Joseph Nakao
Curriculum Vitae

Last updated: November 2025

Swarthmore College, Department of Mathematics & Statistics
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Academic Positions

Swarthmore College — Swarthmore, PA
Assistant Professor of Mathematics (tenure track) — *2023–Present*

Education

University of Delaware — Newark, DE
Ph.D. Applied Mathematics (advisor: Dr. Jingmei Qiu) — *2018–2023*

Seattle University — Seattle, WA
B.S. Applied Mathematics — *2014–2018*

Areas of Interest

- Scientific computing and numerical analysis
- Low-rank methods for time-dependent tensor differential equations
- Computational fluid dynamics and hyperbolic conservation laws
- Kinetic modeling and simulation

Publications

Asterisks (*) denote undergraduate student researchers.

Peer-Reviewed Publications

J. Nakao, J.-M. Qiu, and L. Einkemmer, "Reduced Augmentation Implicit Low-rank (RAIL) integrators for advection-diffusion and Fokker-Planck models", *SIAM Journal on Scientific Computing* **47:2** (2025), pp. A1145-A1169.

J. Chen, J. Nakao, J.-M. Qiu, and Y. Yang, "A high-order Eulerian-Lagrangian Runge-Kutta finite volume (EL-RK-FV) method for scalar nonlinear conservation laws", *Journal of Scientific Computing* **102:12** (2025).

J. Nakao, "Speeding up high-order algorithms in computational fluid and kinetic dynamics: based on characteristics tracing and low-rank structures", *University of Delaware* (2023).

J. Nakao, J. Chen, and J.-M. Qiu, "An Eulerian-Lagrangian Runge-Kutta finite volume (EL-RK-FV) method for solving convection and convection-diffusion equations", *Journal of Computational Physics*, **470** (2022), pp. 111589.

J. Nakao and Y.L. Han, "Preliminary simulated results modeling a dynamic heating cancer ablation probe", *ASME International Mechanical Engineering Congress and Exposition (IMECE) – Applications of Computational Heat Transfer*, Pittsburgh, PA, November 2018.

Articles

D. Crombecque, M. Hill, and J. Nakao, "A Word From...Spectra on the Recent Efforts Supporting LGBTQ+ Mathematicians", *Notices of the American Mathematical Society*, **71:6** (2024), pp. 705-707.

J. Nakao, "Recent Activities and Progress by Spectra and the LGBTQ+ Mathematics Community", *MAA FOCUS*, **43:6** (2023/2024), pp. 10-13.

R. Buckmire, A. Folsom, C. Goff, A. Hoover, J. Nakao, and K.A. Sather-Wagstaff, "On Best Practices for the Recruitment, Retention, and Flourishing of LGBTQ+ Mathematicians", *Notices of the American Mathematical Society*, **70:6** (2023), pp. 979-985.

J. Nakao, "The Pot of Gold at the End of the Rainbow – How Mathematics Departments Can Increase LGBTQ+ Inclusivity", *MAA Math Values Blog*, April 2021.

J. Nakao, "Adventures in Book Collecting", *The Atrium – University of Delaware's Quarterly Newsletter*, September 2019.

Submitted and In Preparation

J. Nakao, G. Ceruti, and L. Einkemmer, "A low-rank, high-order implicit-explicit integrator for three-dimensional convection-diffusion equations", arXiv: 2503.04932, *Submitted* (2025).

A. Galindo-Olarte, J. Nakao, M. Pasha, J.-M. Qiu, and W. Taitano, "A nodal discontinuous Galerkin method with low-rank velocity space representation for the multi-scale BGK model", arXiv: 2508.16564, *Submitted* (2025).

J. Nakao, D. Jacobs*, W. Taitano, and J.-M. Qiu, "A hybrid implicit-explicit low-rank method with structure preservation for solving 1d-2v Vlasov-Fokker-Planck models", *In preparation*.

Open Access Handbooks and Reference Guides

J. Nakao and D. Hayes, "A MATLAB Reference Guide for Undergraduate STEM Majors".

J. Nakao, "A Mathematica Reference Guide (for calculus students)".

J. Nakao, "A Gentle Introduction to LaTeX".

J. Nakao, "The Handbook of MATH221".

Grants and Awards

Grants

- Swarthmore Faculty Research Support Grant — 2025-2027
  Amount: $4000
- Swarthmore Faculty Research Support Grant — 2023-2025
  Amount: $4000

Awards

- Graduate Student Excellence in Scholarly Community Engagement Award, University of Delaware — 12/2022
  Award amount: $1000
- Winter Research Symposium Best Poster Award, University of Delaware — 02/2022
  Award amount: $500
- Baxter-Sloyer Graduate Teaching Award, University of Delaware — 05/2021
  Award amount: $300
- Seth Trotter Book Collecting Contest, University of Delaware — 06/2019
  Award amount: $1000
- Wynne Alexander Guy Award, Seattle University — 06/2018

