

Wuchen Li

Department of Mathematics
University of South Carolina
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Current Positions

Assistant Professor, University of South Carolina Aug, 2020 to now

Academic experience

CAM Assistant Adjunct Professor, UCLA July, 2016 to Aug, 2020
Ph.D in mathematics, Georgia Institute of Technology Aug, 2011 to May, 2016
Bachelor in mathematics, Shandong University Sep, 2005 to Jun, 2009

Research interest

Applied mathematics; Optimal transport; Mean field games; Information geometry; Machine learning.

Teaching experience

- Math 241 Vector Calculus (Fall 2023*2, Spring 2024)
- Math 709 Foundations of Computational Mathematics II (Spring 2023, Fall 2024)
- Math 528 Mathematical Foundation of Data Science and Machine Learning (Fall 2022)
- Math 524 Optimization (Fall 2021)
- Math 520 Differential equations (Spring 2021, Spring 2022)
- Math 141 Calculus I (Fall 2020*2, Fall 2021, Fall 2022)
- Math 164 Optimization (Fall 2019, Winter 2020, Summer 2020)
- Math 151B Applied numerical method (Spring 2017, Winter 2017, Spring 2018)
- Math 151A Applied numerical method (Winter 2018)
- Math 2605 Calculus 3 for Computer Science (Spring 2015)
- Math 3215 Probability (Summer 2015)

Grants

1. NSF, FRG: Collaborative Research: Variationally Stable Neural Networks for Simulation, Learning, and Experimental Design of Complex Physical Systems, Co-PI, 09/01/2023 - 08/31/2026, \$599,999.
2. AFOSR YIP Award, Transport Information Geometric Computations, PI, 05/01/2023 - 05/01/2026, \$450k.
3. NSF, RTG: Mathematical Foundation of Data Science at University of South Carolina. Co-PI, 08/01/2021 - 07/31/2026, \$1,996,609;
4. Start up funding, U of SC, 2020.

Journal publications: *: corresponding author; ◊: project mentor.

1. Shu Liu, Siting Liu, Stanley Osher, Wuchen Li*. *A first-order computational algorithm for Reaction-Diffusion type equations via Primal-Dual Hybrid Gradient method*, accepted in Journal of Computational Physics, 2024.
2. Yuan Gao, Wuchen Li◊, Jian-Guo Liu. *Master equations for finite state mean field games with nonlinear activations*, accepted in Discrete and Continuous Dynamical Systems Series B, 2023.
3. Erhan Bayraktar, Qi Feng, Wuchen Li◊. *Exponential Entropy dissipation for weakly self-consistent Vlasov-Fokker-Planck equations*, accepted in Journal of Nonlinear science, 2023.
4. Wuchen Li*. *Diffusion hypercontractivity via generalized density manifold*, accepted in Information Geometry, 2023.
5. Wuchen Li*, Siting Liu, Stanley Osher. *A kernel formula for regularized Wasserstein proximal operators*, accepted in Research in the Mathematical Sciences, 2023.
6. Xiangcheng Zheng, Zhiwei Yang, Wuchen Li◊, Hong Wang. *A time-fractional mean field game modeling subdiffusive advective transport*, accepted in SIAM Journal on Scientific Computing, 2023.
7. Karthik Elamvazhuthi, Siting Liu, Wuchen Li◊, Stanley Osher. *Optimal Transport of Nonlinear Control-Affine Systems*, accepted in Journal of Computational Dynamics, 2023.
8. Guosheng Fu, Stanley Osher, Wuchen Li*. *High order spatial discretization for variational time implicit schemes: Wasserstein gradient flows and reaction-diffusion systems*, accepted in Journal of Computational Physics, 2023.
9. Guosheng Fu, Siting Liu, Stanley Osher, Wuchen Li*. *High order computation of optimal transport, mean-field planning, and mean field games*, accepted in Journal of Computational Physics, 2023.
10. Jiajia Yu, Rongjie Lai, Wuchen Li◊, Stanley Osher. *A Fast Proximal Gradient Method and Convergence Analysis For Dynamic Mean Field Planning*, accepted in Mathematics of Computation, 2023.
11. Xinzhe Zuo, Stanley Osher, Wuchen Li*. *Primal-dual damping algorithms for optimization*, accepted in Annals of Mathematical Sciences and Applications, 2023.
12. Qi Feng, Wuchen Li◊. *Entropy dissipation for degenerate stochastic differential equations via sub-Riemannian density manifold*, accepted in Entropy, 2023.
13. Jiajia Yu, Rongjie Lai, Wuchen Li◊, Stanley Osher. *Computational Mean-field Games on Manifolds*, accepted in Journal of Computational Physics, 2023.
14. Wuchen Li*, Siting Liu, Stanley Osher. *Controlling conservation laws I: entropy-entropy flux*, accepted in Journal of Computational Physics, 2023.
15. Wuchen Li*, Jiaxi Zhao. *Wasserstein information matrix*, accepted in Information Geometry, 2023.
16. Siting Liu, Stanley Osher, Wuchen Li*, Chi-Wang Shu. *A Primal-Dual approach for solving Conservation Laws with Implicit in Time Approximations*, accepted in Journal of Computational Physics, 2022.
17. Wuchen Li, Javier Rubio Alvarez. *On a prior based on the Wasserstein information matrix*, accepted in Statistics and Probability Letters, 2022.
18. Wonjun Lee, Siting Liu, Wuchen Li*, Stanley Osher. *Mean field control problems for Vaccine distribution*, accepted in Research in the Mathematical Sciences, 2022.
19. Wuchen Li*, Wonjun Lee, Stanley Osher. *Computational Mean-field information dynamics associated with Reaction-diffusion equations*, accepted in Journal of Computational Physics, 2022.
20. Yifei Wang, Peng Chen, Wuchen Li◊. *Projected Wasserstein gradient descent for high-dimensional Bayesian inference*, accepted in SIAM/ASA Journal on Uncertainty Quantification, 2022.

