Tingran Gao

Department of Statistics
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EDUCATION AND TRAINING

Duke University 2010 – 2015
Ph.D. in Mathematics, May 2015
Thesis: *Hypoelliptic Diffusion Maps and Their Applications in Automated Geometric Morphometrics*
Thesis Advisor: Ingrid Daubechies

Duke University 2013 – 2015
M.S. in Computer Science, May 2015

Tsinghua University 2006 – 2010
B.S. in Mathematics, July 2010
Thesis: *Blow-up Analysis of Gauss Curvature Equations*

PROFESSIONAL APPOINTMENTS

Department of Statistics (Computational and Applied Mathematics September 2017 – present
Initiative), The University of Chicago
William H. Kruskal Instructor
Signal/Image/Geometry Processing, Nonparametric Statistics, Applied and Computational Algebra and
Geometry, Optimization, Dynamical Systems, Applied and Computational Harmonic Analysis, Applications
in Real Data Science Problems

Department of Mathematics, Duke University August 2015 – August 2017
Visiting Assistant Professor
Manifold Learning, Topological Data Analysis, Geometry and Topology of High-Dimensional Datasets, Applied Harmonic Analysis, Information Geometry

Department of Mathematics, Duke University August 2010 – May 2015
Graduate Student
Diffusion Geometry, Riemannian Geometry, Machine Learning, Applied Harmonic Analysis

Institute of Computing Technology, Chinese Academy of Sciences July 2009 – July 2010
Research Internship
The mathematical foundations of Formal Concept Analysis: Ordered Sets, Lattices Theory, Decomposition
and Construction of Concept Lattices, Representation Theorems, Distributivity and Modularity

Department of Mathematical Sciences, Tsinghua University April 2009 – August 2009
Undergraduate Independent Studies
Optimization algorithms for nonlinear complementarity problems

AWARDS

- AMS-Simons Travel Grant (2018)
- Duke Arts & Sciences Council Committee on Faculty Research Travel Award (2017)
- SIAM Early Career Travel Award (2017)
- Yongwang Scholarship for Academic Excellence, Tsinghua University (2009)
- National High School Mathematics Olympiad, Zhejiang Division, Second Prize (2005)
- Beijing High School Applied Mathematics Contest, First Prize (2004)

PUBLICATIONS AND PREPRINTS

[1] **Tingran Gao**, Shahab Asoodeh, Yi Huang, and James Evans, "Wasserstein Soft Label Propagation on Hypergraphs: Algorithm and Generalization Error Bounds."*arxiv preprint.* eprint: `arXiv:1809.01833.` (2018)

[2] **Tingran Gao**, Shahar Z. Kovalsky, Doug M. Boyer, and Ingrid Daubechies, "Gaussian Process Landmarking for Three-Dimensional Geometric Morphometrics."*arxiv preprint.* eprint: `arXiv:1807.11887.` (2018)

[3] Shahab Asoodeh, **Tingran Gao**, James Evans. "Curvature of Hypergraphs via Multi-Marginal Optimal Transport." *The 57th IEEE Conference on Decision and Control.* eprint: `arXiv:1803.08584.` (2018)

[4] Chandrajit Bajaj, **Tingran Gao**, Zihang He, Qixing Huang, and Zhenxiao Liang. "SMAC: Simultaneous Mapping and Clustering Using Spectral Decompositions." *2018 International Conference on Machine Learning.* (2018)

[5] **Tingran Gao**, Shahar Z. Kovalsky, and Ingrid Daubechies, "Gaussian Process Landmarking on Manifolds."*arxiv preprint.* eprint: `arXiv:1802.03479.` (2018)

[6] **Tingran Gao**, Gabriel S. Yapuncich, Ingrid Daubechies, Sayan Mukherjee, and Doug M. Boyer, "Development and Assessment of Fully Automated and Globally Transitive Geometric Morphometric Methods, with Application to a Biological Comparative Dataset with High Interspecific Variation." *The Anatomical Record.*, 301:636-658, DOI:10.1002/ar.23700 (2018)

[7] **Tingran Gao**, Jacek Brodzki, and Sayan Mukherjee, "The Geometry of Synchronization Problems and Learning Group Actions." *submitted.* eprint: `arXiv:1610.09051.` (2016)

