Zhe Su

Contact Information

Department of Mathematics and Statistics
Auburn University
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Education

Aug 2014 - Aug 2020: Ph.D., Mathematics, Florida State University, USA

Thesis: Elastic Shape Analysis of Curves and Surfaces.
Advisors: Dr. Eric Klassen and Dr. Martin Bauer.

Sep 2011 - Jul 2014: M.A., Mathematics, Capital Normal University, China

Thesis: A Reading Report About the Mean Curvature Flow, the Inverse Mean Curvature Flow and the Riemannian Penrose Inequality.
Advisors: Dr. Fuquan Fang

Sep 2005 - Jul 2009: B.S., Mathematics, Jilin University, China

Working Experience

Jul 2025 - : Assistant Professor, Auburn University, Auburn, USA

May 2023 - Jun 2025: Research Associate, Michigan State University, East Lansing, USA

Sep 2020 - May 2023: Postdoc, Department of Neurology, University of California, Los Angeles, USA

Research Interests

Differential Geometry, Topological Data Analysis, Geometric Shape Analysis, Data Science, Machine Learning

Preprints

1. Z. Su. A vector field-induced de Rham-Hodge theory on manifolds. *submitted*

Published Articles

1. X. Liu, Z. Su, Y. Shi, Y. Tong, G. Wang, G.-W. Wei. Manifold Topological Deep Learning for Biomedical Data. arXiv:2503.00175, *Nature Communications*, (2026).
https://doi:10.1038/s41467-026-71392-1

2. Z. Su, X. Liu, L. Bou Hamdan, V. Maroulas, J. Wu, G. Carlsson, G.-W. Wei. Topological Data Analysis and Topological Deep Learning Beyond Persistent Homology - A Review. *Artificial Intelligence Review*, 59 (2025).
https://doi.org/10.1007/s10462-025-11462-w

3. D. Chen, J. Jiang, N. Hayes, Z. Su, G.-W. Wei. Artificial intelligence approaches for anti-addiction drug discovery. *Digital Discovery*, 4, (2025).
https://doi.org/10.1039/D5DD00032G

4. Z. Su, Y. Tong, G.-W. Wei. Topology-preserving Hodge Decomposition in the Eulerian Representation. *Beijing Journal of Pure and Applied Mathematics*, 2 (2025) 619-657.
https://dx.doi.org/10.4310/BPAM.250908175047

5. Z. Su, Y. Tong, G.-W. Wei. Persistent de Rham-Hodge Laplacians in Eulerian representation for manifold topological learning. *AIMS Mathematics*, 9 (2024) 27438-27470.
https://doi.org/10.3934/math.20241333

6. Z. Su, Y. Tong, G.-W. Wei. Hodge decomposition of vector fields in Cartesian grids. *SIGGRAPH Asia 2024*, 2024
https://doi.org/10.1145/3680528.3687602

7. Z. Su, Y. Tong, G.-W. Wei. Hodge Decomposition of Single-Cell RNA Velocity. *Journal of Chemical Information and Modeling*, 64 (2024) 3558-3568.
https://doi.org/10.1021/acs.jcim.4c00132

8. N. Cavallucci, Z. Su. The metric completion of the space of vector-valued one-forms. *Annals of Global Analysis and Geometry*, 64 (2023).
https://doi.org/10.1007/s10455-023-09916-x

9. K. Campbell, H. Dai, Z. Su, M. Bauer, T. Fletcher, S. Joshi. Integrated Construction of Multimodal Atlases with Structural Connectomes in the Space of Riemannian Metrics. *The Journal of Machine Learning for Biomedical Imaging*, 1 (2022) 1–25.
https://doi.org/10.59275/j.melba.2022-a871

10. K. Campbell, H. Dai, Z. Su, M. Bauer, T. Fletcher, S. Joshi. Structural Connectome Atlas Construction in the Space of Riemannian Metrics. *Information Processing in Medical Imaging 2021 (IPMI 2021)*, (2021) 291–303.
https://doi.org/10.1007/978-3-030-78191-0_23

