AXEL G. R. TURNQUIST,
Assistant Professor

Beijing Institute of Mathematical Sciences and Applications

PERSONAL INFORMATION

Email agrt@bimsa.cn

RESEARCH INTERESTS

Optimal Transport, Numerical Analysis, Differential Geometry, Analysis, PDE on Manifolds, Diffeomorphic Mappings, Freeform Optics

EDUCATION

2016-2022 **New Jersey Institute of Technology**

Ph.D. in Mathematical Sciences

GPA: 4.0 (out of 4.0) · Advisor: Brittany D. Hamfeldt, Thesis: *Numerical Methods for Optimal Transport and Optimal Information Transport on the Sphere*

2008-2012 **University of Washington**

Bachelor of Science, Physics

GPA: 3.9 (out of 4.0), *Magna Cum Laude* · Minor in Mathematics

ACADEMIC EMPLOYMENT

2022-2025 **R. H. Bing Fellowship Instructor (Postdoc)**

Department of Mathematics, University of Texas at Austin, Texas, United States

2025-Present **Assistant Professor**

Beijing Institute of Mathematical Sciences and Applications, Beijing, China

GRANTS

2018-2021 **NSF GRFP: 1849508**

National Science Foundation Graduate Research Fellowship Program
September 4, 2018-August 9, 2021
$ 138,000 USD

AWARDS & HONORS

2022 **Student Speaker for New Jersey Institute of Technology Doctoral Hooding Ceremony**

2021 **J. Opt. Soc. Am. A Editor's Pick**

For manuscript "Convergent numerical method for the reflector antenna problem via optimal transport on the sphere"

2021 **CMS President's Award**

Canadian Mathematical Society Summer Meeting 2021, $ 100 CAD

2019 **NJIT CSLA Outstanding Graduate Student**

New Jersey Institute of Technology College of Science and Liberal Arts

2016, 2017 Provost Doctoral Assistantship

New Jersey Institute of Technology Department of Mathematical Sciences

2008 Honors Achievement Award

University of Washington Honors Department. One year tuition free.

PUBLICATIONS

Preprints

1. Turnquist, A. G. R. *Optimal Transport Using Cost Functions with Preferential Direction with Applications to Optics Inverse Problems* July 9, 2024, https://arxiv.org/abs/2407.07256.

2. Turnquist, A. G. R. *Optimal Transport with Defective Cost Functions with Applications to the Lens Refractor Problem* August 16, 2023, https://arxiv.org/abs/2308.08701

Refereed Publications

3. Richard Tsai, Axel G. R. Turnquist *A volumetric approach to Monge's optimal transport on surfaces* Journal of Computational Physics, Volume 517, 15 November 2024, 113352.

4. Axel G. R. Turnquist, *Adaptive Mesh Methods on Compact Manifolds via Optimal Transport and Optimal Information Transport*, Journal of Computational Physics, Volume 500, 2024, 112726, ISSN 0021-9991, https://doi.org/10.1016/j.jcp.2023.112726.

5. Hamfeldt, B. F., Turnquist, A. G. R. *On the Reduction in Accuracy of Finite Difference Schemes on Manifolds without Boundary.* IMA Journal of Numerical Analysis (2023) 00, 1-34, https://doi.org/10.1093/imanum/drad048

6. Hamfeldt, B. F., Turnquist, A. G. R. *A Convergence Framework for Optimal Transport on the Sphere* Numerische Mathematik (2022), https://doi.org/10.1007/s00211-022-01292-1

7. Brittany Froese Hamfeldt and Axel G. R. Turnquist, *Convergent numerical method for the reflector antenna problem via optimal transport on the sphere* J. Opt. Soc. Am. A 38, 1704-1713 (2021), **Selected for Editor's Pick**

8. Brittany Froese Hamfeldt and Axel G. R. Turnquist *A convergent finite-difference method for optimal transport on the sphere* Journal of Computational Physics, Volume 445, 15 November 2021, 110621

9. Turnquist A. G. R., Rotstein H. G. (2018) *Quadratization: From Conductance-Based Models to Caricature Models with Parabolic Nonlinearities* In: Jaeger D., Jung R. (eds) Encyclopedia of Computational Neuroscience. Springer, New York, NY

THESES

Numerical Methods for Optimal Transport and Optimal Information Transport on the Sphere, Ph.D. Thesis, New Jersey Institute of Technology, 2022: https://digitalcommons.njit.edu/dissertations/1610/

