Joseph Nakao
Curriculum Vitae

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Swarthmore College
Dept. of Math. & Stat.
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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 — *2020–2023*
Advisor: Jingmei Qiu

University of Delaware — Newark, DE
M.S. Applied Mathematics — *2018–2020*

Seattle University — Seattle, WA
B.S. Applied Mathematics — *2014–2018*
Advisors: Yen-Lin Han (Mechanical Engineering) and Katie Oliveras (Mathematics)

Areas of Interest

- Scientific computing and numerical analysis
- Tensor decompositions and data science applications
- Computational fluid dynamics and computational plasma physics
- Mathematical modeling

Publications

Journals and Conference Proceedings

J. Nakao, W. Taitano, and J.-M. Qiu, "A structure preserving finite difference scheme for solving the 1D2V Vlasov-Fokker-Planck equation in cylindrical coordinates", *In preparation.*

J. Nakao, G. Ceruti, and L. Einkemmer, "A Reduced Augmentation Implicit Low-rank (RAIL) integrator for solving three-dimensional diffusion and advection-diffusion equations in the Tucker tensor format", *In preparation.*

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, J.-M. Qiu, and L. Einkemmer, "Reduced Augmentation Implicit Low-rank (RAIL) integrators for advection-diffusion and Fokker-Planck models", arXiv: 2311.15143 (2023). *Submitted.*

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.

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".

PRESENTATIONS AND POSTERS

Keynote and Plenary 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

- 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

- "Low-rank implicit time integrators based on reduced augmentation for solving advection-diffusion equations in three dimensions" (Upcoming) 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" (Upcoming) November 2024
  SIAM NNP Section Meeting, 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 Meeting, 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

UNDERGRADUATE RESEARCH STUDENTS

- Dylan Jacobs '27 January 2024–Present
  Project: A structure preserving reduced augmentation implicit low-rank (RAIL) scheme for the Fokker-Planck equation in cylindrical coordinates
- Zoe Tang '27 September 2024–Present
  Expected Project: Extending the structure-preserving Chang-Cooper (SPCC) discretization for Fokker-Planck equations to other coordinate systems
- Paolo Bosques-Paulet '27 September 2024–Present
  Expected Project: A structure preserving reduced augmentation implicit low-rank (RAIL) scheme for the Fokker-Planck equation in spherical coordinates
- Joost Almekinders '27 Starting 2025
  Expected Project: Comparing low-rank structures in different inner product spaces

Other Research Experience

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: Modelling 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 043 (basic differential equations) Spring 2025

MATH 054 (partial differential equations) Spring 2025

MATH 093 (introduction to low-rank tensors; directed reading) Spring 2025

MATH 025 (single variable calculus 2 for natural sciences and engineering) Fall 2024

MATH 093 (computational mathematics with MATLAB; directed reading) Fall 2024

MATH 093 (computational mathematics with MATLAB; directed reading) Spring 2024

MATH 043 (basic differential equations) Spring 2024

MATH 025 (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) Download evaluations here Winter 2023

  MATH 243 (calculus 3 for physical sciences and engineering with lab component) Download evaluations here Winter 2022

  MATH 221 (calculus 1 for life sciences and business) Download evaluations here Winter 2021

  MATH 221 (calculus 1 for life sciences and business) Download evaluations here Winter 2020

- **Teaching Assistantships**

  MATH 243 (calculus 3 for physical sciences and engineering with lab component) Download evaluations here Fall 2022

  MATH 243 (calculus 3 for physical sciences and engineering with lab component) Download evaluations here Fall 2021

  MATH 243 (calculus 3 for physical sciences and engineering with lab component) Download evaluations here Fall 2020

  MATH 221 (calculus 1 for life sciences and business) Download evaluations here Spring 2020

  MATH 221 (calculus 1 for life sciences and business) Download evaluations here Fall 2019

  MATH 241 (calculus 1 for physical sciences and engineering) Download evaluations here Spring 2019

  MATH 221 (calculus 1 for life sciences and business) Download evaluations here Fall 2018

- **Other Instruction**

  Graduate qualifying exam review for techniques of applied mathematics (3 out of 3 students passed) Summer 2021

  Graduate qualifying exam review for techniques of applied mathematics (2 out of 2 students passed) Winter 2021

Seattle University

- **Teaching Assistantships**

  MATH 2330 (multivariable calculus for physical sciences and engineering) Spring 2018

  MATH 2340 (ordinary differential equations) Winter 2018

  MATH 2340 (ordinary differential equations) Fall 2017

  MATH 2330 (multivariable calculus for physical sciences and engineering) Spring 2017

  MATH 2340 (ordinary differential equations) Winter 2017

  MATH 2330 (multivariable calculus for physical sciences and engineering) Fall 2016

Professional Service

The Broader Mathematics Community (Positions Held)

- *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.