21. Wuchen Li*, Siting Liu, Stanley Osher. *Controlling conservation laws II: compressible Navier-Stokes equations*, accepted in Journal of Computational Physics, 2022.
22. Lisang Ding, Wuchen Li*, Stanley Osher, Wotao Yin. *A Mean-Field Game Inverse Problem*, accepted in Journal of Scientific Computing, 2022.
23. Shu Liu, Wuchen Li*, Hongyuan Zha, Haomin Zhou. *Neural Parametric Fokker-Planck equations*, accepted in SIAM Journal on Numerical Analysis, 2022.
24. Yifei Wang, Wuchen Li*. *Accelerated information gradient flow*, accepted in Journal of Scientific Computing, 2021.
25. Wuchen Li*. *Transport information Bregman divergences*, accepted in Information Geometry, 2021.
26. David Jekel, Wuchen Li \diamond , and Dimitri Shlyakhtenko. *Tracial smooth functions of non-commuting variables and the free Wasserstein manifold*, accepted in Dissertationes Mathematicae, 2021.
27. Wuchen Li*. *Transport information geometry: Riemannian calculus on probability simplex*, accepted in Information Geometry, 2021.
28. Hao Gao, Wuchen Li \diamond , Miao Pan, Han Zhu, Vincent Poor. *Modeling COVID-19 with Mean Field Evolutionary Dynamics: Social Distancing and Seasonality*, accepted in Journal of Communications and Networks, 2021.
29. Siting Liu, Matt Jacobs, Wuchen Li \diamond , Levon Nurbekyan, Stanley Osher. *Computational methods for nonlocal mean field games with applications*, accepted in SIAM journal on Numerical Analysis, 2021.
30. Alex Tong Lin, Samy Wu Fung, Wuchen Li \diamond , Levon Nurbekyan, Stanley Osher. *ApacNet: An Alternating Population-Agent Control Neural Network for High-Dimensional Stochastic Mean Field Games*, accepted in Proceedings of the National Academy of Sciences of the United States of America (PNAS), 2021.
31. Wonjun Lee, Wuchen Li \diamond , Bo Lin, and Anthea Monod. *Tropical optimal transport and Wasserstein distance in Phylogenetic Tree Space*, accepted in Information Geometry, 2021.
32. Wuchen Li*. *Hessian metric via transport information geometry*, accepted in Journal of Mathematical Physics, 2021.
33. Yuhan Kang, Siting Liu, Hongliang Li, Wuchen Li \diamond , Han Zhu, Stanley Osher, Vincent Poor. *Joint Sensing Task Assignment and Collision-Free Trajectory Optimization for Mobile Vehicle Networks using Mean-Field Games*, accepted in IEEE Internet of Things Journal, 2020.
34. Wonjun Lee, Siting Liu, Hamidou Tembine, Wuchen Li*, Stanley Osher. *Controlling Propagation of epidemics via mean-field control*, accepted in SIAM Journal on Applied Mathematics, 2020.
35. Wonjun Lee, Rongjie Lai, Wuchen Li*, Stanley Osher. *Generalized unnormalized optimal transport and its fast algorithm*, accepted in Journal of Computational Physics, 2020.
36. Simon Becker, Wuchen Li \diamond , *Quantum statistical learning via Quantum Wasserstein natural gradient*, accepted in Journal of Statistical Physics, 2020.
37. Shui-Nee Chow, Wuchen Li*, Chenchen Mou, Haomin Zhou. *Dynamical Schrödinger bridge problems on graphs*, Journal of Dynamics and Differential Equations, 2020.
38. Flavien Leger, Wuchen Li \diamond . *Hopf-Cole transform via generalized Schrödinger bridge problem*, Journal of Differential Equations, 2020.
39. Jialin Liu, Wotao Yin, Wuchen Li*, Yat Tin Chow. *Multilevel Optimal Transport: a Fast Approximation of Wasserstein-1 distances*, SIAM Journal on Scientific Computing, 2020.
40. Hao Gao, Wuchen Li \diamond , Reginald A. Banez, Han Zhu, Vincent Poor, Mean Field Evolutionary Dynamics in Dense-user Multi-access Edge Computing Systems, IEEE Transactions on Wireless Communications, 2020.
41. Yifan Chen, Wuchen Li \diamond , *Optimal transport natural gradient for statistical manifolds with continuous sample space*, Information Geometry, 2020.

