

Education

- PhD in Mathematics, Colorado State University, Fort Collins, CO Expected: Summer 2027
 - Course Work: Real Analysis, Abstract Algebra, Algebraic Topology, PDEs, Measure Theory, Mathematics of Radar, Differential Geometry, Discrete Differential Geometry, Fourier Analysis, Random Walks
- M.S. in Applied Mathematics, University of Colorado, Boulder, CO May 2020
 - Thesis: A 3D Extension of the Sierpinski Relatives and an Analysis of Their Persistent Homology (Supervisor: Dr. James Meiss)
 - Course Work: Numerical Analysis, Mathematical Statistics, Modeling in Applied Mathematics, Markov Processes, Dynamics on Networks, Computer Graphics, Computer Animation
 - GPA: 3.900/4.0
- B.S. in Applied Mathematics, University of Colorado, Boulder, CO May 2020
 - Minors in Computer Science, Physics, and Spanish
 - Course Work: Applied Analysis, Electromagnetism, Chaos in Dynamical Systems, Algorithms, Numerical Analysis, Classical Mechanics, Computer Systems, Fourier Series & Boundary Value Problems, Complex Variables, Applied Probability, Discrete Applied Mathematics, Data Structures
 - GPA: 3.861/4.0

Work Experience

- Research and Development Year Round Intern May 2024 - Present
Sandia National Laboratories
 - Trained vision transformers for time series analysis under the Banyan Project
 - Contributed to data curation for Undocumented Orphaned Wells research program
 - Improved VoroClust, a persistent homology inspired clustering algorithm
 - Learned the mathematical formulation of Synthetic Aperture Radar (SAR) Imaging
 - Investigated applications of Machine Learning and Artificial Intelligence to Radar
- Research Engineer Aug 2022 – May 2024
Michigan Tech University, Great Lakes Research Center
 - Continued work on projects with former USGS employers
 - Wrote python package to easily analyze robotic operating system data from autonomous underwater vehicles (AUV)
 - Published Datasets, Code, and Journal Articles related to research projects
- Computer Scientist Aug 2020 — Aug 2022
U.S. Geological Survey, Great Lakes Science Center
 - Coded machine learning algorithms to analyze Great Lakes AUV data
 - Maintained a dataset of nearly 1petabyte of AUV data

- Created science products and presentations to study invasive species, benthic ecology, and lake substrate
- Coordinated and filmed underwater 360 videos for the National Parks Service

Teaching Experience

- Teaching Assistant CSU Mathematics
 - MATH 340: Ordinary Differential Equations Jan – May 2026
 - MATH 160: Calculus for Engineers Aug – Dec 2025
 - MATH 340: Ordinary Differential Equations Aug – Dec 2024
 - MATH 120: College Algebra Aug – Dec 2023
- Teaching Assistant CU Boulder Applied Mathematics
 - APPM 1345: Calculus 1B Jan – May 2020
 - APPM 1340: Calculus 1A Aug – Dec 2019
- Course Assistant CU Boulder Applied Mathematics
 - APPM 4350: Fourier Series and PDE's Aug – Dec 2018
 - APPM 3310: Matrix Methods and Linear Algebra Aug – Dec 2017

Written Publications

1. M. Cheney, R. Moll, M. Ferrara and J. Geisz, "How Doppler Information Contributes to SAR Wavenumbers," *IEEE Transactions on Radar Systems*, vol. 4, pp. 871-882, 2026
2. Geisz, Joseph. 2025. "A Model of Flocking Using Sheaves". *Conference Proceedings: TAG-DS*, Topology Algebra and Geometry in Data Science.
3. Esselman, P. C., Moradi, S., Geisz, J., & Roussi, C. 2025. "A transferable approach for quantifying benthic fish sizes and densities in annotated underwater images." *Methods in Ecology and Evolution*, 16, 145–159. <https://doi.org/10.1111/2041-210X.14453>
4. Geisz, Joseph K., Phillipe A. Wernette, and Peter C. Esselman. 2024. "Classification of Lakebed Geologic Substrate in Autonomously Collected Benthic Imagery Using Machine Learning." *Remote Sensing* 16, no. 7: 1264. <https://doi.org/10.3390/rs16071264>
5. Geisz, Joseph. 2020. "A 3D Extension of the Sierpinski Relatives and an Analysis of their Persistent Homology." Order No. 27958282, University of Colorado at Boulder.

Dataset Publications

1. Down-looking Images of Lake Trout (*Salvelinus namaycush*) and Round Goby (*Neogobius melanostomus*) to Support Automated Biomass Estimation Oct 2024
2. Autonomously Collected Benthic Imagery for Substrate Prediction, Lake Michigan 2020-2021 Jan 2024

Code Publications

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| 1. FishScale: Estimating fish length, abundance, and biomass density | Oct 2024 |
| 2. LabelingGUIs: Graphical user interface for image labeling | Dec 2023 |

