

# Robert Baraldi

Sandia National Laboratories  
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## Areas of specialization

Inverse Problems • Nonsmooth Optimization • Nonconvex Optimization • Trust Regions Methods  
• PDE-constrained Optimization • Uncertainty Quantification

My research focuses on algorithm design and convergence analysis for nonsmooth and nonconvex problems in physical/biological modeling and learning applications.

## Employment

- 2023- Senior Computer Science R&D S&E, Sandia National Labs. **Group:** Optimization and Uncertainty Quantification (1463).
- 2021-2023 John von Neumann Postdoctoral Fellow, Sandia National Labs. **Group:** Optimization and Uncertainty Quantification (1463). **Postdoctoral Advisor:** [Drew P. Kouri](#).
- 2020 Argonne National Lab: DOE CSGF Practicum: ADMM and Filter Methods. **Advisor:** [Sven Leyffer](#).
- 2018 Lawrence Berkeley National Lab: DOE CSGF Practicum: Reduced Order Models and Implicit Sampling. **Advisor:** [Matthew Zahr](#).

## Education

- 2021 PhD in Applied Mathematics, University of Washington. **PhD Advisor:** [Aleksandr Aravkin](#).
- 2017 MSc in Applied Mathematics, University of Washington.
- 2016 BS in Mathematics, NC State University. **Academic Advisor:** Alina Duca. **Research Advisor:** Harvey Thomas Banks.
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## Grants & Awards

### STAFF

- 2023 Laboratory Directed Research and Development: Robust Nonsmooth Stochastic Methods for Machine Learning  
**Team Members:** [Aurya Javeed](#), [Drew P. Kouri](#).  
**Amount:** \$1.2 million over 3 years.  
**Consultants:** [Jong-shi Pang](#), [Katya Scheinberg](#), [Eric Cyr](#).

### POSTDOCTORAL

- 2022 Air Force Office of Scientific Research: Compression and Randomization of Extreme-Scale Training and Optimization (CREST-Opt).  
**Team Members:** [Harbir Antil](#), [Evelyn Herberg](#), [Drew P. Kouri](#), [Denis Ridzal](#).  
**Amount:** \$700,000 over 3 years.

## GRADUATE

- 2021 Department of Energy Advanced Scientific Computing Research: John von Neumann Postdoctoral Fellowship.  
**Amount:** \$170,000 over 2 years.
- 2017-2021 Department of Energy Computational Science Graduate Fellowship (DOE CSGF).
- 2017 National Science Foundation Graduate Research Fellowship (NSF-GFRP, declined).
- 2016 Department of Applied Math Boeing Fellowship/Top Scholar Award, UW.
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## Publications

### IN REVIEW<sup>1</sup>

- 2023 Robert Baraldi, Drew P. Kouri (2023), “Efficient Proximal Subproblem Solvers for a Nonsmooth Trust-Region Method”, *Computational Optimization and Applications*.
- 2023 Robert Baraldi, Stefan Wild, Sven Leyffer (2023), “Using Filter Methods to Guide Convergence for ADMM with Applications to Nonnegative Matrix Factorization”, *SIAM Journal on Optimization*.
- 2023 Robert Baraldi, Drew P. Kouri (2023), “Local Convergence Analysis of an Inexact Trust-Region Method for Nonsmooth Optimization”, *Optimization Letters*.
- 2022 Robert Baraldi, Aleksandr Aravkin, Dominique Orban (2022), “A Levenberg-Marquardt Method for Nonsmooth Regularized Least Squares”, *SIAM Journal on Scientific Computing*.