42. Wuchen Li, Jiangfeng Lu, Li Wang. *Fisher information regularization schemes for Wasserstein gradient flows*, Journal of Computational Physics, 2020.
43. Lars Ruthotto, Stanley Osher, Wuchen Li, Levon Nurbekyan, Samy Wu Fung. *A Machine Learning Framework for Solving High-Dimensional Mean Field Game and Mean Field Control Problems*, Proceedings of the National Academy of Sciences of the United States of America (PNAS), 2020.
44. Wuchen Li*, Guido Montufar. *Ricci curvature for parametric statistics via optimal transport*, Information Geometry, 2020.
45. Wuchen Li*, Lexing Ying. *Hessian transport gradient flows*, Research in the Mathematical Sciences, 2019.
46. Alfredo Garbuno-Inigo, Franca Hoffmann, Wuchen Li, Andrew M Stuart. *Interacting Langevin Diffusions: Gradient Structure And Ensemble Kalman sampler*, SIAM Journal on Applied Dynamical Systems, 2019.
47. Shui-Nee Chow, Wuchen Li*, Jun Lu, Haomin Zhou. *Equilibrium selection via Optimal transport*, SIAM Journal on Applied Mathematics, 2019.
48. Wilfrid Gangbo, Wuchen Li*, Stanley Osher, Michael Puthawala. *Unnormalized optimal transport*, Journal of Computational Physics, 2019.
49. Shui-Nee Chow, Wuchen Li*, Haomin Zhou. *Wasserstein Hamiltonian flows*, Journal of Differential Equations, 2019.
50. Yat-Tin Chow, Wuchen Li^o, Wotao Yin, Stanley Osher. *Algorithm for Hamilton-Jacobi equations in density space via a generalized Hopf formula*, Journal of Scientific Computing, 2019.
51. Matt Jacobs, Flavien Leger, Wuchen Li, Stanley Osher. *Solving Large-Scale Optimization Problems with a Convergence Rate Independent of Grid Size*, SIAM journal on Numerical Analysis, 2019.
52. Shui-Nee Chow, Wuchen Li*, Haomin Zhou. *A discrete Schrödinger equation via optimal transport on graphs*, Journal of Functional Analysis, 2019.
53. Yupeng Li, Wuchen Li*, Guo Cao. *Image Segmentation via L1 Monge-Kantorovich Problem*, Inverse problem and Imaging, 2019.
54. Wuchen Li*, Guido Montufar. *Natural gradient via optimal transport*, Information Geometry, 2018.
55. Shui-Nee Chow, Wuchen Li*, Jun Lu, Haomin Zhou. *Population games and Discrete optimal transport*, Journal of Nonlinear Science, 2018.
56. Wilfrid Gangbo, Wuchen Li, Chenchen Mou. *Geodesic of minimal length in the set of probability measures on graphs*, ESAIM: Control, Optimisation and Calculus of Variations (ESAIM: COCV), 2018.
57. Ernest Ryu, Yongxin Chen, Wuchen Li, Stanley Osher. *Vector and Matrix Optimal Mass Transport: Theory, Algorithm, and Applications*, SIAM Journal on Scientific Computing, 2018.
58. Shui-Nee Chow, Wuchen Li*, Haomin Zhou. *Entropy dissipation on finite graphs*, Discrete and Continuous Dynamical Systems-Series A, 2018.
59. Shui-Nee Chow, Luca Dieci, Wuchen Li*, Haomin Zhou. *Entropy dissipation semi-discretization schemes for Fokker-Planck equations*, Journal of Dynamics and Differential Equations, 2018.
60. Ernest Ryu, Wuchen Li*, Penghang Yin, Stanley Osher. *Unbalanced and Partial L1 Monge-Kantorovich Problem: A Scalable Parallel First-Order Method*, Journal of Scientific Computing, 2017.
61. Wuchen Li*, Penghang Yin, Stanley Osher. *Computation of optimal transport distance with Fisher information regularization*, Journal of Scientific Computing, 2017.
62. Wuchen Li*, Ernest Ryu, Stanley Osher, Wotao Yin, Wilfrid Gangbo. *A parallel method for Earth Mover's distance*, Journal of Scientific Computing, 2017.