PRESENTATIONS AND POSTERS

Keynote Talks

- Towards improving diversity, queerness, and empathy: how to support LGBTQ+ mathematics students 06/2024
  Spectra Survey of Mathematics Conference (SSMC), The Ohio State University, Columbus, OH
- Navigating Graduate School as a Queer Student 11/2022
  LGBTQ+ Math Day (virtual), Fields Institute for Research in Mathematical Sciences, Toronto, CAN

Colloquium and Seminar Talks

- Balancing efficiency, physics, and robustness: what goes into designing a *good* algorithm? (Upcoming) 01/2026
  Mathematics Colloquium, Department of Mathematics, Seattle University, Seattle, WA
- Implicit low-rank integrators with structure preservation for convection-diffusion and kinetic simulations (Upcoming) 12/2025
  Applied Mathematics and Computational Science Seminar, University of Pennsylvania, Philadelphia, PA
- Implicit low-rank integrators with structure preservation for convection-diffusion and kinetic simulations 09/2025
  Center for Mathematics and Artifical Intelligence Colloquium, Department of Mathematical Sciences, George Mason University, Fairfax, VA
- Implicit low-rank integrators for advection-diffusion and Fokker-Planck models with structure preservation 05/2025
  Plasma Seminar, Department of Aeronautics & Astronautics, University of Washington, Seattle, WA
- Low-rank implicit integrators based on reduced augmentation for solving advection-diffusion equations in higher dimensions 10/2024
  Numerical Analysis Seminar, University of Innsbruck, Innsbruck, AUT
- High-order implicit low-rank time integrators for advection-diffusion and Fokker-Planck models 03/2024
  Applied & Computational Mathematics Seminar, Department of Mathematical Sciences, George Mason University, Fairfax, VA
- Balancing efficiency, physics, and robustness: what goes into designing a *good* algorithm? 02/2024
  Mathematics Colloquium, Department of Mathematics & Statistics, Williams College, Williamstown, MA
- Balancing efficiency, physics, and robustness: what goes into designing a *good* algorithm? 02/2024
  Mathematics Colloquium, Department of Mathematics, Bryn Mawr College, Bryn Mawr, PA
- Speeding up high-order algorithms in computational fluid and kinetic dynamics: based on characteristics tracing and low-rank structures 05/2023
  Dissertation defense, University of Delaware, Newark, DE
- A structure preserving, conservative, low-rank tensor scheme for solving the 1D2V Vlasov-Fokker-Planck equation 08/2022
  AFRL/RQRS Technical Talks, Air Force Research Laboratory, Edwards, CA
- A brief introduction to low-rank tensor decompositions 08/2022
  AFRL/RQRS Technical Talks, Air Force Research Laboratory, Edwards, CA
- Solving for Exact Stationary Solutions to Shallow-Water Waves 11/2017
  Analysis Seminar, Department of Mathematics, Washington State University, Pullman, WA
- Modifying an Optimal Payload Sensor Model to Detect Mobile Targets 08/2017
  Summer Scholar Presentations, Air Force Research Laboratory, Albuquerque, NM

Conference Talks

- Title TBD 07/2026
  SIAM Annual Conference, Cleveland, OH
- A nodal discontinuous Galerkin method with low-rank velocity space representation for the BGK model 11/2025
  SIAM NNP Section Conference, hosted by Penn State University, State College, PA
- A nodal discontinuous Galerkin method with low-rank velocity space representation for the BGK model 10/2025
  SIAM PNW Section Conference, hosted by University of Washington, Seattle, WA
- Low-rank implicit time integrators based on reduced augmentation for solving advection-diffusion equations in three dimensions 03/2025