Research Projects

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| 1. Random Knots and Stick Numbers | Nov 2025 – Present |
| 2. Banyan Institute for Generative AI | Mar 2025 - Present |
| 3. Unidentified and Orphaned Oil Wells Project | Sept 2025 - Present |
| 4. Pattern Analysis Lab – Understanding Diffusion Models | Aug 2025 – June 2026 |
| 5. VoroClust: Scalable Accurate Clustering for High Dimensional Data | Oct 2024 – Sept 2025 |
| 6. Consensus Dynamics and Sheaf Laplacians | Jan 2024 – Oct 2024 |
| 7. Synthetic Aperture Radar Passive Source Localization | Aug 2024 – May 2025 |
| 8. Classifying Benthic Substrate Type with Computer Vision, Stereo Imagery, and Machine Learning | May 2021 – May 2024 |
| 9. Identifying Toxic Stamp Sands in Benthic Images with Computer Vision and Machine Learning | Feb. 2021 – May 2024 |
| 10. Detecting Quagga and Zebra Mussels in Underwater Imagery using Machine Learning | Mar 2021 – Aug 2023 |
| 11. Great Lakes National Parks 360 Degree Underwater Films | Aug. 2021 – Aug 2023 |
| 12. Topological Data Analysis and 3D Fractals, CU Applied Math | June 2019 – May 2020 |
| 13. Summer Research for Undergraduates Program: Finite Element Methods for Seismic Modeling, CU Computer Science | June – Aug. 2019 |
| 14. Neutral Vehicle and Geotab Data Analysis and Visualization | Jan – May 2019 |
| 15. Topological Data Analysis: Using Topology to Detect Bifurcations, CU Applied Math | Aug 2017 – Dec 2018 |

Presentations

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| 1. <i>Knot Spaces</i> , Colorado State University Topology Seminar and Greenslopes Seminar | Apr 2026 |
| 2. <i>Random Knot Models</i> , Front Range Applied Math Student Conference | Mar 2026 |
| 3. <i>A Model of Flocking Using Sheaves</i> , Topology Algebra and Geometry in Data Science Conference | Dec 2025 |
| 4. <i>3D Fractals</i> , CSU Math Day 2025 | Nov 2025 |
| 5. <i>A Model of Flocking Using Sheaves</i> , Colorado State University Topology Seminar | Nov 2025 |
| 6. <i>Math for Statisticians: Topology</i> , Colorado State University Greenslopes Seminar | Oct 2025 |
| 7. “Fish Math” – How I used math and stats in my job even though my title wasn’t mathematician, Colorado State University Greenslopes Seminar | Mar 2025 |
| 8. <i>Consensus on Higher Order Networks</i> , Colorado State University Topology Seminar | Oct 2024 |
| 9. <i>Artificial Intelligence Applied to Radar: Summer Internship</i> , Colorado State University Inverse Problems, Data Science, and Applied Math Seminar | Sept 2024 |
| 10. <i>Toward a Spectral Theory of Cellular Sheaves and an Application to Flocking</i> , Colorado State University Topology Seminar | Feb 2024 |

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| 11. <i>Topological Fractal Dimensions: Discreteness, Connectedness, and Beyond</i> , Colorado State University Topology Seminar | Oct 2023 |
| 12. <i>3D Sierpinski Relatives and their Persistent Homology</i> , Colorado State University Greenslopes Seminar | Sept 2023 |
| 13. <i>USGS Great Lakes Science Center Advanced Tech Work</i> , Michigan Technological University | Mar 2023 |
| 14. <i>Large-Scale Prediction of Nearshore Substrates in Lake Michigan from LiDAR Bathymetry using Machine Learning</i> , Joint Aquatic Sciences Meeting | May 2022 |
| 15. <i>High-Resolution Mapping of Spawning Reefs to Support Conservation in Northern Lake Michigan</i> (Co-Author), Joint Aquatic Sciences Meeting | May 2022 |
| 16. <i>Whole-lake indexing of round goby abundances and habitat in Lake Michigan with an imaging AUV</i> (Co-Author), Joint Aquatic Sciences Meeting | May 2022 |
| 17. <i>Persistent Homology and Extending the Sierpinski Relatives to 3D</i> , Front Range Applied Math Student Conference | Mar 2020 |
| 18. <i>Topological Data Analysis: Using Topology to Detect Bifurcations</i> , Front Range Applied Math Student Conference | Mar 2019 |

Posters

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| 1. <i>A Model of Flocking Using Sheaves</i> , Topology Algebra and Geometry in Data Science Conference | Dec 2025 |
| 2. <i>Consensus on Higher Order Networks</i> , Dynamics Days 2025 and ICERM Patterns, Dynamics, and Data in Complex Systems | Jan 2025 |
| 3. <i>Artificial Intelligence Applied to Radar</i> , Sandia National Laboratories Summer Intern Symposium | Aug 2024 |
| 4. <i>Using Machine Learning to Differentiate Toxic Stamp Sands from Native Sands along the Keweenaw Peninsula</i> , Joint Aquatic Sciences Meeting | May 2022 |
| 5. <i>A Microcosm Experiment of Round Goby Catch Efficiency using Down Looking Still Imaging</i> (Co-Author), Joint Aquatic Sciences Meeting | May 2022 |
| 6. <i>Large-Scale Assessment of Benthic Algae Spatiotemporal Variation Enabled by Deep Learning on Autonomously Collected Imagery</i> (Co-Author), Joint Aquatic Sciences Meeting | May 2022 |

Service and Mentoring

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| 1. President of CSU Society for Applied and Industrial Mathematics (SIAM) Graduate chapter | Aug 25 - May 26 |
| 2. Treasurer of CSU SIAM Graduate Chapter | Aug 24 – May 25 |
| 3. CSU Greenslopes Seminar organizer | Aug – Dec 24 |
| 4. CSU Mathematics Directed Reading Program Graduate Mentor | |
| ▪ Mentee William Miller (joint with Jacob Cleveland) | Aug 25 – May 26 |
| ▪ Mentee Nassim Raja (joint with Tatum Rask) | Aug -Dec 24 |

Computer Programs/Languages

- Languages: Python, C++, Mathematica, MATLAB, LaTeX
- Frameworks: Numpy, Pandas, OpenCV, Tensorflow, Scikit-Learn, OpenGL, ROS