TALKS AND POSTER PRESENTATIONS

Talks

Volumetric Methods for Computing the Optimal Transport Mapping on Surfaces - Application of Optimal Transport in Control and Inverse Problems, March, 2025, SIAM Conference on Computational Science and Engineering, Fort Worth, Texas, United States

Volumetric Methods for Computing the Optimal Transport Mapping on Surfaces - AMS Special Session on Recent Advancements in the Numerical Analysis of Nonlinear Partial Differential Equations, January, 2025, Joint Mathematics Meeting 2025, Seattle, United States

Volumetric Methods for Computing the Optimal Transport Mapping on Surfaces - Analysis Seminar, September 4, 2024, University of Texas at Austin, Texas, United States

Optimal Transport and Applications - Applied Mathematics/Data Science Journal Club, April 16, 2024, Southern Methodist University, Dallas, Texas, United States

Computing Freeform Optics Problems via Optimal Transport PDE - Mathematics PDE Seminar, December 5, 2023, Wayne State University, Detroit, Michigan, United States

Computing Freeform Optics Inverse Problems via Optimal Transport - Junior Applied Math Seminar, October 2, 2023, University of Texas at Austin, Austin, Texas, United States

Finite-Difference Methods for Computing Optimal Transport PDE on the Unit Sphere - 13th AIMS Conference on Dynamical Systems, Differential Equations and Applications, May 31-June 4, 2023, University of North Carolina Wilmington, Wilmington, North Carolina, United States

Numerical Methods for PDE Formulations of Some Freeform Optical Systems - New Ideas in Computational Inverse Problems, October 23-28, 2022, Banff International Research Station, Banff, Alberta, Canada

Convergent Numerical Schemes for Optimal Transport with Applications on the Sphere and Beyond - Schrödinger Problem and Mean-field PDE Systems: Computational and Theoretical Advances, November 15-19, 2021, Aix Marseille University, Marseille, France

Optical Inverse Problems and Optimal Transport - Entropic Regularization of Optimal Transport and Applications (Online), Jun. 21, 2021, Banff International Research Station, Banff, Alberta, Canada

Optimal Transport on the Sphere - Canadian Mathematical Society Summer Meeting StudC Research Session - Optimal Transport and Applications (Online) - Jun. 11, 2021, University of Ottawa, Ottawa, Ontario, Canada

Towards Convergent Finite-Difference Schemes for the Monge-Ampère PDE on the Sphere Invited Talk. Recent Developments in Numerical Methods for PDEs: Joint Mathematics Meeting January 2020, Denver Convention Center, Denver, Colorado, United States

Poster Presentations

Smooth Mesh Redistribution on Manifolds Using PDE Techniques - Graduate Student Association 3-Minute Research Presentation, New Jersey Institute of Technology - Mar. 31, 2022, Newark, New Jersey, United States

Optimal Transport on the Sphere - Canadian Mathematical Society Summer Meeting Poster Session - Optimal Transport and Applications (Online) - Jun. 10, 2021, Ottawa, Ontario, Canada - **Won CMS President's Award for Poster Presentation**

Optimal Transport on the Sphere - Dana Knox Student Research Showcase (Online) - Apr. 21, 2021, New Jersey Institute of Technology, Newark, New Jersey, United States

Solution Guarantees for the Reflector Antenna Inverse Problem - Graduate Student Association 3-Minute Research Presentation (Online), New Jersey Institute of Technology - Apr. 13, 2021, Newark, New Jersey, United States

A Convergence Framework for the Monge-Ampère PDE on the Sphere - IMA Workshop on Optimal Control, Optimal Transport, and Data Science (Online), Nov. 10, 2020, University of Minnesota, Minnesota, United States

Effects of Input Amplitude and Global Coupling on Network Synchrony and Entrainment Dana Knox Student Research Showcase - April 19, 2017, New Jersey Institute of Technology, Newark, New Jersey, United States

EVENTS HOSTED

Optimization & Machine Learning Talks

Founded and Hosted NJIT Department of Mathematical Sciences Optimization & Machine Learning Talks, Fall 2020-Spring 2022.

Mental Health Talks

Founded & Hosted NJIT Department of Mathematical Sciences Mental Health Talks, Spring 2020.