63. Wuchen Li*, Shui-Nee Chow, Magnus Egerstedt, Jun Lu, Haomin Zhou. *Method of evolving junctions: A new approach for the optimal path-planning in a dynamic environment*, The International Journal of Robotics Research, 2017.
64. Shui-Nee Chow, Wuchen Li*, Jun Lu, Haomin Zhou. *Method of evolving junctions: A new approach to optimal control with constraints*, Automatica, 2017.
65. Shui-Nee Chow, Wuchen Li*, Haomin Zhou. *A Newton-like algorithm for the shortest path based on the method of evolving junctions*, Communications in mathematical sciences, 2016.
66. Luca Dieci, Wuchen Li*, Haomin Zhou. *A new model for realistic random perturbations of stochastic oscillators*, Journal of Differential equations, 2016.

Conference publications

1. Qi Feng, Wuchen Li*. *Entropy dissipation via information Gamma calculus: Non-reversible stochastic differential equations*, Poster session in Geometric Science of Information (GSI), 2023.
2. Wuchen Li*, *Transport information Hessian distances*, Geometric Science of Information (GSI), 2021.
3. Alex Lin, Wuchen Li*, Stanley Osher, Guido Montufar. *Wasserstein proximal of GANs*, Geometric Science of Information (GSI), 2021.
4. Hao Gao, Alex Lin, Reginald A. Banez, Wuchen Li[◇], Zhu Han, Stanley Osher, and H. Vincent Poor. *Opinion Evolution in Social Networks: Connecting Mean Field Games to Generative Adversarial Nets*, IEEE 2021, IEEE International Conference on Communications (ICC): SAC Social Networking Track.
5. Hao Gao, Wuchen Li[◇], Miao Pan, Zhu Han, Vincent Poor. *Analyzing Social Distancing and Seasonality of COVID-19 with Mean Field Evolutionary Dynamics*, IEEE Globecom 2020, December 7 - 11.
6. Yuhan Kang, Siting Liu, Wonjun Lee, Hongliang Zhang, Wuchen Li[◇], and Zhu Han. *Joint Task Assignment and Trajectory Optimization for a Mobile Robot Swarm by Mean-Field Game*, IEEE Globecom 2020, December 7 - 11.
7. Hao Gao, Wonjun Lee, Wuchen Li[◇], Zhu Han, Stanley Osher, and H. Vincent Poor. *Energy-efficient Velocity Control for Massive Rotary-Wing UAVs: A Mean Field Game Approach*, IEEE Globecom 2020, December 7 - 11. Journal in IEEE Transactions on Vehicular Technology, 2022.
8. Michael Arbel, Arthur Gretton, Wuchen Li[◇], Guido Montufar. *Kernelized Wasserstein Natural Gradient*, International Conference on Learning Representations (ICLR), Oral, 2020.
9. Alex Lin, Yonatan Dukler, Wuchen Li[◇], Guido Montufar. *Wasserstein Diffusion Tikhonov Regularization*, OTML Workshop NeurIPS, 2019.
10. Hao Gao, Wuchen Li[◇], Reginald A. Banez, Zhu Han, and H. Vincent Poor. *Mean Field Evolutionary Dynamics in Ultra Dense Mobile Edge Computing Systems*, IEEE Global Communications Conference, Puako, HI, December 2019.
11. Flavien Leger, Wuchen Li. *Hopf-Cole transformation and Schrödinger problems*, Geometric Science of Information (GSI), 2019.
12. Wuchen Li[◇], Shu Liu, Hongyuan Zha, Haomin Zhou. *Parametric Fokker-Planck equation*, Geometric Science of Information (GSI), 2019.
13. Wuchen Li[◇], Alex Lin, Guido Montufar. *Affine natural proximal learning*, Geometric Science of Information (GSI), 2019.
14. Yonatan Dukler, Wuchen Li[◇], Alex Lin, Guido Montufar. *Wasserstein of Wasserstein Loss function for learning generative models*, International Conference on Machine Learning (ICML), Long beach, 2019.