The Broader Mathematics Community (Contributions)

- Spectra Student Chapters August 2023
  Organized and oversaw the creation of Spectra student chapters from institutions worldwide.
- Spectra LGBTQ+ Twitter Visibility Campaign June 2023, June 2022
  Co-organizer. Spectra highlighted a different LGBTQ+ mathematician each day of June (pride month) on Twitter.
- AMS-Sponsored Spectra LGBTQ+ Mathematicians Posters February 2022
  Co-organizer. This poster series highlights LGBTQ+ mathematicians.

University of Delaware (Positions Held)

- Mathematics Department Graduate Committee September 2021–August 2022
  Member
  Responsibilities: communicating between the graduate students and faculty, ensuring every decision is inclusive of all graduate students, organizing meetings with prospective and incoming graduate students, and ensuring the voices and interests of the graduate student body were heard and accounted for at graduate committee meetings.
- Queer and Trans Graduate Student Union (QTGSU) June 2021–June 2022
  Executive Board Member, Founding Member
  Responsibilities: ensuring accessibility of all activities, assisting the treasurer, organizing community events, and upholding the values of the organization.
- Society for Industrial and Applied Mathematics (SIAM) Student Chapter July 2019–June 2021
  Treasurer
  Responsibilities: managing the student chapter finances, funding requests, and the end-of-year final report. Also helped coordinate general meetings and social events.
- Association for Women in Mathematics (AWM) Student Chapter September 2020–June 2021
  Professional Development Chair
  Responsibilities: organizing and coordinating professional development workshops, and helping form open discussion on articles about women in STEM.

University of Delaware (Contributions)

- Graduate Student Mentor-Mentee Program August 2022–June 2023
  Co-organized the peer mentoring program sponsored by the AWM student chapter. Graduate student mentors are paired up with an incoming first year student to help guide them through the first year of graduate school.

- Graduate Student Mentor-Mentee Program September 2020–July 2023
  Mentored three first-year graduate students (one per year), helping them adjust to graduate school. Provided monthly check-ins, and offering advice on coursework, balancing life and graduate school, and qualifying exams.
- New Qualifying Exam System April 2022
  As a member of the graduate committee, I helped draft a new qualifying exam system that went on to be passed by the faculty vote.
- QTGSU Accessibility Committee June 2021–June 2022
  Co-drafted access guides and documents, as well as ensured all events were accessible.
- QTGSU Bylaws Committee June 2021 –September 2021
  Co-drafted the bylaws and organizational structure for QTGSU.
- UD SIAM Seminar Series September 2020–June 2021
  Instigated and organized the UD SIAM Seminar Series inviting PhD students and post-docs from other universities to present their research.

Other

- Memberships
  Society for Industrial and Applied Mathematicians (SIAM), Association for Women in Mathematics (AWM), American Mathematical Society (AMS), The Association for LGBTQ+ Mathematicians (Spectra), Out in STEM (oSTEM)
- Incoming Student Handbook May 2018
  Instigated and created a student handbook for the Seattle University Mathematics Department's future incoming students. The intention was to give a student point-of-view of life at Seattle University as a mathematics major.

Honors and 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."

Panels, Workshops, and Minisymposia

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.
- People of Color Caucus — October 2017
  Invited by Dr. Rose Ernst (formerly) of the Political Science Department at Seattle University to facilitate a people of color caucus. Topics of discussion included: racism in academia, and living as a person of color in college.

Conferences, Workshops, and Minisymposia Organized

- 2025 Spectra Conference - hosted by Swarthmore College — (Upcoming) June 2025
  Co-organizer. PI for NSF conference grant proposal.
- SIAM NNP24: Minisymposium: Advances in efficient and accurate kinetic and fluid solvers — November 2024
  Co-organizer.
- SIAM NNP Conference (NNP24) - hosted by Rochester Institute of Technology — November 2024
  Organizing Committee.
- SIAM LA23: Low-rank tensor methods for high-dimensional problems — May 2024
  Co-organizer.
- JMM24: Spectra Special Session — January 2024
  Co-organizer.
- SIAM NNP23: Low-rank methods and their applications in large data and high-dimensional problems — October 2023
  Co-organizer.
- SIAM AN22: LGBT Minisymposia — July 2022
  Co-organizer.
- Mathematica Workshop — March 2021
  Led a Mathematica workshop tailored for undergraduate students in the calculus sequence. Organized by the UD AWM Student Chapter.
- LaTeX Workshop — October 2020
  Led an introductory LaTeXworkshop geared towards graduate students in both the mathematics and other departments. Organized by the UD AWM Student Chapter.

Computer Skills

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