Emmanuel Hartman

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Education

University of Houston — Houston, Texas
Aug. 2024 - Present
Post Doctoral Scholar

Florida State University — Tallahassee, Florida
Aug. 2018 - May 2024
PhD Candidate - Pure Mathematics
GPA: 3.853

University of North Carolina at Asheville — Asheville, North Carolina
Aug. 2014 - May. 2018
Bachelor of Arts in Pure Mathematics
with a Minor in Computer Science
and Distinction as a University Scholar
GPA: 3.938 (Summa Cum Laude); Mathematics GPA: 4.0; Computer Science GPA: 4.0

Extended Research Stays

Johns Hopkins University — Baltimore, Maryland
Oct. 2021 - Nov. 2021
Visiting Scholar at the Department of Applied Mathematics and Statistics
and Center for Imaging Sciences

Institut Henri Poincaré — Paris, France
Oct. 2022 - Nov. 2022
Participant of the Thematic Semester on Geometry and Statistics in Data Sciences

Publications

In Preparation

Emmanuel Hartman, Karen Habermann. Stochastic Completeness of Sobolev Metrics on Spaces of Discrete Curves.

Jose Jaramillo, Emmanuel Hartman, Nicolas Charon, Charles Puelz. Stratifying Coronary Ischemia Risk with Mean Curvature Distributions of Aorta Meshes.

Minglang Yin, Zan Ahmad, Emmanuel Hartman, Yashil Sukurdeep, Shiyi Chen, Jiwoo Noh, Nicolas Charon, David D Spragg, Natalia A Trayanova. Geometric Deep Learning For Correlating Left Atrium Morphology with Stroke Risk in Patients with Atrial Fibrillation

Preprints

[12] *Mary Chriselda Antony Oliver, Emmanuel Hartman, Tom Needham. Conic Formulations of Transport Metrics for Unbalanced Measure Networks and Hypernetworks
Preprint available here: https://arxiv.org/abs/2508.10888

[11] Emmanuel Hartman, Nicolas Charon. SVarM: Linear Support Varifold Machines for Classification and Regression on Geometric Data.
Preprint available here: https://arxiv.org/abs/2506.01189

[10] Emmanuel Hartman, Martin Bauer, Nicolas Charon. Self Supervised Networks for Learning Latent Space Representations of Human Body Scans and Motions.
Preprint available here: https://arxiv.org/abs/2411.03475

Publications

[9] Luís F. Pereira, Alice Le Brigant, Adele Myers, Emmanuel Hartman, Amil Khan, Malik Tuerkoen, Trey Dold, Mengyang Gu, Pablo Suárez-Serrato, and Nina Miolane. Learning from landmarks, curves, surfaces, and shapes in Geomstats. *Transactions on Mathematical Software (Forthcoming)*
Preprint available here: https://arxiv.org/abs/2406.10437v1

[8] Jonathan Cerqueira, Emmanuel Hartman, Eric Klassen, Martin Bauer. Sobolev Metrics on Spaces of Discrete Regular Curves. *Discrete and Continuous Dynamical Systems (DCDS)*
Preprint available here: https://www.aimsciences.org/article/doi/10.3934/dcds.2025086

[7] Emmanuel Hartman, Emery Pierson, Martin Bauer, Mohamed Daoudi, Nicolas Charon. Basis restricted elastic shape analysis on the space of unregistered surfaces. *International Journal of Computer Vision*
Preprint available here: https://arxiv.org/abs/2311.04382.pdf

[6] Emmanuel Hartman, Martin Bauer, Eric Klassen. Square Root Normal Fields for Lipschitz surfaces and the Wasserstein Fisher Rao metric. *In SIAM Mathematical Analysis*
Preprint available here: https://arxiv.org/abs/2301.00284

[5] Emmanuel Hartman, Emery Pierson. VariGrad: A Novel Feature Vector Architecture for Geometric Deep Learning on Unregistered Data. *In Eurographics Workshop on 3D Object Retrieval* (2023)
Preprint available here: https://arxiv.org/abs/2307.03553

[4] Emmanuel Hartman, Emery Pierson, Martin Bauer, Nicolas Charon, Mohamed Daoudi. BaRe-ESA: A Riemannian Framework for Unregistered Human Body Shapes. *In Proceedings of the IEEE/CVF International Conference on Computer Vision (ICCV)*
Preprint available here: https://arxiv.org/abs/2211.13185