[8] Rujie Yin, **Tingran Gao**, Yue M. Lu, and Ingrid Daubechies, "A Tale of Two Bases: Local-Nonlocal Regularization on Image Patches with Convolution Framelets." *SIAM Journal on Imaging Sciences,* 10(2), 711-750. (2017)

[9] Natasha S. Vitek, Carly L. Manz, **Tingran Gao**, Jonathan I. Bloch, Suzanne G. Strait, and Doug M. Boyer, "Semi-Supervised Determination of Pseudocryptic Morphotypes Using Observer-Free Characterizations of Anatomical Alignment and Shape." *Methods in Ecology and Evolution,* 2017;7:5041-5055. DOI:`https://doi.org/10.1002/ece3.3058` (2017)

[10] **Tingran Gao**, "The Diffusion Geometry of Fibre Bundles: Horizontal Diffusion Maps." *under review.* eprint: `arXiv:1602.02330.` (2016)

[11] **Tingran Gao**, "Hypoelliptic Diffusion Maps and Their Applications in Automated Geometric Morphometrics." *PhD thesis, Duke University.* (2015) eprint: `http://hdl.handle.net/10161/9931`

[12] Liping Zhang, Soon-Yi Wu, and **Tingran Gao**, "Improved Smoothing Newton Methods for Nonlinear Complementarity Problems." *Applied Mathematics and Computation,* 215(1), pp.324-332. (2009)

TEACHING EXPERIENCES

STAT 27400/37400: Nonparametric Inference Autumn 2018
The University of Chicago

STAT 25100: Introduction to Mathematical Probability Autumn 2018
The University of Chicago

STAT 25100: Introduction to Mathematical Probability Spring 2018
The University of Chicago

STAT 27400/37400: Nonparametric Inference Winter 2018
The University of Chicago

MATH 181.02: Math Everywhere Spring 2016
Duke University

MATH 212L.12 & 14: Multivariable Calculus Fall 2015
Duke University

MATH 105L.01: Lab Calculus I Summer Term II 2014
Duke University

MATH 122L.13: Introductory Calculus II with Applications Fall 2015
Duke University

INTERNSHIP
Data Science Intern at MarkMonitor, Part of Thomson Reuters June 2015 – August 2015
Data Scientist – Machine Learning

RECENT AND UPCOMING INVITED PRESENTATIONS

- *Synchronization Problems: From Geometry to Learning*, Applied and Computational Mathematics Seminar, National University of Singapore, Singapore, September 18, 2018

- *Synchronization Problems: From Geometry to Learning*, Twenty Years' Anniversary of the Academic Talent Program 1998-2018, Symposium on Mathematics, Beijing, China, July 18, 2018

- *Gaussian Process Landmarking on Manifolds*, The 9th International Conference on Curves and Surfaces, Palais des Congrès, Arcachon, France, June 30, 2018

- *Gaussian Process Landmarking on Manifolds*, Daubechies64: Time, Frequency, and Everything That Follows, Park Molenheide, Houthalen-Helchteren, Belgium, June 27, 2018

- *A Tale of Two Bases: Local-Nonlocal Regularization on Image Patches with Convolution Framelets*, 2018 SIAM Conference on Imaging Science: Minisymposium on "Low Dimensional Structures in Imaging Science", Bologna, Italy, June 7, 2018

- *The Geometry of Synchronization Problems and Learning Group Actions*, 2018 SIAM Conference on Imaging Science: Minisymposium on "Geometry and Learning in 3D Shape Analysis", Bologna, Italy, June 6, 2018

- *Synchronization Problems: From Geometry to Learning*, IMA Workshop on "Bridging Statistics and Sheaves", The Institute for Mathematics and Its Applications, Minneapolis MN, USA, May 22, 2018

- *Synchronization Problems: From Geometry to Learning*, Oberwolfach Workshop on "Applied Harmonic Analysis and Data Processing", Mathematisches Forschungsinstitut Oberwolfach, Oberwolfach, Germany, March 25 – March 31, 2018

- *Manifold Learning on Fibre Bundles*, ENAR 2018 Spring Meeting: IMS Invited Session on "Geometry and Topology in Statistical Inference", Atlanta GA, March 25 – March 28, 2018

