Tingran Gao

Department of Statistics
The University of Chicago
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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 Initiative), The University of Chicago September 2017 – present
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

Internship

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

• Prototyped in Python a high-accuracy real-time machine learning system for malicious URL detection based on Random Forest. Implementation involved extensive programming with Spark Streaming and MLlib; final product deployed to Amazon EC2.

• Built a Titan graph database from real web crawler data, and created a Python demo for infringement prediction based on graph inference algorithm Loopy Belief Propagation. The database is highly available through Rexster Graph Server, backed by Cassandra and ElasticSearch.

Awards

• 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)

Publications and Preprints

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

[2] **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.* DOI:`10.1002/ar.23700` (2017)

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

[4] 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)

[5] 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)

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

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

[8] 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)

Recent and Upcoming Invited Presentations

- *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, Janunary 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

- *2017 SIAM Conference on Applied Algebraic Geometry*, Georgia Institute of Technology, Atlanta GA, July 31 – August 4, 2017
- *2017 Joint Statistical Meetings*, 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
- 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*, IMA, 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 2017 - Minisymposium on "Geometry and Computational Challenges in Data Science," Pittsburgh, PA, July 2017
- 42nd SIAM Southeastern Atlantic Section Conference (SIAM-SEAS 2018) - Minisymposium on "Manifold Learning in Modern Signal Processing," Chapel Hill, NC, March 2017

Journal Referee

- Constructive Approximation
- SIAM Journal on Imaging Sciences
- SIAM Journal on Applied Algebra and Geometry
- Electronic Journal of Statistics
- Communications in Mathematical Sciences
- Frontiers in Applied Mathematics and Statistics
- Annals of Statistics
- IEEE Transactions on Image Processing
- Journal of the American Mathematical Society (JAMS)
- IEEE Signal Processing Letters

Seminar Organizer

- Applied Mathematics & Analysis Seminar (Duke University)