[3] Emmanuel Hartman, Yashil Sukurdeep, Eric Klassen, Martin Bauer, Nicolas Charon. Elastic shape analysis of surfaces with second-order Sobolev metrics: a comprehensive numerical framework. *International Journal of Computer Vision*, 131(5), 1183-1209. (2022)
Paper available here: https://link.springer.com/article/10.1007/s11263-022-01743-0

[2] *Martin Bauer, Emmanuel Hartman, Eric Klassen. The Square Root Normal Field Distance and Unbalanced Optimal Transport. *Applied Mathematics and Optimization*, 85(3), 35. (2022)
Preprint available here: https://arxiv.org/abs/2105.06510

[1] Emmanuel Hartman, Yashil Sukurdeep, Nicolas Charon, Eric Klassen, Martin Bauer. Supervised deep learning of elastic SRV distances on the shape space of curves. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops*, 4425-4433. (2021)
Preprint available here: https://arxiv.org/abs/2101.04929

Software Packages

Pytorch_VariGrad. Pytorch implementation of the VariGrad feature vector architecture proposed in *VariGrad: A Novel Feature Vector Architecture for Geometric Deep Learning on Unregistered Data.*
Available on Github at https://github.com/emmanuel-hartman/Pytorch_VariGrad

H2_SurfaceMatch. A toolbox for the comparison, matching and interpolation of triangulated surfaces with respect to a second order Sobolev metric. Includes a comprehensive statistical pipeline that allows for the computation of the Karcher means, tangent space principal component analysis, and motion transfer in the space of parametrized surfaces and in shape space. Available on Github at https://github.com/emmanuel-hartman/H2_SurfaceMatch

**BCMOUT-pytorch. An implementation of the block coordinate method introduced in *The Square Root Normal Field Distance and Unbalanced Optimal Transport* that operates on a larger set of manifolds and computes the Wasserstein-Fisher-Rao and Hellinger-Kantoriovich distances. Available on Github at https://github.com/emmanuel-hartman/BCMOUT-pytorch

SphericalRieszSearch. An implementation of projected gradent descent to find minimal configurations of measures with large numbers of supports with respect to the Riesz energy. Available on Github at https://github.com/emmanuel-hartman/SphericalRieszSearch

WassersteinFisherRaoDistance. An implementation of the framework introduced in *The Square Root Normal Field Distance and Unbalanced Optimal Transport.* Available on Github at https://github.com/emmanuel-hartman/WassersteinFisherRaoDistance

supervisedDL-SRVFdistances. An implementation of the framework introduced in *Supervised deep learning of elastic SRV distances on the shape space of curves.* Available on Github at https://github.com/emmanuel-hartman/supervisedDL-SRVFdistances

*Author order reflects equal contributions by all listed authors

** Joint work with Dylan Connell as a part of the FSU directed reading Program

Awards

Best Poster at CIRM Conference on Geometric Sciences in Action	2024
Tam Family Travel Award Recipient	2024
Dwight B. Goodner Endowed Fellow	2023
Tam Family Travel Award Recipient	2022
Bettye Anne Busbee Case Graduate Fellowship Recipient	2021
Florida State Legacy Fellow	2018-2023
UNC Asheville Mathematics Department Top Math Student Award Recipient	2018
UNC Asheville Mathematics Department Scholarship Recipient	2018
UNC Asheville Honors Program Citizenship Award Recipient	2018
UNC Asheville Laurel Scholarship Recipient	2014-2018

Advising and Mentoring

Samundra Regmi - UH Graduate Student	2024-Present
Jose Jaramillo - UH Undergraduate Research	2024-Present
Sophie Allen - FSU Directed Reading Program	2023-2024
Samuel Vecchio - FSU Directed Reading Program	2023-2024
Dylan Connell - FSU Directed Reading Program	2022-2023

Presentations

Summer 2025, Studying the Geometry of Discretizations of Infinite Dimensional Manifolds, *Math in Umbria: Geometry, Shapes and PDEs* Città di Castello, Umbria, Italy

Spring 2025, Parameterization Invariant Representations for Efficient Shape Learning, *Infinite-dimensional Geometry: Theory and Applications, ESI* Vienna, Austria

Fall 2024, Geometric Deep Learning for Unregistered Shape Data, *SIAM Mathematics of Data Science* Atlanta, GA