### PEER-REVIEWED

- 2022 Robert Baraldi, Drew P. Kouri (2022), “A Proximal Trust-Region Method for Nonsmooth Optimization with Inexact Function and Gradient Evaluations”, *Mathematical Programming*. 201(1), 1–40.
- 2022 Donsub Rim, Robert Baraldi, Christopher Liu, Randall LeVeque, Kenjiro Terada (2022), “Tsunami Early Warning from Global Navigation Satellite System Data using Convolutional Neural Networks”, *Geophysical Research Letters* 49(20).
- 2021 Robert Baraldi, Aleksandr Aravkin, Dominique Orban (2021), “A Proximal Quasi-Newton Trust-Region Method for Nonsmooth Regularized Optimization”, *SIAM Journal of Optimization*. 32(2): 900–929.
- 2021 Christopher Liu, Donsub Rim, Robert Baraldi, Randall LeVeque (2021), “Comparison of Machine Learning Approaches for Tsunami Forecasting from Sparse Observations”, *Pure and Applied Geophysics* 178, 5129–5153.
- 2019 Robert Baraldi, Rajiv Kumar, Aleksandr Aravkin (2019), “Basis Pursuit Denoise with Nonsmooth Constraints”, *IEEE Transactions on Signal Processing* 67(22): 5811–5823.
- 2019 Robert Baraldi, Carl Ulberg, Rajiv Kumar, Kenneth Creager, Aleksandr Aravkin (2019), “Relaxation Algorithms for matrix completion, with applications to seismic travel-time data interpolation”, *Inverse Problems* 35(10):105009.
- 2016 Harvey Thomas Banks, Robert Baraldi, Jared Catenacci, Nicholas Myers (2016), “Parameter Estimation Using Unidentified Individual Data in Individual Based Models”. *Mathematical Modeling of Natural Phenomena* 11(6):103–121.
- 2016 Harvey Thomas Banks, Robert Baraldi, Kevin Flores, Michael Stemkovski (2016), “Validation of a Mathematical Model for Green Algae (*Raphidocelis subcapitata*) Growth and Implications for a Coupled Dynamical System with *Daphnia Magna*”, *Applied Sciences* 6(5): 155.
- 2015 Kaska Adoteye, Harvey Thomas Banks, Robert Baraldi, John Nardini, W Clay Thompson (2015), “Correlation of Parameter Estimators for Models Admitting Multiple Parametrizations”, *International Journal of Pure and Applied Mathematics* 105(3): 497–522.

<sup>1</sup>Note that Sandia National Laboratories’ Review and Approval process may prevent some of this work from being publically available on ArXiv until cleared.

- 2015 Harvey Thomas Banks, Robert Baraldi, Kevin Flores (2015), “[Optimal Design for Minimizing Uncertainty in Dynamic Equilibrium Systems](#)”, *Eurasian Journal of Mathematical and Computer Applications* 3: 20-43.
- 2015 Harvey Thomas Banks, Robert Baraldi, Karissa Cross, Christina McChesney, Laura Poag, Emma Thorpe, Kevin Flores (2015), “[Uncertainty quantification in modeling HIV viral mechanics.](#)”, *Mathematical Biosciences and Engineering* 12(5): 937-964.

#### CONFERENCE PROCEEDINGS

- 2023 Robert Baraldi, Evelyn Herberg, Drew P. Kouri, Harbir Antil (2023), “Adaptive Randomized Sketching for Dynamic Nonsmooth Optimization”, *Proceedings of the International Model Analysis Conference XLI: Model Validation and Uncertainty Quantification*, #14609.
- 2014 Harvey Thomas Banks, Robert Baraldi, et al. (2014), [Uncertainty quantification for a model of HIV-1 patient response to antiretroviral therapy interruptions.](#) *Proceedings of the 2014 American Control Conference*, 2753-2758.

#### BOOK CHAPTERS

- 2023 Robert Baraldi, Drew Kouri, Denis Ridzal (2023), “Trust-Region Methods with Inexact and Adaptive Computations”, *Encyclopedia of Optimization*.

#### TECHNICAL REPORTS (NOT PEER-REVIEWED)

- 2014 Robert Baraldi, John Nardini, Emma Thorpe, and Harvey Thomas Banks (2014), [The Effects of Parameterization on Inverse Problems](#), CRSC Technical report CRSC-TR14-07, Raleigh, NC.
- 2013 Robert Baraldi, Karissa Cross, Christina McChesney, Laura Poag, Emma Thorpe, Kevin Flores, and Harvey Thomas Banks (2013), [Mathematical Modeling of HCV Viral Kinetics](#). CRSC Technical report CRSC-TR13-07, Raleigh, NC.

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## Seminar/Conference Presentations

- 2023 Robert Baraldi, Drew P. Kouri (2023), “A Proximal Trust-Region Method for Nonsmooth Optimization with Inexact Function and Gradient Evaluations”, Applied Inverse Problems, September 4, Göttingen, Germany.
- 2023 Robert Baraldi, Drew P. Kouri (2023), “A Proximal Trust-Region Method for Nonsmooth Optimization with Inexact Function and Gradient Evaluations”, WIAS Research Seminar on Mathematical Optimization Nonsmooth Variational Problems and Operator Equations, August 29, Berlin, Germany.
- 2023 Robert Baraldi, Evelyn Herberg, Harbir Antil, Drew P. Kouri (2023), “Adaptive Randomized Sketching for Dynamic Nonsmooth Optimization”, SIOPT, May 31 - June 4, Seattle, WA.
- 2023 Robert Baraldi, Drew P. Kouri (2023), “Efficient Proximal Subproblem Solvers for an Inexact Nonsmooth Trust-Region Method”, SIAM CSE, February 28 - March 4, Amsterdam, ND.
- 2023 Robert Baraldi, Drew P. Kouri (2023), “An Inexact Trust-Region Algorithm for Nonsmooth Non-convex Regularized Problems”, Bayreuth Applied Mathematics Seminar, February 24, Bayreuth, Germany.
- 2023 Robert Baraldi, Evelyn Herberg, Harbir Antil, Drew P. Kouri (2023), “Adaptive Randomized Sketching for Dynamic Nonsmooth Optimization”, IMAX XLI, February 15, Austin, TX.
- 2022 Robert Baraldi, Drew P. Kouri (2022), “An Inexact Trust-Region Algorithm for Nonsmooth Non-convex Regularized Problems”, Centre de recherches mathématiques Seminar at McGill, October

