance computing, conservative methods

**EDUCATION**

**Brown University, Providence, RI**

*Ph.D., Applied Mathematics* — May 2018
*Sc.M., Applied Mathematics* — May 2014

- Advisor: Martin Maxey, Professor of Applied Mathematics, Brown University
- Dissertation: Numerical simulations to investigate particle dispersion in non-homogenous suspension flows.
- Relevant coursework: High Performance Computing, Computational Fluid Dynamics, Numerical Solutions to Partial Differential Equations, Partial Differential Equations, Complex Fluids

**Stanford University, Stanford, CA**

*B.S., Mathematics* — June 2012
*Minors: Physics and Computer Science*

**PROFESSIONAL APPOINTMENTS**

**Pacific Northwest National Laboratory, Richland, WA**

*Mathematician* — July 2020 – present
*Post Doctorate Research Associate* — July 2018 – July 2020
Advisor: Dr. Alexandre Tartakovsky

**Sandia National Laboratories, Albuquerque, NM** — March 2017
*Intern*

**IPAM, University of California, Los Angeles, CA** — June 2011 – August 2011
*Research in Industrial Projects for Students*
Advisor: Professor Jorge Balbas, California State University, Northridge

**HONORS AND AWARDS**

**Fellowships and Grant Support**

Pacific Northwest National Laboratory Labratory Directed Resarch and Development *"A Multifidelity and Multimodal Machine Learning Approach for Extracting Bonding Environments of Impurities and Dopants from X-ray Spectroscopies"*, Co-PI — December 2021

XSEDE Startup Allocation for *"Particle dispersion and segregation in suspension flows with bidispersed particle sizes"* project, Primary Investigator. Value: $2,066.50 — August 2017

National Science Foundation Graduate Research Fellowship — June 2014

**Awards**

Rising Star in Computational and Data Sciences — April 2019
Brown University Graduate Contribution to Community Life Award — May 2018
Simon Ostrach Fellowship, Division of Applied Mathematics, Brown University — May 2018
Brown University Chapter of the Society of Sigma Xi — April 2018
Stanford University Award of Excellence — June 2012

**PAPERS**

**Howard, Amanda A.**, Maxey, Martin R., & Gallier, Stany. (2022). A bidisperse suspension balance model. *Physical Review Fluids, 7,* 124301.

**Howard, Amanda A.**, Perego, Mauro, Karniadakis, George E., & Stinis, Panos. (2022). Multifidelity Deep Operator Networks. *arXiv,* arXiv:2204.09157.

**Howard, Amanda A.**, Yu, Tong, Wang, Wei, & Tartakovsky, Alexandre M. (2022). Physics-informed CoKriging model of a redox flow battery. *Journal of Power Sources, 542,* 231668.

**Howard, Amanda A.**, & Tartakovsky, Alexandre M. (2021). A conservative level set method for $N$-phase flows with a free-energy-based surface tension model. *Journal of Computational Physics, 426,* 109955.

Reyes, Brandon, **Howard, Amanda A.**, Perdikaris, Paris, & Tartakovsky, Alexandre M. (2021). Learning unknown physics of non-Newtonian fluids. *Phys. Rev. Fluids, 6,* 073301.

**Howard, Amanda A.**, & Tartakovsky, Alexandre M. (2020). Non-local model for surface tension in fluid-fluid simulations. *Journal of Computational Physics,* 109732.

**Howard, Amanda A.**, Zhou, Yongcheng, & Tartakovsky, Alexandre M. (2019). Analytical steady-state solutions for pressure with a multiscale non-local model for two-fluid systems. arXiv:1905.08052.

**Howard, Amanda A.**, Maxey, Martin R., & Yeo, Kyongmin (2018). Settling of heavy particles in concentrated suspensions of neutrally buoyant particles under uniform shear. *Fluid Dynamics Research, 4,* 041401.

**Howard, Amanda A.** & Maxey, Martin R. (2018). Simulation study of particle clouds in oscillating shear flow. *J. Fluid Mech, 852,* 484-506.

Cui, Francis R., **Howard, Amanda A.**, Maxey, Martin R. & Tripathi, Anubhav (2017). Dispersion of a suspension plug in oscillatory pressure-driven flow. *Phys. Rev. Fluids, 2,* 094303.