SIAM Conference on Computational Science and Engineering, Fort Worth, TX

- Low-rank implicit time integrators based on reduced augmentation for solving advection-diffusion equations in three dimensions 11/2024
  SIAM NNP Section Conference, hosted by Rochester Institute of Technology, Rochester, NY
- Reduced Augmentation Implicit Low-rank (RAIL) integrators for advection-diffusion and Fokker-Planck models 01/2024
  Joint Mathematics Meetings, San Francisco, CA
- Navigating College and Beyond as a Queer Student 11/2023
  Fourth Annual OURFA2M2 Conference (virtual)
- Implicit low-rank integrators for solving time-dependent problems 10/2023
  SIAM NNP Section Conference, hosted by New Jersey Institute of Technology, Newark, NJ
- A structure preserving, conservative, low-rank tensor scheme for solving the 1D2V Vlasov-Fokker-Planck equation 02/2023
  SIAM Conference on Computational Science and Engineering, Amsterdam, NLD
- A structure preserving, conservative, low-rank tensor scheme for solving the 1D2V Vlasov-Fokker-Planck equation 11/2022
  SIAM TX-LA Sectional Meeting, hosted by the University of Houston, Houston, TX
- A structure preserving, conservative, low-rank tensor scheme for solving the 1D2V Vlasov-Fokker-Planck equation 09/2022
  Sayas Numerics Day, hosted by the University of Maryland, Baltimore County, Baltimore, MD
- A new Eulerian-Lagrangian Finite Volume (ELFV) Method for Solving Convection-Diffusion Equations and Hyperbolic Conservation Laws 03/2022
  AMS Spring Central Sectional Meeting (virtual), originally hosted by Purdue University, West Lafayette, IN
- An Eulerian-Lagrangian Finite Volume Method for Solving Nonlinear Transport Equations 07/2021
  SIAM Annual Meeting (virtual), originally at Spokane, WA

Posters

- Implicit low-rank integrators for solving time-dependent problems 10/2023
  Workshop on Sparse Tensor Computations, hosted by the University of Illinois, Chicago, IL
- An Eulerian-Lagrangian Runge-Kutta finite volume (ELRK-FV) method for solving convection-diffusion equations 02/2022
  Winter Research Symposium, University of Delaware, Newark, DE
- Modifying an Optimal Payload Sensor Model to Detect Mobile Targets 08/2017
  Summer Scholar Poster Session, Air Force Research Laboratory, Albuquerque, NM
- Reconstructing the water-wave profile from pressure measurements in a moving body of water 04/2017
  AMS Sectional Meeting, Washington State University, Pullman, WA

Summer Positions

Air Force Research Laboratory Edwards, CA
Aerospace Systems Directorate *05/2022–08/2022*

Mentors: William Taitano and Alexander Alekseenko

Project: Building conservative, structure-preserving low rank tensor algorithms for solving the Vlasov-Fokker-Planck equation

Air Force Research Laboratory Edwards, CA
Aerospace Systems Directorate *05/2021–08/2021*

Mentors: Robert Martin and Alexander Alekseenko

Project: Modeling the Fokker-Planck and Vlasov-Fokker-Planck equations

Air Force Research Laboratory Albuquerque, NM
Space Vehicles Directorate *06/2017–08/2017*

Mentor: Reed Weber

Project: Modifying and implementing an optimal payload sensor model

Interim security clearance (secret)

Teaching

Swarthmore College

- **Instructorships**

MATH 34 (several-variable calculus)	(Upcoming) Spring 2026
MATH 93 (theory and computation of hyperbolic conservation laws; directed reading)	(Upcoming) Spring 2026
MATH 66 (stochastic and numerical methods)	Fall 2025
MATH 93 (mathematical contest in modeling prep course; directed reading)	Fall 2025
MATH 43 (basic differential equations)	Spring 2025
MATH 54 (partial differential equations)	Spring 2025
MATH 93 (introduction to low-rank tensors; directed reading)	Spring 2025
MATH 25 (single variable calculus 2 for natural sciences and engineering)	Fall 2024
MATH 93 (computational mathematics with MATLAB; directed reading)	Fall 2024
MATH 93 (computational mathematics with MATLAB; directed reading)	Spring 2024
MATH 43 (basic differential equations)	Spring 2024
MATH 25 (single variable calculus 2 for natural sciences and engineering)	Fall 2023

University of Delaware

- **Instructorships**

MATH 243 (calculus 3 for physical sciences and engineering with lab component)	Winter 2023
MATH 243 (calculus 3 for physical sciences and engineering with lab component)	Winter 2022
MATH 221 (calculus 1 for life sciences and business)	Winter 2021
MATH 221 (calculus 1 for life sciences and business)	Winter 2020

Undergraduate Mentorship

- Dylan Jacobs '27 01/2024–Present
  Project: *A structure-preserving reduced augmentation implicit low-rank (RAIL) scheme for the 1d-2v Vlasov-Dougherty-Fokker-Planck equation*
  Internships/REUs: *Naval Research Enterprise Internship Program (summer 2025, invited back for summer 2026)*
- Paolo Bosques-Paulet '27 09/2024–Present
  Project: High-order implicit low-rank integrators for high-dimensional diffusion models in the hierarchical Tucker tensor format
  Internships/REUs: *Los Alamos National Laboratory (upcoming summer 2026)*
- Zoe Tang '27 09/2024–Present
  Expected Project: Low-rank structure-preserving Chang-Cooper (SPCC) discretizations for Fokker-Planck equations
  Internships/REUs: *REU at Arizona State University in Quantative Research for the Life and Social Sciences (summer 2025)*
- Joost Almekinders '27 05/2025–08/2025
  Project: Writing a MATLAB toolbox for the Reduced Augmentation Low-rank Implicit (RAIL) integrator