Summer 2024, Conic Gromov Wasserstein Distance for Unbalanced Measure Networks, *Math in Maine: A Workshop centered around Geometry, Shapes and PDEs,* Andover, Maine

Summer 2024, Elastic Shape Analysis of Surfaces with Second-Order Sobolev Metrics, *CIRM Conference on Geometric Sciences in Action,* CIRM, Marseilles, France

Summer 2024, Geometric Deep Learning for Unregistered Shape Data *CIRM Conference on Geometric Sciences in Action,* CIRM, Marseilles, France (Won Best Poster Award)

Spring 2024, Numerical Frameworks For Elastic Shape Analysis Using Second Order Sobolev Metrics *AMS Special Session on the Geometry of the Shape Space* Joint Mathematics Meeting, San Francisco, CA

Fall 2022, H2_SurfaceMatch: A numerical framework for elastic shape analysis. *Shape Workshop at Universite Lille* Universite Lille, Lille, France

Spring 2022, SRNF Elastic Shape Distance as unbalanced optimal transport *SIAM Conference on Imaging Science* (Virtual)

Spring 2022, SRNF Elastic Shape Distance as unbalanced optimal transport *Florida State Mathematics Machine Learning Seminar* Florida State University, Tallahassee, FL

Spring 2022, A Numerical Framework for Shape Analysis Using Split Second-Order Sobolev Metrics *UF/FSU Topology & Geometry Meeting* University of Florida, Gainesville, FL

Spring 2022, A Numerical Framework for Shape Analysis Using Split Second-Order Sobolev Metrics *Florida State Mathematics Machine Learning Seminar* Florida State University, Tallahassee, FL

Fall 2021, A Numerical Framework for Shape Analysis Using H^2 Metrics *Florida State Statistics Shape Group Meeting* Florida State University, Tallahassee, FL

Fall 2021, Optimal Reparameterizations in the SRVF and SRNF *Florida State Mathematics Machine Learning Seminar* Florida State University, Tallahassee, FL

Fall 2021, SRNF Elastic Shape Distance as the Wasserstein-Fisher-Rao distance *Geometry and Topology meet Data Analysis and Machine Learning* (Virtual)

Summer 2021, Supervised Deep Learning Framework for Computing Distances on the Shape Space of Curves *6th International Workshop on Differential Geometry in Computer Vision and Machine Learning* (Virtual)

Spring 2021, An optimal transport approach to SRNF shape matching *Florida State Statistics Shape Group Meeting* Florida State University, Tallahassee, FL

Fall 2020, An algorithm for fast computation of shape distance in the SRNF framework. *Florida State Statistics Shape Group Meeting* Florida State University, Tallahassee, FL

Fall 2020, Precise computation of the SRNF shape distance. *Florida State Mathematics Machine Graduate Student Seminar* Florida State University, Tallahassee, FL

Fall 2020, A supervised deep learning approach for the computation of elastic SRV distances. *Florida State Mathematics Machine Learning Seminar* Florida State University, Tallahassee, FL

Summer 2020, Advanced Topics Exam Presentation. *Florida State Statistics Shape Group Meeting* Florida State University, Tallahassee, FL

Spring 2020, Deep Learning for Shape Analysis. *Florida State Statistics Shape Group Meeting* Florida State University, Tallahassee, FL

Spring 2020, Introduction to StyleGAN. *Florida State Mathematics Machine Learning Seminar* Florida State University, Tallahassee, FL

Spring 2018, Using Topology to Study Groups. *Twelfth Annual Undergraduate Math Conference* University of Tennessee at Knoxville, Knoxville, TN

Fall 2017, Building an Active Honors Student Administration. *2017 SRHC Conference* Southern Regional Honors Council, Asheville, NC

Fall 2016, Building an Active Honors Student Administration. *North Carolina Honors Association Fall 2016 Conference,* University of North Carolina at Greensboro, Greensboro, NC

Conferences Attended

Math in Umbria: Geometry, Shapes and PDEs, Città di Castello, Umbria, Italy, 2025

Infinite-dimensional Geometry: Theory and Applications, ESI, Vienna, Austria, 2025

SIAM Mathematics of Data Science, Atlanta, GA, 2024

Geometric Sciences in Action, CIRM, Marseilles, France, 2024

Math in Maine: A Workshop centered around Geometry, Shapes and PDEs, Andover, Maine, 2024