11. M. Bauer, E. Klassen, S. Preston, Z. Su. A Diffeomorphism-Invariant Metric on the Space of Vector-Valued One-Forms. *Pure and Applied Mathematics Quarterly*, 17 (2020), 141–183.
https://dx.doi.org/10.4310/PAMQ.2021.v17.n1.a4

12. Z. Su, M. Bauer, E. Klassen, K. Gallivan. Simplifying Transformations for a Family of Elastic Metrics on the Space of Surfaces. *2020 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)*, (2020) 3705–3714.
https://doi.org/10.1109/CVPRW50498.2020.00432

13. Z. Su, M. Bauer, S. Preston, H. Laga, E. Klassen. Shape Analysis of Surfaces Using General Elastic Metrics. *Journal of Mathematical Imaging and Vision*, 62 (2020) 1087–1106.
https://doi.org/10.1007/s10851-020-00959-4

14. Z. Su, M. Bauer, E. Klassen. Comparing Curves in Homogeneous Spaces. *Differential Geometry and its Applications*, 60 (2018) 9–32.
https://doi.org/10.1016/j.difgeo.2018.05.001

15. Z. Su, M. Bauer, E. Klassen. The Square Root Velocity Framework for Curves in a Homogeneous Space. *2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)*, (2017) 680–689.
https://doi.org/10.1109/CVPRW.2017.97

Software Packages

1. A 5-component Hodge decomposition of vector fields in the Cartesian grid. Available on https://github.com/zhesu1/5ComponentHD.
2. The Helmholtz-Hodge decomposition of vector fields on a bounded domain in a 2d Cartesian grid. Available on https://github.com/zhesu1/HHD.
3. Surface registration of spherical surfaces with the general elastic metrics. Available on https://github.com/zhesu1/surfaceRegistration.
4. Geometric shape analysis of spherical surfaces with first order elastic metrics. Available on https://github.com/zhesu1/elasticMetrics.
5. Geometric shape analysis of open curves with values in homogeneous spaces. Available on https://github.com/zhesu1/SRVFhomogeneous.

Grants

FSU Math Department Travel Grant, $500, 2019
Qian Award, $350, 2017
FSU Math Department Travel Grant, $400, 2017
Congress of Graduate Students (COGS) Travel Grant, $500, 2017

Awards

IPMI Best Paper Award, 2021
Distinguished Teaching Assistant Award, 2020
The Second Prize Scholarship, Jilin University, China, 2009
Outstanding College Student Award, Jilin University, China, 2009

Talks

- International Society in Quantization, Geometry, and Dynamics (ISQGD) – Topology and Geometry, Online, May 2–3, 2026
- NCSU biomath seminar, Online, April 14, 2026
- 2026 Spring Southeastern Sectional Meeting (SS16A) Special Session on Geometric Methods for Data Science, Georgia Southern University Armstrong Campus, March 28-29, 2026
- 2026 Spring Topology and Dynamics Conference, University of Alabama at Birmingham, March 11-13, 2026
- Auburn Topology and Geometry Seminar, March 6, 2026
- FSU colloquium, November 07, 2025: Topological data analysis on manifolds via de Rham-Hodge Theory
- SIAM Central States Section Annual Meeting, University of Arkansas, October 11-12, 2025: Topological Data Analysis on Manifolds
- SIAM Great Lakes Section Annual Meeting, Illinois Institute of Technology, September 27-28, 2025: De Rham Hodge theory in topological data analysis
- Data Science and Machine Learning Seminar, Online, January 17, 2025: Mathematical AI and Its Applications.
- Midwest Mathematical Biology Seminar, Online, November 22, 2024: De Rham Hodge theory in topological data analysis.
- Mathematical Biosciences Workshop, Pennsylvania State University, August 9, 2024: De Rham Hodge Topological Learning.