Preprint

1. Yifei Wang, Wuchen Li[◊]. *Information Newton's flow: second-order optimization method in probability space.*
2. Qi Feng, Wuchen Li[◊]. *Hypoelliptic entropy dissipation for stochastic differential equations (II).*
3. Yifei Wang, Peng Chen, Mert Pilanci, Wuchen Li[◊]. *Optimal Neural Network Approximations of Wasserstein Gradient Direction via Convex Optimization.*
4. Wuchen Li[◊], Hansol Park. *Mean field Kuramoto models on graphs.*
5. Wuchen Li^{*}, Linyuan Lu. *Mean field information Hessian matrices on graphs.*
6. Wuchen Li^{*}, Linyuan Lu. *Optimal Ricci curvature Markov chain Monte Carlo methods on finite states.*
7. Guosheng Fu, Stanley Osher, Will Pazner, Wuchen Li^{*}. *Generalized optimal transport and mean field control problems for reaction-diffusion systems with high-order finite element computation.*
8. Wuchen Li^{*}, Tryphon Georgiou. *Minimal Wasserstein Surfaces.*
9. Wuchen Li^{*}. *Langevin dynamics for the probability of Markov jumping processes.*
10. Hong Ye Tan, Stanley Osher, Wuchen Li^{*}. *Noise-Free Sampling Algorithms via Regularized Wasserstein Proximals.*
11. Yiqun Li, Hong Wang, Wuchen Li^{*}. *A time-fractional optimal transport and mean-field planning: Formulation and algorithm.*
12. Wuchen Li[◊], Jiayi Zhao. *Scaling Limits of the Wasserstein information matrix on Gaussian Mixture Models.*
13. Tingwei Meng, Wenbo Hao, Siting Liu, Stanley Osher, Wuchen Li^{*}. *Primal-dual hybrid gradient algorithms for computing time-implicit Hamilton-Jacobi equations.*
14. Wonjun Lee, Li Wang, Wuchen Li[◊]. *Deep JKO: time-implicit particle methods for general nonlinear gradient flows.*
15. Mo Zhou, Stanley Osher, Wuchen Li^{*}. *A deep learning algorithm for computing mean field control problems via Forward-backward score dynamics.*
16. Fuqun Han, Stanley Osher, Wuchen Li^{*}. *Tensor train based sampling algorithms for approximating regularized Wasserstein proximal operators.*
17. Shu Liu, Xinzhe Zuo, Stanley Osher, Wuchen Li^{*}. *Numerical analysis of a first-order computational algorithm for reaction-diffusion equations via the primal-dual hybrid gradient method.*
18. Qi Feng, Xinzhe Zuo, Wuchen Li[◊]. *Fisher information dissipation for time inhomogeneous stochastic differential equations.*
19. Benjamin Zhang, Siting Liu, Wuchen Li, M. Katsoulakis, Stanley Osher. *Wasserstein proximal operators describe score-based generative models and resolve memorization.*
20. Guosheng Fu, Hangjie Ji, Will Pazner, Wuchen Li^{*}. *Mean field control of droplet dynamics with high order finite element computations.*

Upcoming presentations

- Invited talk, "Information Gamma calculus: Convexity analysis for stochastic differential equations", Caltech, May 13-17, 2024.
- Invited talk, "Mean-Field Games for Scalable Computation and Diverse Applications", Financial/Actuarial Mathematics seminar, University of Michigan, Ann Arbor, April 2-4, 2024.
- Invited talk, "Information Gamma calculus: Convexity analysis for stochastic differential equations", Mathematical Advances in Scientific Machine Learning, AMS Spring 2024 Southeastern Sectional Meeting. Florida State University, March 23-24, 2024.

- Invited talk, “Information Gamma calculus: Convexity analysis for stochastic differential equations”, Optimal transport - machine learning/optimization - dynamical systems”, Berlin, Germany, March 11th - 15th, 2024.