PROFESSIONAL DEVELOPMENT

03/25 SIAM Conference on Computational Science and Engineering

Fort Worth, Texas, United States

01/25 Joint Mathematics Meeting 2025

Seattle, Washington, United States

05/24 Algorithms and PDE

Texas State University and the University of Texas at Austin, Texas, United States

05/23-06/23 13th AIMS Conference on Dynamical Systems, Differential Equations and Applications

University of North Carolina Wilmington, Wilmington, North Carolina, United States

10/22 New Ideas in Computational Inverse Problems

Banff International Research Station, Banff, Canada

05/22 IMSI Decision Making and Uncertainty: Applied Optimal Transport (Online)

IMSI, University of Chicago, United States

11/21 Schrödinger Problem and Mean-field PDE Systems: Computational and Theoretical Advances

Aix Marseille University, Marseille, France

10/21-12/21 IMSI Distributed Solutions to Complex Societal Problems: (1) Introduction to Distributed Solutions and (2) Mathematical Advances in Mean-Field Games (Online)

IMSI, University of Chicago, United States

07/21 Fifth Conference on Geometric Science of Information in Paris

Sorbonne University, Paris, France

06/21 Entropic Regularization of Optimal Transport and Applications (Online)

Banff International Research Station, Banff, Alberta, Canada

06/21 Canadian Mathematical Society Summer Meeting - Optimal Transport and Applications (Online)

University of Ottawa, Ottawa, Ontario, Canada

04/21 East Coast Optimization Meeting 2021 (Online)

George Mason University, Fairfax, Virginia, United States

11/20 IMA Workshop on Optimal Control, Optimal Transport, and Data Science (Online)

University of Minnesota, Minneapolis, Minnesota, United States

03/20-06/20 IPAM High-Dimensional Hamilton-Jacobi PDEs (In Person/Online)

IPAM, University of California Los Angeles, Los Angeles, California, United States

01/20 Joint Mathematics Meeting 2020

Denver Convention Center, Denver, Colorado, United States

06/17 Mathematical Problems in the Industry

New Jersey Institute of Technology, Newark, New Jersey, United States

WORK EXPERIENCE AND COURSES TAUGHT

2022-2025 Assistant Professor

BIMSA, Beijing, China

2022-2025 Postdoctoral Instructor

UT Austin, Austin, United States

· MATH 340L - Matrices and Matrix Calculations, Fall 2022, Spr. 2023
· MATH 427J - Differential Equations with Linear Algebra, Fall 2023, Spr. 2024

· MATH 348 - Scientific Comp. in Numerical Analysis, Fall 2024, Spr. 2025
· MATH 475T - Conference Course: Optimal Mass Transport, Spring 2025

2016-2018 Teaching Assistant at NJIT

· MATH 111 - Calculus 1 - Fall 2016
· MATH 450 - Methods of Applied Math (Honors Undergraduate) - Fall 2017
· MATH 110 - University Mathematics B II (Precalculus) - Spring 2018

01/16 - 05/16 Mandarin Chinese-English Interpreter

Accurate Communication, New York, New York, USA

05/13 - 07/15 English Teacher

Meten English, Suzhou, Jiangsu, China, 25 in-class hours/week

PROFESSIONAL AFFILIATIONS

· Society of Industrial and Applied Mathematics (SIAM)

· SIAM SIAG on Optimization

· SIAM SIAG on Analysis of Partial Differential Equations

· Canadian Mathematical Society (CMS)

SERVICE

Reviewer for:

Mathematics of Computation

Applied Numerical Mathematics

SKILLS AND CERTIFICATIONS

Certifications, Exams, & Skills

HSK (Mandarin Chinese) Level 6, November 2014

TESOL Certification, Beijing, PRC, May 2013

Languages

English · Native Speaker
Mandarin · Advanced
Spanish · Intermediate
Japanese · Beginner
Cantonese · Beginner
French · Beginner

Interests Reading, travel, languages, guitar, bass, drums, tabla

PROFESSIONAL REFERENCES

Brittany D. Hamfeldt, Associate Professor, Department of Mathematical Sciences, New Jersey Institute of Technology, brittany.d.froese@njit.edu

Richard Tsai, Professor, Department of Mathematics and Oden Institute for Computational Engineering and Sciences, University of Texas at Austin, ytsai@math.utexas.edu

Tom Lewis, Associate Professor, Department of Mathematics and Statistics, University of North Carolina Greensboro, tllewis3@uncg.edu

May 31, 2025