- *Gaussian Process Landmarking on Manifolds*, The 42nd SIAM Southeastern Atlantic Section Conference (SIAM-SEAS 2018): Minisymposium on "Mathematics in Data Analysis and Machine Learning", Chapel Hill NC, March 10, 2018

- *Manifold Learning on Fibre Bundles*, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing, Dec 7, 2017

- *Manifold Learning on Fibre Bundles*, SING (Signals, Information, and Networks Group) Group Seminar, Harvard University, Boston MA, Nov 28, 2017

- *The Geometry of Synchronization Problems and Learning Group Actions*, 2017 SIAM Conference on Applied Algebra and Geometry, Atlanta GA, August 1, 2017

- *Manifold Learning on Fibre Bundles*, 2017 Meeting of the International Linear Algebra Society, Ames IA, July 27, 2017

- *Diffusion Geometry and Manifold Learning on Fibre Bundles*, 2017 SIAM Annual Meeting, Minisymposium on "Geometry and Computational Challenges in Data Science," Pittsburgh PA, July 12, 2017

- *Synchronization Problems and Manifold Learning on Fibre Bundles*, Geometry and Topology Seminar, North Carolina State University, Raleigh NC, Jananury 18, 2017

- *The Diffusion Geometry of Shape Spaces*, AMS Sectional Meeting: Special Session on Geometry and Topology in Image and Shape Analysis, North Carolina State University, Raleigh NC, November 13, 2016

- *Synchronization Problems and the Diffusion Geometry of Shape Spaces*, Department of Computer Science, Stanford University, Palo Alto CA, May 2, 2016

- *Synchronization Problems and the Diffusion Geometry of Shape Spaces*, Department of Mathematics, Rensselaer Polytechnic Institute, Troy NY, April 18, 2016

- *Geometry Processing and Visualization in Paleontology*, Visualization Friday Forum, Duke University, Durham NC, March 11, 2016

- *Machine Learning, Fibre Bundles and Biological Morphology*, Shape Analysis and Learning by Geometry and Machine, IPAM, Los Angeles CA, February 11, 2016

- *An Invitation to Geometry Processing*, Graduate/Faculty Seminar, Duke University, Durham NC, September 25, 2015

- *Hypoelliptic Diffusion Maps*, Data Seminar, Duke University, Durham NC, April 16, 2015

- *The Diffusion Geometry of Shape Spaces*, Student Talk at Triangle Area Graduate Mathematics Conference (TAGMaC), North Carolina State University, Raleigh NC, March 21, 2015

SELECTED ACTIVITIES

- *Conference on Geometric Data Analysis*, Stevanovich Center for Financial Mathematics, The University of Chicago, Chicago, Illinois, May 20 – May 24, 2019

- Workshop on *Computational Imaging*, Semester Program on Computer Vision, ICERM, Brown University, Providence, March 18 – March 22, 2019

- *Nonlinear Algebra Bootcamp*, Semester Program on Nonlinear Algebra, ICERM, Brown University, Providence, September 5 – September 12, 2018

- *Building Community in the Foundations of Data Science*, ICERM, Brown University, Providence, August 13 – August 14, 2018

- *The 9th International Conference on Curves and Surfaces*, Palais des Congrès, Arcachon, France, June 28 – July 4, 2018

- *2018 SIAM Annual Meeting*, Oregon Convention Center, Oregon OR, July 9 – July 13, 2018

- *Dynamics, Topology and Computations 2018*, Mathematical Research and Conference Center in Będlewo, Poland, June 18 – June 23, 2018

- *2018 SIAM Conference on Imaging Science: Minisymposium on "Geometry and Learning in 3D Shape Analysis"*, Bologna, Italy, June 5 – June 8, 2018

- *IMA Workshop on "Bridging Statistics and Sheaves"*, The Institute for Mathematics and Its Applications, Minneapolis MN, May 21 – May 25, 2018

- *Oberwolfach Workshop on "Applied Harmonic Analysis and Data Processing"*, Mathematisches Forschungsinstitut Oberwolfach, Oberwolfach Germany, March 25 – March 31, 2018

- *ENAR 2018 Spring Meeting: IMS Invited Session on "Geometry and Topology in Statistical Inference"*, Atlanta GA, March 25 – March 28, 2018

- *2017 SIAM Conference on Applied Algebraic Geometry*, Georgia Institute of Technology, Atlanta GA, July 31 – August 4, 2017