- Workshop on scRNA-Seq, Spatiotemporal Transcriptomic, and Genomic Data Analysis, Michigan State University, August 9, 2023: Single-cell RNA velocity fields.
- 2020 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), Online, June 19, 2020: Simplifying Transformations for a Family of Elastic Metrics on the Space of Surfaces.
- Shape group seminar, Florida State University, February 4, 2020: A Split Metric on the Space of Metrics.
- Seminar at the Math. Bio. Inst.(MBI), Ohio State University, March 21, 2019: Comparing Curves, Surfaces and Higher Dimensional Shapes.
- UF-FSU Geometry and Topology meeting, Florida State University, February 9, 2019: A Diffeomorphism Invariant Metric on the Space of Vector-Valued One-Forms.
- Shape group seminar, Florida State University, January 23, 2019: A Diffeomorphism Invariant Metric on the Space of Vector-Valued One-Forms.
- Shape group seminar, Florida State University, November 28, 2017: Comparing Curves in Homogeneous Spaces.
- 2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), Honolulu, Hawaii, July 21, 2017: The Square Root Velocity Framework for Curves in a Homogeneous Space.
- Topology seminar, Florida State University, April 25, 2017: The Square Root Velocity Framework for Curves in a Homogeneous Space.
- Shape group seminar, Florida State University, November 18, 2016: Ways to Compare Surfaces in $\mathbb{R}^3$ - the work of Sebastian Kurtek and Ian Jermyn et al.
- Topology seminar, Florida State University, March 1, 2016: A way to compute geodesics between curves in homogeneous spaces.
- Shape group seminar, Florida State University, February 19, 2016: A Way to Compute Geodesics Between Curves in Homogeneous Spaces Using the SRVF Method.

Conference Organization

UARK-SIAM-CSS-25 Mathematical Modeling in Biosciences, Co-organizer: Hongsong Feng (University of North Carolina at Charlotte)

GLSIAM 2025 Mathematical Modeling for Bioscience, Co-organizer: Hongsong Feng (University of North Carolina at Charlotte)

2023 MSU Workshop on Spatial and Time-Resolved Single-Cell Transcriptomics Analysis, Co-organizers: G.-W. Wei; C. Piermarocchi, Y. Hozumi, S. Cottrell; https://sites.google.com/view/2023-msu-scrnaseq

2023 Workshop on scRNA-Seq, Spatiotemporal Transcriptomic, and Genomic Data Analysis, Co-organizers: G.-W. Wei;
https://sites.google.com/view/2023scrnaseq-internal1

Reviewer

Journal of Mathematical Imaging and Vision (JMIV)
Image and Vision Computing (IMAVIS)
SIAM Journal on Mathematics of Data Science (SIMODS)
Data Analytics and Topology
Differential Geometry in Computer Vision and Machine Learning (DiffCVML)
Journal of Chemical Information and Modeling (JCIM)
AAAI Conference on Artificial Intelligence
Medical Image Computing and Computer-Assisted Intervention - MICCAI

Programming skills

Matlab, Python, Pytorch, Pandas, Scikit-Learn

Teaching

Department of Mathematics and Statistics, Auburn University, USA

- Fall 2026: Introduction to Topology (MATH 5500/6500)
- Spring 2026: Instructor for Honors Calculus III (Math 2637)
- Fall 2025: Instructor for Calculus III (Math 2630)

Department of Mathematics, Michigan State University, USA

- Fall 2023, Spring 2024, Fall 2024: Instructor for Matrix Algebra with Computational Applications (CMSE/MTH 314)

Department of Mathematics, Florida State University, USA

- Fall 2019: Grader for Linear Algebra (MAS3105)
- Summer 2019: Instructor of record for Calculus III (MAC2313)
- Spring 2019: Instructor of record for Calculus III (MAC2313)
- Fall 2018: Instructor of record for Calculus I (MAC2311)
- Spring 2018: Instructor of record for PreCalculus (MAC1140)
- Fall 2017: Instructor of record for PreCalculus (MAC1140)
- Spring 2017: Grader for Introduction to Advanced Mathematics (MGF3301) and Advanced Calculus (MAA4226)
- Fall 2016: Recitations TA for Calculus I (MAC 2311)
- Summer 2018, Summer 2017, Fall 2014-Summer 2016 : Lab instructor for College Algebra, Business Calculus, Trigonometry, Precalculus, Mathematics for Liberal Arts, Practical Finite Math