Presentations

1. Invited talk, *Calculus of score functions dedicated to Prof. Shui-Nee Chow*, Workshop on Recent Topics in Dynamical Systems, Memorial in Honor of Professor Shui-Nee Chow, Georgia Institute of Technology, Atlanta, GA, Feb 17- Feb 18, 2024.
2. Organization lectures, *Transport Information Geometry with Computations*, Variational and Information Flows in Machine Learning and Optimal Transport, Oberwolfach seminar, Germany, Nov 19-Nov 25, 2023.
3. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, Applied and Computational Math Seminar, UC Irvine, Nov 6, 2023.
4. Invited talk, *Transport Information Geometric Computations*, SIAM+ Applied Numerical Math Seminar, University of Florida, Gainesville, Oct 27, 2023.
5. Invited talk, *Information Gamma calculus: Convexity analysis for stochastic differential equations*, SIAM-NNP, NJ, October 20-22, 2023.
6. Organization lectures, *Transport Information Geometric Sampling in Inverse problems*, SQuaRE, AIMS, Caltech, LA, Oct 9-Oct 13, 2023.
7. Invited talk, *Information Gamma calculus: Convexity analysis for stochastic differential equations*, Data Science Seminar series, School of Mathematics, University of Minnesota, Sep 25-26, 2023.
8. Invited talk, *Information Gamma calculus: Convexity analysis for stochastic differential equations*, Machine learning seminar, Department of Mathematics and Statistics, University of Massachusetts Amherst, Sep 14-15, 2023.
9. Invited talks, *Transport Information Geometric Computations*, AFOSR review meeting, Aug 7-Aug 11, VA, 2023.
10. Invited talk, *Information Gamma calculus: Convexity analysis for stochastic differential equations*, Applied and Computational Differential Geometry and Geometric PDEs, BIRS, Canada, July 31, 2023.
11. Invited talk, *Controlling regularized conservation laws via entropy-entropy flux pairs*, Special Session: Scientific machine learning for dynamics related inverse problems, June 3, Wilmington, North Carolina, 2023.
12. Organization lectures, *Transport Information Geometric Computations: Optimal Ricci curvature Markov chain Monte Carlo on finite states*, Ricci Curvatures of Graphs and Applications to Data Science, AMS Mathematics Research Communities, Beaver Hollow Conference Center, Java Center, New York, May 29-May 30, 2023.
13. Invited talk, *Controlling conservation laws via entropy-entropy flux pairs*, “Optimal Transport in Data Science”, ICERM, Brown university, May 8-May 12, 2023.
14. Organization talk, *Optimal Ricci curvature Markov chain Monte Carlo on finite states*, RTG seminar, U of SC, March 3, 2023.
15. Invited talk, *Controlling conservation laws via entropy-entropy flux pairs*, CAM seminar, Iowa state university, Feb 27, 2023.
16. Invited talk, *Transport Optimization Methods for Bayesian sampling problems*, Mathematical Sciences Colloquium, Rensselaer Polytechnic Institute, Troy, New York, Jan 19, 2023.
17. Invited talk, *Controlling conservation laws via entropy-entropy flux pairs*, Hamilton-Jacobi PDEs Reunion Conference (HJRC2), Lake Arrowhead, LA, Dec 11 to Dec 16, 2022.
18. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, CNA seminar, Carnegie Mellon University, Pittsburgh, Oct 27 to Oct 28, 2022.

19. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, Analysis seminar, Clemson University, Clemson, SC, Oct 21, 2022.
20. Organization talk, *Information Gamma calculus for sampling problems*, “Transport information geometric sampling in inverse problems”, SQuaRE, AIM, San Jose, Oct 10 to Oct 14, 2022.
21. Invited talk, *Transport optimization methods in Bayesian sampling problems*, Exploiting low-dimensional structure in PDE-constrained Bayesian inverse problems, SIAM MDS, San Diego, CA, Sep 30, 2022.
22. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, Applied math seminar, The George Washington University, Sep 30, 2022.
23. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, Numerical analysis seminar, North Carolina State University, Sep 27, 2022.
24. Plenary talk, *Transport information Bregman divergences*, “Information Geometry in Data Science”, Hamburg University of Technology, Germany, Sep 21, 2022.
25. Invited talk, *Controlling conservation laws via entropy-entropy flux pairs*, Applied math seminar, University of Notre Dame, Sep 15, 2022.
26. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, Applied math seminar, Duke University, Durham, NC, Sep 6, 2022.
27. Organization talk. *Computational Mean-field information dynamics associated with Reaction-diffusion equations*. “MURI mean field game review conferences”, DC, Aug 1-2, 2022.
28. Invited talk, *Controlling conservation laws via entropy-entropy flux pairs*, “International Conference on New Trends in Scientific Computing”, IPAM, UCLA, LA, April 20-22, 2022.
29. Invited talk, *Transport information Newton’s flows*, “Sampling via Variational Methods”, SIAM Conference on Uncertainty Quantification, Atlanta, Georgia, April 12-14, 2022.
30. Invited participates, “Socio-Math Workshop”, Basic Research Innovation Collaboration Center (BRICC), Arlington, VA, April 11-12, 2022.
31. Organization talk, *Transport information flows for Bayesian sampling problems*, U of SC RTG seminar, March 4, 2022.
32. Invited talk, *Wasserstein information matrix and its estimation properties*, Statistics Seminar, Imperial College, March 4, 2022.
33. Invited talk, *Computational Mean-field information dynamics associated with Reaction-diffusion equations*, High Dimensional Hamilton-Jacobi PDEs Reunion, IPAM, UCLA, LA, Jan 13, 2022.
34. Invited talk, *Transport information flows for Bayesian sampling problems*, Applied math seminar, Illinois institute of Technology, Dec 17, 2021.
35. Organization talk, *Controlling conservation laws via entropy–entropy flux pairs*, Optimal transport and Mean field game seminar, U of SC/UCLA, Dec 15, 2021.
36. Invited talk, *Controlling propagation of pandemics via mean-field games*, Applications of Mean Field Games: from Models to Practice, IMSI, University of Chicago, Nov 19, 2021.
37. Invited talk, *Neural computational mean field games*, Mathematical finance seminar, UC Berkeley, Nov 5, 2021.
38. Invited talk, *Transport information dynamics for sampling problems*, Mathematical data science seminar, Purdue University, Nov 1, 2021.
39. Invited talk, *Computational mean field games, Accelerated Information flows, Transport information Newton’s flows*, 2021 SIAM Southeastern Atlantic Section Conference, Auburn University, Sep 18-19, 2021.
40. Invited talk, *Entropy dissipation via information Gamma calculus*, Wasserstein gradient flows and their applications, the 13th International Conference on Monte Carlo Methods and Applications, University of Mannheim, Aug 18, 2021.
41. Organization talk, *Transport information Hessian distances*, Transport information geometry/Divergence statistics, Geometric Science of Information, July 21 to July 23, 2021.