- *2017 Joint Statistical Meetings* (Invited Poster), Baltimore Convention Center, Baltimore MD, July 29 – August 3, 2017

- *2017 Meeting of the International Linear Algebra Society*, Iowa State University, Ames IA, July 24 – July 28, 2017

- *2017 SIAM Annual Meeting* and *2017 SIAM Conference on Industrial and Applied Geometry*, David Lawrence Convention Center, Pittsburgh PA, July 10 – July 14, 2017

- *AMS Sectional Meeting: Special Session on "Geometry and Topology in Image and Shape Analysis,"* North Carolina State University, Raleigh NC, November 12 – November 13, 2016

- *Stochastic Numerical Algorithms, Multiscale Modeling and High-Dimensional Data Analytics,* ICERM, Brown University, Providence RI, July 18 – July 22, 2016

- *NSF-CBMS Regional Conference on Topological Data Analysis,* University of Texas at Austin, Austin TX, May 31 – June 4, 2016

- *Topology, Geometry, and Data Analysis Conference,* Ohio State University, Columbus OH, May 16 – May 20, 2016.

- Short-Term Visiting Scholar, Department of Computer Science, Stanford University, Palo Alto CA, May 1 – May 28, 2016

- Conference: *Geometry and Data Analysis*, The University of Chicago, Chicago IL, June 8 – June 10, 2015

- Summer Graduate Workshop: *Optimal Transport: Geometry and Dynamics*, MSRI, Berkeley CA, August 26 – August 30, 2013

- Short-Term Visiting Graduate Student, Weizmann Institute of Science, Rehovot Israel, July 6 – July 19, 2013

- The 11th Symposium on Geometry Processing, Genova, Italy, July 3 – July 5, 2013

- IMA New Directions Short Course, *Applied Statistics and Machine Learning*, The Institute for Mathematics and Its Applications, Minneapolis MN, June 17 – June 28, 2013

- Short-Term Visiting Graduate Student, Weizmann Institute of Science, Rehovot Israel, May 2 – May 26, 2012

- Second Abel Conference: *A Mathematical Celebration of John Milnor*, IMA, Minneapolis MN, January 30 – February 1, 2012

- Summer Graduate Workshop: *Geometric Measure Theory and Applications*, MSRI, Berkeley CA, July 11 – July 22, 2011

- Workshop on Frontiers in Computational and Applied Mathematics, Tsinghua University, Beijing, China, August 9 – August 10, 2009

- Summer Workshop on Duality Theory and Application, Tsinghua University, Beijing, China, May 23 – May 24, 2009

PROFESSIONAL SERVICES

Conference Organizer
- SIAM Annual Meeting 2018 (SIAM AN18) - Minisymposium on "Numerical Differential Geometry Meets Numerical Algebraic Geometry," Portland, OR, July 2018 (with Dr. Jose I. Rodriguez)

- SIAM Annual Meeting 2018 (SIAM AN18) - Minisymposium on "Data Science with Tools from Applied Geometry and Algebra," Portland, OR, July 2018 (with Prof. Ke Ye)

- The 42nd SIAM Southeastern Atlantic Section Conference (SIAM-SEAS 2018) - Minisymposium on "Manifold Learning in Modern Signal Processing," Chapel Hill, NC, March 2018

- SIAM Annual Meeting 2017 (SIAM AN17) - Minisymposium I & II on "Geometry and Computational Challenges in Data Science," Pittsburgh, PA, July 2017 (with Prof. Haizhao Yang)

Journal Referee
- Annals of Statistics

- Communications in Mathematical Sciences
- Constructive Approximation
- Electronic Journal of Statistics
- Frontiers in Applied Mathematics and Statistics
- IEEE Transactions on Image Processing
- IEEE Signal Processing Letters
- Journal of Machine Learning Research (JMLR)
- Journal of the American Mathematical Society (JAMS)
- Journal of the Royal Society Interface
- SIAM Journal on Applied Algebra and Geometry
- SIAM Journal on Mathematics of Data Science
- SIAM Journal on Imaging Sciences
- SIAM Journal on Matrix Analysis and Applications
- SIAM Journal on Scientific Computing

Seminar Moderator
- Applied Mathematics & Analysis Seminar, 2016-2017 (Duke University)