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| REPORTS | D'Elia, Marta, **Howard, Amanda A.**, Kirby, Michael R., Kutz, Nathan, Tarkavoksky, Alexandre, & Viswanathan, Hari. (2021). Machine Learning in Heterogeneous Porous Materials: Discovering New Governing Equations Using Machine Learning. *arXiv,* arXiv:2203.04137. |

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| INVITED TALKS | 2022 | *Multifidelity Machine Learning Methods* <br> CMIT Seminar, University of Liverpool, Liverpool, UK (virtual) |
| | 2022 | *High performance computing for multiphase flows* <br> 2022 HPC Parallel Programming Workshop, Lehigh University, Bethlehem, PA (virtual) |
| | 2022 | *Multifidelity Deep Operator Networks* <br> CRUNCH Seminar, Brown University, Providence, RI (virtual) |
| | 2022 | *Nonlocal surface tension for N-phase flows* <br> Fluids Seminar, Brown University, Providence, RI (virtual) |
| | 2021 | *Two multifidelity approaches for machine learning* <br> RAMSES: Reduced order models; Approximation theory, Machine Learning; Surrogates, Emulators and Simulators, Trieste Italy (virtual) |
| | 2021 | *Nonlocal models for modeling multiphase fluids* <br> Arizona State University, Tempe, AZ (virtual) |
| | 2021 | *Nonlocal models for modeling multiphase fluids* <br> San Diego State University, San Diego, CA (virtual) |
| | 2021 | *Nonlocal models for modeling multiphase fluids* <br> University of Washington, Seattle, WA (virtual) |
| | 2018 | *Particle Dispersion in Non-Homogeneous Suspension Flows* <br> National Institute of Standards and Technology, Gaithersburg, MD |
| | 2017 | *Particle Dispersion in Non-Homogeneous Suspension Flows* <br> Computational and Applied Math Seminar, Tufts University, Medford, MA |

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| CONTRIBUTED TALKS AND POSTER PRESENTATIONS | 2022 | Presentation: *Physics-informed machine learning for particle stresses in dense suspensions.* APS Division of Fluid Dynamics, Indianapolis, IN (Virtual). |
| | 2022 | Presentation: *Multifidelity Deep Operator Networks.* The Sixth Annual Sandia Machine Learning and Deep Learning (MLDL) Workshop, Albuquerque, NM (virtual). |
| | 2022 | Presentation: *Multifidelity Deep Operator Networks.* SIAM Annual Meeting, Pittsburgh, PA (virtual). |

2022    Presentation: *Multifidelity Nonlinear Operator Learning.* TechFest, Pacific Northwest National Laboratory, Richland, WA (virtual).

2022    Presentation: *Learning unknown physics of non-Newtonian fluids.* SIAM PNW, Vancouver, WA (virtual).

2022    Presentation: *Physics-informed CoKriging model of a redox flow battery.* Artificial Intelligence for Robust Engineering & Science 3, Knoxville, TN (virtual).

2021    Presentation: *Physics-informed CoKriging model of a redox flow battery.* MRS, Boston, MA (virtual).

2021    Presentation: *Physics-informed CoKriging model of a redox flow battery.* MMLDT-CSET, San Diego, CA (virtual).

2021    Presentation: *Physics-informed CoKriging model of a redox flow battery.* ACS, Atlanta, GA (virtual)

2021    Presentation: *Learning a non-local model for non-Newtonian fluid rheology.* Non-local World (virtual)

2020    Presentation: *Learning unknown physics of non-Newtonian fluids.* International Congress on Rheology, Rio, Brazil (virtual)

2019    Presentation: *Non-local surface tension model for N-phase flows.* APS Division of Fluid Dynamics, Seattle, WA

2019    Presentation: *Conservative level set method for N-phase flows with a non-local surface tension model.* SIAM PNW, Seattle, WA

2019    Presentation: *Non-local surface tension model for multiphase flows.* Rising Stars in Computational and Data Science, Austin, TX

2019    Presentation: *A mathematical model for fluid flow in a fractured media.* Association for Women in Mathematics Research Symposium, Dallas, TX

2018    Presentation: *Simulations of suspension flows with a meshless moving least squares scheme.* World Congress on Computational Mathematics, New York, NY

2018    Poster: *Simulation study of particle clouds in oscillating shear flow.* Women in Mathematics of Materials, Ann Arbor, MI

2018    Presentation: *Simulations of suspension flows with a meshless moving least squares scheme.* Joint Mathematics Meetings, San Diego, CA

2017    Presentation: *Particle dispersion and segregation in suspension flows with bidispersed particle sizes.* APS Division of Fluid Dynamics, Denver, CO

2017    Poster: *Implementation of a meshless MLS scheme for simulations of suspension flows.* SC17 Women in HPC Workshop, Denver, CO

2017    Presentation: *Simulations of Suspension Flows with a Meshless MLS Scheme.* 18th International Workshop on Numerical Methods for Non-Newtonian Flows and 3rd Complex Fluids and Flows in Industry and Nature workshop, Vancouver, Canada

2017    Presentation: *Investigating Irreversibility in Suspension Flows.* Applied Mathematics Graduate Seminar, Brown University, Providence, RI

2017    Presentation: *Simulations of Viscous Suspension Flows with a Meshless MLS Scheme.* SIAM Conference on Computational Science and Engineering, Atlanta, GA

2016    Presentation: *Development of wall layering in non-homogenous suspension shear flows.* APS Division of Fluid Dynamics, Portland, OR

2016    Presentation: *Particle fluxes and irreversibility due to shear flow in a bidisperse suspension.* International Conference on Multiphase Flow, Florence, Italy