Professional Service

Swarthmore College

- Sigma Xi Board - Treasurer 08/2025–07/2026
  Treasurer for the Swarthmore College Chapter of Sigma Xi.
- Colloquium Chair 07/2025–06/2026
  Organize department colloquium and invite speakers.
- Assessment Coordinator 07/2024–06/2025
  Coordinated the department's annual assessment report. Primary focus of the 2024-2025 academic year was on the effectiveness of the new calculus attachment course, Math 15X, for students that don't place into Math 15 (calculus I).
- Faculty Committee on Diversity and Excellence 09/2024–05/2025
  Faculty committee member.
- Colloquium Helper 07/2023–06/2024
  Assist the colloquium chair in organizing the department colloquium.

The Broader Mathematics Community

- *Northeast Applied Mathematics at Small Colleges* 01/2025–Present
  Participant and volunteer for a newly formed group intended to connect applied mathematicians at small colleges and universities in the northeast region of the United States. The group was formed by Becca Thomases of Smith College.
- *SIAM New York-New Jersey-Pennsylvania (NNP) Section* 08/2024–Present
  District Liaison for Eastern Pennsylvania
  Duties include attending the regular Zoom meetings of the officers, and helping with communications between the section and the institutions of Eastern Pennsylvania.
- *MAA FOCUS* 08/2023–Present
  Editorial Board
  The newsmagazine of the Mathematical Association of America (MAA) (website link here), contains information about MAA activities, news from the mathematical community, and thought-provoking articles about mathematics, mathematics education, and related areas.
- Spectra 07/2021–08/2024
  Board of Directors – Membership Committee Chair
  Spectra (website link here) is the association for LGBTQ+ mathematicians.
  Contributions: creation of Spectra student chapters, Spectra LGBTQ+ Twitter visibility campaign, AMS-sponsored Spectra LGBTQ+ mathematicians posters.

Conference Organizing

- SIAM NNP 2026 Section Conference, hosted by Rutgers University (Upcoming) 10/2026
  Organizing committee. Responsible for the conference website, approving all submissions, and organizing the minisymposia session schedule.
- SIAM NNP 2025 Section Conference, hosted by Penn State University 11/2025
  Organizing committee. Responsible for the conference website, approving all submissions, organizing the minisymposia session schedule, and building the booklet of abstracts.
- SIAM NNP 2024 Section Conference, hosted by Rochester Institute of Technology 11/2024
  Organizing committee.

Panels

- Panelist at the Virtual Joint Mathematics Meetings 04/2022
  Spectra Workshop: Identifying Best Practices Fostering Inclusion and Retention of LGBTQ Mathematicians.
  Topics of discussion: supporting transgender mathematicians in the work place (Keri Sather-Wagstaff), LGBTQ+ mathematicians balancing work choices with family (Ron Buckmire), best practices for recruitment of LGBTQ+ faculty (Amanda Folsom), and supporting LGBTQ+ graduate students (Joseph Nakao).
- Panelist at Society for Industrial and Applied Mathematics (SIAM) Annual Meeting 07/2021

Minisymposium: Presentations by LGBTQ Mathematicians. Responsible for leading discussion about LGBTQ inclusivity in the applied mathematics community, as well as Spectra's current projects.

Journal Reviewer

- Numerical Analysis and Scientific Computing Journals
  Journal of Computational Physics
  SIAM Journal on Matrix Analysis and Applications
  Journal of Scientific Computing
  BIT Numerical Mathematics

Minisymposia and Workshops

Minisymposia and Workshop Sessions Organized

- SIAM NNP Section Conference 11/2025
  Recent advances in low-rank methods and their applications
- SIAM NNP Section Conference 11/2024
  Advances in efficient and accurate kinetic and fluid solvers
- ICERM Workshop: Empowering a Diverse Computational Mathematics Research Community 07/2024
  Co-led a research team at this two-week ICERM workshop. Team leaders: Jingmei Qiu (University of Delaware), Joseph Nakao (Swarthmore College), William Taitano (Los Alamos National Laboratory). Team project: low rank tensor methods for high dimensional multi-scale multi-physics PDE models.
- SIAM Conference on Applied Linear Algebra 05/2024
  Low-rank tensor methods for high-dimensional problems
- Joint Mathematics Meetings 01/2024
  Spectra Special Session
- SIAM NNP Section Conference 10/2023
  Low-rank methods and their applications in large data and high-dimensional problems
- SIAM Annual Meeting 07/2022
  LGBT Minisymposia

Computer Skills

Proficient: MATLAB, Mathematica, LaTeX, Word, Excel, Powerpoint
Some experience: Fortran 90, Python, Julia