Joseph Nakao
Curriculum Vitae

Last updated: August 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, "The Handbook of MATH221".

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".

Awards and Grants

Awards

- Graduate Student Excellence in Scholarly Community Engagement Award, University of Delaware December 2022
  "This excellence award serves the following major purposes: 1. To highlight the University's commitment to engaged scholarship in teaching, engaged research/creative activities, and engaged service; 2. To reward Graduate Student excellence in mutually beneficial, scholarly engaged teaching, research/creative activities and service; and 3. To thereby promote excellence in community engagement among other Graduate Students." ($1000 award)
- Winter Research Symposium Best Poster Award, University of Delaware February 2022
  Voted best poster at the annual Winter Research Symposium hosted by the University of Delaware Department of Mathematical Sciences. ($500 award)
- Baxter-Sloyer Graduate Teaching Award, University of Delaware May 2021
  "Given to a graduate student teaching assistant, in mathematical sciences, who has demonstrated superior effectiveness in teaching, and in the performance of their responsibilities." ($300 award)
- Seth Trotter Book Collecting Contest, University of Delaware June 2019
  Placed first in the book collecting contest put on by the Friends of the University of Delaware Library, and entered into the National Student Book Collecting Contest. Won with my reference library of (now) roughly 400 mathematical and engineering texts. ($1000 award)
- Wynne Alexander Guy Award, Seattle University June 2018

"Given in grateful acknowledgment of a graduating mathematics major whose extraordinary contribution to the department always went above and beyond what was expected. Named to honor beloved teacher Mrs. Guy, who performed extraordinary service to the Mathematics department and Seattle University for 30 years."

Grants

- NSF Standard Grant Proposal: DMS, Computational Mathematics (Re)submitted November 2024
  "Collaborative Research: RUI: Low-rank tensor methods with high-order accuracy and structure-preserving properties for kinetic simulations"
  PIs: Joseph Nakao (Swarthmore College) and William Sands (University of Delaware)
  Requested Amount: $227,943
  Result: ***TBD***

PRESENTATIONS AND POSTERS

Keynote Talks

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

Colloquium and Seminar Talks

- Implicit low-rank integrators with structure preservation for convection-diffusion and kinetic simulations (Upcoming) September 2025
  PDEs & Data Control Seminar, Department of Mathematical Sciences, George Mason University, Fairfax, VA
- Implicit low-rank integrators for advection-diffusion and Fokker-Planck models with structure preservation May 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 October 2024
  Numerical Analysis Seminar, University of Innsbruck, Innsbruck, AUT
- High-order implicit low-rank time integrators for advection-diffusion and Fokker-Planck models March 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? February 2024
  Mathematics Colloquium, Department of Mathematics & Statistics, Williams College, Williamstown, MA
- Balancing efficiency, physics, and robustness: what goes into designing a *good* algorithm? February 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 May 2023
  Dissertation defense, University of Delaware, Newark, DE
- A structure preserving, conservative, low-rank tensor scheme for solving the 1D2V Vlasov-Fokker-Planck equation August 2022
  AFRL/RQRS Technical Talks, Air Force Research Laboratory, Edwards, CA
- A brief introduction to low-rank tensor decompositions August 2022
  AFRL/RQRS Technical Talks, Air Force Research Laboratory, Edwards, CA
- Solving for Exact Stationary Solutions to Shallow-Water Waves November 2017
  Analysis Seminar, Department of Mathematics, Washington State University, Pullman, WA
- Modifying an Optimal Payload Sensor Model to Detect Mobile Targets August 2017
  Summer Scholar Presentations, Air Force Research Laboratory, Albuquerque, NM

Conference Talks

- A low-rank structure-preserving method for solving the 1d-2v Vlasov-Fokker-Planck equation (Upcoming) November 2025
  SIAM NNP Section Conference, hosted by Penn State University, State College, PA
- A low-rank structure-preserving method for solving the 1d-2v Vlasov-Fokker-Planck equation (Upcoming) October 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 March 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 November 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 January 2024
  Joint Mathematics Meetings, San Francisco, CA
- Navigating College and Beyond as a Queer Student November 2023
  Fourth Annual OURFA2M2 Conference (virtual)
- Implicit low-rank integrators for solving time-dependent problems October 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 February 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 November 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 September 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 March 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 July 2021
  SIAM Annual Meeting (virtual), originally at Spokane, WA

Posters

- Implicit low-rank integrators for solving time-dependent problems October 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 February 2022
  Winter Research Symposium, University of Delaware, Newark, DE
- Modifying an Optimal Payload Sensor Model to Detect Mobile Targets August 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 April 2017
  AMS Sectional Meeting, Washington State University, Pullman, WA

Summer Positions

Air Force Research Laboratory Edwards, CA
Aerospace Systems Directorate *May 2022–August 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 *May 2021–August 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 *June 2017–August 2017*

Mentor: Reed Weber

Project: Modifying and implementing an optimal payload sensor model

Interim security clearance (secret)

Teaching

Swarthmore College

- **Instructorships**

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 January 2024–Present
  Project #1: *A structure-preserving reduced augmentation implicit low-rank (RAIL) scheme for the 1d-2v Vlasov-Dougherty-Fokker-Planck equation*
  Project #2: *High-order implicit low-rank integrators for high-dimensional advection-diffusion models in the hierarchical Tucker tensor format*
  Internships/REUs: *Naval Research Enterprise Internship Program (summer 2025, invited back for summer 2026)*
- Zoe Tang '27 September 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)*
- Paolo Bosques-Paulet '27 September 2024–Present

Project: High-order implicit low-rank integrators for high-dimensional advection-diffusion models in the hierarchical Tucker tensor format
Internships/REUs: *Los Alamos National Laboratory (upcoming summer 2026)*

- Joost Almekinders '27 May 2025–August 2025
  Project: Writing a MATLAB toolbox for the Reduced Augmentation Low-rank Implicit (RAIL) integrator

Professional Service

Swarthmore College

- Sigma Xi Board - Treasurer August 2025–July 2026
  Treasurer for the Swarthmore College Chapter of Sigma Xi.
- Colloquium Chair July 2025–June 2026
  Organize department colloquium and invite speakers.
- Assessment Coordinator July 2024–June 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 September 2024–May 2025
  Faculty committee member.
- Colloquium Helper July 2023–June 2024
  Assist the colloquium chair in organizing the department colloquium.

The Broader Mathematics Community

- *Northeast Applied Mathematics at Small Colleges* January 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* August 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* August 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 July 2021–August 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 2025 Section Conference, hosted by Penn State University (Upcoming) November 2025
  Organizing committee. Responsible for the conference website, approving all submissions, and organizing the minisymposia session schedule.
- SIAM NNP 2024 Section Conference, hosted by Rochester Institute of Technology November 2024
  Organizing committee.

Panels

- Panelist at the Virtual Joint Mathematics Meetings April 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 July 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 Scientific Computing
  BIT Numerical Mathematics

Minisymposia and Workshops

Minisymposia and Workshop Sessions Organized

- SIAM NNP Section Conference (Upcoming) November 2025
  Recent advances in low-rank methods and their applications
- SIAM NNP Section Conference November 2024
  Advances in efficient and accurate kinetic and fluid solvers
- ICERM Workshop: Empowering a Diverse Computational Mathematics Research Community July 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 May 2024
  Low-rank tensor methods for high-dimensional problems
- Joint Mathematics Meetings January 2024
  Spectra Special Session
- SIAM NNP Section Conference October 2023
  Low-rank methods and their applications in large data and high-dimensional problems
- SIAM Annual Meeting July 2022
  LGBT Minisymposia

Computer Skills

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