2016    Presentation: *Simulation study of oscillating particle clouds.* Rensselaer Polytechnic Institute Applied Math Days, Troy, NY

2015    Presentation: *Particle Dispersion in Non-Stationary Suspension Flows.* Applied Mathematics Graduate Seminar, Brown University, Providence, RI

2015    Presentation: *Particle dispersion in non-stationary and non-uniform suspension flows.* APS Division of Fluid Dynamics, Boston, MA

2015    Presentation: *Particle Dispersion in Oscillating Suspension Flows.* CRUNCH Seminar, Brown University, Providence, RI

2014    Presentation: *Simulation study of suspension plugs in unsteady microchannel flows.* APS Division of Fluid Dynamics, San Francisco, CA

2012    Poster: *Volumetric Mode Sorter based on Phase Holography.* Joint Math Meetings, Boston, MA

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| TEACHING EXPERIENCE | **University of Washington** |
| | 2020 Fall    Math 399: Washington Experimental Project Lab project leader |
| | **Brown University** |
| | 2014 – 2017    Workshop leader, Sheridan Center for Teaching and Learning |
| | 2015 Summer    Catalyst Summer Program Mathematics Instructor (online course) |
| | 2015 Spring    Applied Mathematics 350: Methods of Applied Mathematics I teaching assistant |
| | 2014 Spring    Applied Mathematics 350: Methods of Applied Mathematics I teaching assistant |
| | 2014 Spring    Guest lecturer, Applied Mathematics 330: Methods of Applied Mathematics I |
| | 2013 Spring    Grader, Applied Mathematics 116: Introduction to Scientific Computing |

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| WORKSHOPS attended | May 2018    Women in Mathematics of Materials, University of Michigan, Ann Arbor, MI |
| | August 2016    Argonne Training Program on Extreme-Scale Computing, Argonne National Laboratory, St. Charles, IL |
| | June 2016    Summer School on Multiscale Modeling of Materials, Stanford University, Stanford, CA |
| | May 2014    Collective Dynamics of Particles: from Viscous to Turbulent Flows, International Centre for Mechanical Sciences, Udine, Italy |

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| EDUCATION training | 2017 – 2018    Sheridan Center for Teaching and Learning: Head Teaching Consultant for STEM |
| | 2015 – 2017    Sheridan Center for Teaching and Learning: Experienced Teaching Consultant |
| | 2015 – 2016    Sheridan Center for Teaching and Learning Certificate II: Course Design |
| | 2014 – 2015    Sheridan Center for Teaching and Learning Certificate IV: Teaching Consultant |
| | 2013 – 2014    Sheridan Center for Teaching and Learning Certificate I: Reflective Teaching |

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| COMPUTER SKILLS | • Languages: C, C++, R, Python, Matlab |
| | • Libraries: MPI, OpenMP, FFTW, TensorFlow, JAX |
| | • Publishing: LaTeX |

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| OUTREACH AND SERVICE | **Service to Research Community** |

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| *Minisymposium co-organizer*, SIAM Annual Meeting | 2022 |
| *Minisymposium co-organizer*, MMLDT-CSET meeting | 2021 |
| *Minisymposium co-organizer*, SIAM PNW Section Meeting | 2019 |
| *Fellowship review panel member*, The GEM Fellowship Program | 2018 |
| *Organizing committee*, Women's Intellectual Network Research Symposium, Brown University, Providence, RI | 2017 |

*Referee*, Journal of Fluid Mechanics, Journal of Non-Newtonian Fluid Mechanics, International Journal of Multiphase Flow, Fluid Dynamics Research, Journal of Computational Physics

**Service to Brown University**

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| *Organizer*, Applied Mathematics Graduate/Undergraduate Mentorship Program | 2016 – 2018 |
| *Organizer*, Scientific Computing in Linear Algebra Reading Group | 2016 |
| *Graduate student representative*, Academic Technology Steering Committee | 2015 – 2017 |
| *Graduate student representative*, Instructional Technology Advisory Board | 2015 – 2017 |
| *Faculty-Graduate Liaison*, Division of Applied Mathematics | 2015 – 2016 |
| *Workshop leader*, New TA Orientation | 2015 – 2017 |
| *Panelist*, Brown AWM Panel on Research and Internship Opportunities for mathematics undergraduate students | 2015 |
| *Event coordinator*, Rose Whelan Society for Women in Math | 2014 – 2016 |

**STEM Outreach**

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| *Organizer*, Women Educators in STEM Discussion Group | 2017 – 2018 |
| *Judge*, AWM Essay Contest (Grades 9-12) | 2017, 2019 |
| *Tutor*, Mathematics Resource Center | 2013 – 2016 |
| *Volunteer*, Math NECAP test preparation, Hope High School, Providence, RI | 2013 |

**Service to PNNL**
  *Co-chair*, PCSD IDEA council                                                                 2022–

<span style="font-variant:small-caps">Professional Organizations</span>   Association for Women in Mathematics – Founded the Brown University Student Chapter
Member: APS, SIAM, ACS