

# EMMANUEL HARTMAN

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## EDUCATION

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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

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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

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### Preprints

[8] 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  
Preprint available here: <https://arxiv.org/pdf/2406.10437v1>

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

### Publications

[6] Emmanuel Hartman, Martin Bauer, Eric Klassen. Square Root Normal Fields for Lipschitz surfaces and the Wasserstein Fisher Rao metric. *SIAM Mathematical Analysis* (Forthcoming)  
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>

## In Preparation

Mary Chriselda Antony Oliver, Emmanuel Hartman, Thomas Needham. Conic Co-Optimal Transport

Emmanuel Hartman, Martin Bauer, Nicolas Charon. Self Supervised Networks for Learning Latent Space Representations of Human Body Scans and Motions.

## 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](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](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-Kantorovich distances. Available on Github at

<https://github.com/emmanuel-hartman/BCMOUT-pytorch>

SphericalRieszSearch. An implementation of projected gradient 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

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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

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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

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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

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

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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

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Florida State University, Tallahassee, FL August 2018- Present

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 College Algebra Teaching Assistant	August 2018 - December 2018 August 2018 - December 2018
French Broad River Academy, Asheville, NC	September 2016- May 2018
Extracurricular Computer Science Instructor Volunteer Teaching Assistant After School Tutor	January 2017 - Dec 2017 September 2016 - May 2017 January 2017 - May 2018
UNC Asheville Student Employee, Asheville, NC	September 2016- May 2018
Math Lab Assistant Computer Science Peer Tutor Freshman Peer Mentor	September 2016 - May 2018 September 2017 - May 2018 September 2017 - Dec 2017

## EXTRACURRICULAR ACTIVITIES AND SKILLS

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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