

Joseph Nakao

Curriculum Vitae

Last updated: December 2024

Swarthmore College
Dept. of Math. & Stat.
500 College Avenue
Swarthmore, PA 19081

✉ jnakao1@swarthmore.edu

🏠 [jhknakao.github.io/](https://github.com/jhknakao)

ACADEMIC POSITIONS

Swarthmore College

Assistant Professor of Mathematics (tenure track)

Swarthmore, PA

2023–Present

EDUCATION

University of Delaware

Ph.D. Applied Mathematics

Advisor: Jingmei Qiu

Newark, DE

2020–2023

University of Delaware

M.S. Applied Mathematics

Newark, DE

2018–2020

Seattle University

B.S. Applied Mathematics

Advisors: Yen-Lin Han (Mechanical Engineering) and Katie Oliveras (Mathematics)

Seattle, WA

2014–2018

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. Nakao, J.-M. Qiu, and L. Einkemmer, “[Reduced Augmentation Implicit Low-rank \(RAIL\) integrators for advection-diffusion and Fokker-Planck models](#)”, arXiv: 2311.15143. *Accepted in SIAM Journal on Scientific Computing*, (2024).

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.

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 L^AT_EX”.

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

Aerospace Systems Directorate

Edwards, CA

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

Aerospace Systems Directorate

Edwards, CA

May 2021–August 2021

Mentors: Robert Martin and Alexander Alekseenko

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

Air Force Research Laboratory

Space Vehicles Directorate

Albuquerque, NM

June 2017–August 2017

Mentor: Reed Weber

Project: Modifying and implementing an optimal payload sensor model
Interim security clearance (secret)

TEACHING

Swarthmore College

- Instructorships

<i>MATH 043 (basic differential equations)</i>	Spring 2025
<i>MATH 054 (partial differential equations)</i>	Spring 2025
<i>MATH 093 (introduction to low-rank tensors; directed reading)</i>	Spring 2025
<i>MATH 025 (single variable calculus 2 for natural sciences and engineering)</i>	Fall 2024
<i>MATH 093 (computational mathematics with MATLAB; directed reading)</i>	Fall 2024
<i>MATH 093 (computational mathematics with MATLAB; directed reading)</i>	Spring 2024
<i>MATH 043 (basic differential equations)</i>	Spring 2024
<i>MATH 025 (single variable calculus 2 for natural sciences and engineering)</i>	Fall 2023

University of Delaware

- Instructorships**

<i>MATH 243 (calculus 3 for physical sciences and engineering with lab component)</i>	Download evaluations here	Winter 2023
<i>MATH 243 (calculus 3 for physical sciences and engineering with lab component)</i>	Download evaluations here	Winter 2022
<i>MATH 221 (calculus 1 for life sciences and business)</i>	Download evaluations here	Winter 2021
<i>MATH 221 (calculus 1 for life sciences and business)</i>	Download evaluations here	Winter 2020

- Teaching Assistantships**

<i>MATH 243 (calculus 3 for physical sciences and engineering with lab component)</i>	Download evaluations here	Fall 2022
<i>MATH 243 (calculus 3 for physical sciences and engineering with lab component)</i>	Download evaluations here	Fall 2021
<i>MATH 243 (calculus 3 for physical sciences and engineering with lab component)</i>	Download evaluations here	Fall 2020
<i>MATH 221 (calculus 1 for life sciences and business)</i>	Download evaluations here	Spring 2020
<i>MATH 221 (calculus 1 for life sciences and business)</i>	Download evaluations here	Fall 2019
<i>MATH 241 (calculus 1 for physical sciences and engineering)</i>	Download evaluations here	Spring 2019
<i>MATH 221 (calculus 1 for life sciences and business)</i>	Download evaluations here	Fall 2018

- Other Instruction**

<i>Graduate qualifying exam review for techniques of applied mathematics (3 out of 3 students passed)</i>	Summer 2021
<i>Graduate qualifying exam review for techniques of applied mathematics (2 out of 2 students passed)</i>	Winter 2021

Seattle University

- Teaching Assistantships**

<i>MATH 2330 (multivariable calculus for physical sciences and engineering)</i>	Spring 2018
<i>MATH 2340 (ordinary differential equations)</i>	Winter 2018
<i>MATH 2340 (ordinary differential equations)</i>	Fall 2017
<i>MATH 2330 (multivariable calculus for physical sciences and engineering)</i>	Spring 2017
<i>MATH 2340 (ordinary differential equations)</i>	Winter 2017
<i>MATH 2330 (multivariable calculus for physical sciences and engineering)</i>	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.
- L^AT_EX Workshop October 2020
Led an introductory L^AT_EX workshop geared towards graduate students in both the mathematics and other departments. Organized by the UD AWM Student Chapter.

COMPUTER SKILLS

Proficient: MATLAB, Mathematica, L^AT_EX, Word, Excel, Powerpoint

Some experience: Fortran 90, Python, Julia