Joint Mathematics Meetings, San Francisco, CA, 2024

CIS 25th Anniversary Workshop, Johns Hopkins University, Baltimore, MD, 2023

Shape Workshop at Universite Lille, Universite Lille, Lille, France, 2022

Geometry, Topology and Statistics in Data Sciences, Institut Henri Poincaré, Paris, France, 2022

Non-Linear and High Dimensional Inference, Institut Henri Poincaré, Paris, France, 2022

SIAM Conference on Imaging Science, Virtual, 2022

UF/FSU Topology & Geometry Meeting, University of Florida, Gainesville, FL 2022

Geometry and Topology meet Data Analysis and Machine Learning, Virtual, 2021

6th International Workshop on Differential Geometry in Computer Vision and Machine Learning, Virtual, 2021

Twelfth Annual Undergraduate Math Conference, University of Tennessee at Knoxville, Knoxville, TN, 2018

2017 SRHC Conference , Southern Regional Honors Council, Asheville, NC 2017

North Carolina Honors Association Fall 2016 Conference, University of North Carolina at Greensboro, Greensboro, NC, 2016

North Carolina Honors Association Fall 2015 Conference, University of North Carolina at Asheville, Asheville, NC, 2015

Consortium for CS in Colleges: Southeastern Conference , Roanoke College, Salem, VA, 2015

Undergraduate Research

Order Theory Research, UNC Asheville — Jan 2017 - May 2018

Our group explored how certain configurations within a partial order affect the order dimension. Specifically, we sought to show that every poset whose order dimension is greater than two contains a certain sub-order.

Topology and Group Theory Research, UNC Asheville — Jan 2018 - May 2018

This research project investigates a method of generating a topological space from a group. Furthermore, we used the topology generated by this method to prove facts about groups.

Computer Science Research, UNC Asheville — August 2016 - May 2018

This large scale software development project was an iteratively developed Unity implementation of a popular board game, King of Tokyo, using Object Oriented abstractions and Model-View-Controller architecture. I developed an Artificially Intelligent actor to compete against human players of the game and stayed on the project as the software architect for the final semester of development.

Professional Experience

Florida State University, Tallahassee, FL — August 2018- May 2024

Linear Algebra Instructor	January 2023- May 2023
Calculus III Instructor	May 2022- August 2022
Calculus II Instructor	January 2022-May 2022
Calculus I Instructor	May 2021- August 2021
Research Assistant	August 2020 - Present
Discrete Mathematics Recitation Instructor	May 2020 - July 2020
Precalculus Algebra Instructor of Record	August 2019 - April 2020
Business Calculus Teaching Assistant	June 2019 - July 2019
Linear Algebra Grader	January 2019 - April 2019
Trigonometry Teaching Assistant	August 2018 - December 2018
College Algebra Teaching Assistant	August 2018 - December 2018

French Broad River Academy, Asheville, NC — September 2016- May 2018

- After School Computer Science Course Instructor — January 2017 - Dec 2017
- Volunteer Teaching Assistant — September 2016 - May 2017
- After School Tutor — January 2017 - May 2018

UNC Asheville Student Employee, Asheville, NC — September 2016- May 2018

- Math Lab Assistant — September 2016 - May 2018
- Computer Science Peer Tutor — September 2017 - May 2018
- Freshman Peer Mentor — September 2017 - Dec 2017

Extracurricular Activities and Skills

Member of the Mathematics Graduate Student Council — March 2021-Present

President and Founding Member of the UNCA Student Honors Advisory Council — April 2017-May 2018

Founder of the Sparks Lecture Series through the UNCA Honors Program — November 2015-August 2017

Extensive Experience in: Java, Python, Processing, Mathematica, LaTeX, Matlab and C#

UNC Asheville Dean or Chancellor's List — Fall 2014-Spring 2018

Volunteer at the Southern Regional Honors Conference — Spring 2017

Participant in the ICPC Mid-Atlantic USA Contest-2nd Place at UNC Chapel Hill — November 2016

Attendee of the North Carolina Governor's School West in Mathematics — Summer 2013

Volunteer Teaching Assistant at the French Broad River Academy — January 2017 - May 2017

Participant in the Consortium for CS in Colleges:SE Conference Programming Contest — November 2015

Volunteer at the NC Honors Association Conference — Fall 2015