42. Invited talk, *Transport information Bregman divergences*, Analysis of nonlinear wave models, SIAM Conference on Applications of Dynamical Systems (DS21), May 23 to 27, 2021.
43. Invited talk, *Transport information Bregman divergences*, One World Seminar Series on the Mathematics of Machine Learning, May 12, 2021.
44. Invited talk, *Entropy dissipation via Information Gamma calculus*, Analysis Seminar at the Center of Mathematics, University of Coimbra, Portugal, April 9, 2021.
45. Invited talk, *Free Wasserstein manifold*, Probabilistic operator algebra seminar, UC Berkeley, Feb 22, 2021.
46. Invited talk, *Learning via transport information geometry*, Applied math seminar, Auburn university, Feb 19, 2021.
47. Home talk, *Transport information dynamics with applications*, Applied math seminar, University of South Carolina, Jan 22, 2021.
48. Invited talk, *Mean field games with applications*, Gatsby Seminar, University College London, Jan 13, 2021.
49. Invited talk, *High order MCMC methods via transport information geometry*, “New Frontiers in Computational Mathematics” in the Joint Mathematics Meeting (JMM), Washington DC, Jan 8, 2021.
50. Invited talk, *Transport information flows for Bayesian sampling problems*, “Mathematics in Imaging, Data and Optimization”, Rensselaer Polytechnic Institute, Dec 9, 2020.
51. Invited talk, *Transport information flows for Bayesian sampling problems*, Applied Math/PDE seminar, UC Santa Barbara, Nov 13, 2020.
52. Invited talk, *Mean field games with applications*, UC SOUTHERN HUB: Frontiers in Machine Learning for the Physical Sciences, UC Irvine, Oct 26, 2020.
53. Invited talk, *Controlling Propagation of epidemics via mean-field games*, Math and deep learning collective, Iowa State University, Sep 11, 2020.
54. Invited talk, *Transport information geometric learning*, workshop on computation and applications of PDEs based on machine learning, July 14, 2020.
55. Invited talk, *Wasserstein information matrix*, Optimal Transport: Regularization and Applications, July 7-8, 2020, Columbia university.
56. Organization talk, *Controlling propagation of pandemics via mean-field games*, Optimal control in data space minisymposium, SIAM Conference on Mathematics of Data Science, June 17, 2020.
57. Invited talk, *Transport information Newton’s flow*, Optimal Transport minisymposium, SIAM Conference on Mathematics of Data Science, May 29, 2020.
58. Invited talk, *Transport information geometric computation: Mean field games*, Math and deep learning (MDL) collective, Iowa State University, May 8, 2020.
59. Invited talk, *Transport information geometric computation: Neural Fokker-Planck equations*, Data science seminar, Shanghai Jiao Tong university, May 4, 2020.
60. Invited talk, *Accelerated information gradient flow*, Workshop II: PDE and Inverse Problem Methods in Machine Learning, IPAM, LA, April 23, 2020.
61. Invited talk, *Transport information Newton’s flow*, Computational and Applied Mathematics Seminar, Carnegie Mellon University, Pittsburgh, April 14, 2020.
62. Invited talk, *Transport information Newton’s flow*, probability and statistics seminar, University of Southern California, LA, April 10, 2020.
63. Invited talk, *Transport information geometry: current and future*, IPAM, UCLA, March 26 and April 6, 2020.
64. Joint Stochastic and Applied Math Seminar talk: *Accelerated information gradient flow*, The University of Utah, Salt Lake City, Jan 22, 2020.