24, Montréal, Quebec.

- 2022 Robert Baraldi, Drew P. Kouri (2022), “An Inexact Trust-Region Algorithm for Nonsmooth Non-convex Regularized Problems”, GERAD Seminar, October 20, Polytechnique Montréal, Montréal, Quebec.
- 2022 Robert Baraldi, Drew P. Kouri (2022), “An Inexact Trust-Region Algorithm for Nonsmooth Non-convex Regularized Problems”, Center for Mathematics and Artificial Intelligence Colloquium, September 30 (Virtual).
- 2022 Robert Baraldi, Stefan Wild, Sven Lyeffer (2022), “Using Filter Methods to Guide Convergence for ADMM, with Applications to Nonnegative Matrix Factorization Problems”, ICCOPT/MOPTA 2022, July 25-28. Bethlehem, PA.
- 2021 Robert Baraldi, Aleksandr Aravkin, Dominique Orban (2021), “A Proximal Quasi-Newton Trust-Region Method for Nonsmooth Regularized Optimization”, SIOPT 2021 (virtual), July 22.
- 2021 Robert Baraldi, Stefan Wild, Sven Lyeffer (2021), “Using Filter Methods to Guide Convergence for ADMM, with Applications to Nonnegative Matrix Factorization Problems”, SIAM CSE 2021 (virtual), March 1.
- 2020 “Moreau-Yoshida Regularization and First Order Methods with Firedrake”, Firedrake 2020, Seattle, WA; February 22.
- 2019 “Basis Pursuit Denoise with Nonsmooth Constraints”, DOE CSGF Annual Program Review, Arlington, VA; July 14-18.
- 2019 “An Acceleration Framework for Parameter Estimation using Implicit Sampling and Adaptive Reduced order Models”, SIAM CSE, Spokane WA; 2/25-3/1.
- 2018 “Relaxation Algorithms for matrix completion, with applications to seismic travel-time data interpolation”, DOE CSGF Annual Program Review, Arlington, VA; July 15-19.
- 2016 “Systems Modeling and Data Assimilation in Drug Development”, SIAM Annual Life Sciences Conference, Boston, MA; July 11-15.

## Code Development

- 2022- [Rapid Optimization Library](#) (part of [Trilinos](#)) - C++.
- 2019- [RegularizedOptimization](#) (part of [JuliaSmoothOptimizers](#)) - Julia.
- 2019- [ShiftedProximalOperators](#) (part of [JuliaSmoothOptimizers](#)) - Julia.
- 2019- [RegularizedProblems](#) (part of [JuliaSmoothOptimizers](#)) - Julia.
- 2019-2021 [UW-AMO Group](#).

### CODING LANGUAGES

- Active Matlab, Python, PyTorch, Julia, C++.
- Inactive Java, R, Markdown, HTML, OpenMP/MPI.

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## Service

- 2019- Reviewer: Advances in Continuous and Discrete Models, Inverse Problems, SIAM Journal On Scientific Computing, Mathematical Computing, Optimization Letters, Operations Research Letters, SIAM Journal on Optimization.
- 2021- Minisymposia Organizer: SIAM Optimization (2021), ICCOPT/MOPTA (2022), SIAM CSE (2021,2023).

## Teaching/Tutorials

2023 Sandia + GMU PDECO Seminar  
2016-2021 UW Applied Mathematics SIAM Student Chapter  
2016-2019 Organizer - UW Applied Mathematics Numerical Analysis Research Club  
2016 Teaching Assistant: MATH 126 Calculus 3, University of Washington.  
2013 Mathematics Tutor: MA 121 Calculus 1, MA 241 Calculus 2, NC State University.

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## References

Drew P. Kouri - Sandia National Laboratories: [dpkouri@sandia.gov](mailto:dpkouri@sandia.gov)  
Aleksandr Aravkin - University of Washington: [saravkin@uw.edu](mailto:saravkin@uw.edu)  
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<http://rjbaraldi.github.io/cv>