65. Colloquia talk: *Transport information geometric learning*, The University of Utah, Salt Lake City, Jan 21, 2020.
66. Invited talk: *Accelerated information gradient flow*, Applied Math Youth Forum, Peking university, Dec 22, 2019.
67. Lecture series: *Transport information geometry with applications in data science, statistics and data-driven scientific computing*, Tsinghua university, Dec 19–23, 2019.
68. Invited talk: *Wasserstein information matrix*, SIAM Conference on Analysis of Partial Differential Equations, session: PDEs in machine learning, La Quinta, Dec 14, 2019.
69. Invited talk: *Accelerated information gradient flow*, SIAM Conference on Analysis of Partial Differential Equations, session: Gradient Flows and Beyond: New Directions in Geometric Flows and Partial Differential Equations, La Quinta, Dec 11, 2019.
70. Colloquia talk: *Transport information geometric learning*, University of South Carolina, Columbia, Dec 6, 2019.
71. Invited talk: *Transport information geometric learning*, Applied and Computational Mathematics, UCI, Irvine, Nov 4, 2019.
72. Invited talk: *Accelerated Information Gradient flow*, Applied Math seminar, Stanford university, San Jose, Oct 23, 2019.
73. Invited talk: *Wasserstein information geometric learning*, CAM seminar, Iowa state university, Iowa, Ames, Sep 16, 2019.
74. Plenary talk: *Learning via Wasserstein information geometry*, Peter G. Hall Conference: Statistics and Machine Learning, UC Davis, May 10, 2019.
75. Invited talk: *Wasserstein information geometric learning*, SOCAMS, Caltech, Pasadena, April 27, 2019.
76. Invited talk: *Wasserstein information geometric learning*, Applied Math seminar, Stanford University, San Jose, April 17, 2019.
77. Invited talk: *Wasserstein information geometric learning*, Special seminar on optimal transport and information geometry, UCLA, April 10, 2019.
78. Invited talk: *Wasserstein information geometric learning*, Deep learning kickoff conference, Max-Planck institute, Leipzig, Germany, March 29, 2019.
79. Invited talk: *Wasserstein information geometric learning*, Applied Math seminar, University of California, Santa Cruz, March 4, 2019.
80. Invited talk: *Wasserstein information geometric learning*, Special seminar, Courant Institute of Mathematical Sciences, New York, Feb 21, 2019.
81. Invited talk: *Wasserstein information geometric learning*, Special seminar, New Jersey Institute of Technology, New Jersey, Feb 20, 2019.
82. Invited talk: *Wasserstein information geometric learning*, Optimal transport seminar, Caltech, Pasadena, Jan 2019.
83. Invited talk: *Learning via Wasserstein information geometry*, Applied mathematics and Statistics Youth Forum, Peking university, Dec 2018.
84. Organization talk: *Mean field games and Optimal transport*, Mean field games kickoff conference, UCLA, Dec 2018.
85. Invited talk: *Optimal transport on graph with applications*, Special event, University of Minnesota, Nov 2018.
86. Invited talk: *Wasserstein statistical manifold*, AIM conference on Restricted Boltzmann machine, San Jose, Sep 2018.
87. Plenary talk: *Machine learning via Wasserstein statistical manifold*, A first conference in Machine learning and optimal control, Shenzhen, July 2018.
88. Plenary talk: *Dynamics in Wasserstein statistical manifold*, International conference on infinite dimensional dynamical systems, Sichuan University, Chengdu, July 2018.

89. Lecture series: *Mean field games via probability manifold I, II*, IPAM lectures, UCLA, Los Angeles, June 2018.
90. Invited talk: *Wasserstein Natural gradient*, Level set seminar, UCLA, Los Angeles, June 2018.
91. Invited talk: *Wasserstein statistical manifold*, Level set seminar, UCLA, Los Angeles, April 2018.
92. Invited talk: *Optimal transport on graphs with applications*, Applied Math/PDE seminar, UCSB, Santa Barbara, Feb 2018.
93. *Optimal transport on graphs with applications*, Level set seminar, UCLA, Los Angeles, Feb 2018.
94. Plenary talk: *Schrödinger equation on graphs via optimal transport*, ICMC Differential equations, USP, Sao Carlos, Brazil, Feb 2018.
95. Invited talk: *Entropy dissipation on finite graphs*, 10 to 60 conference, Georgia Tech, Atlanta, Dec 2017.
96. Invited talk: *Discrete Schrödinger equation via optimal transport*, AIMS, UC riverside, Nov 2017.
97. Invited talk: *Fokker-Planck equations on finite graphs*, Probability and Statistics seminar, USC, Sep 1, 2017.
98. Home talk: *Optimal control problems in density space*, Level set seminar, UCLA, Aug 29, 2017.
99. Invited talk: *Dynamical system in density manifold for finite graphs*, Workshop in dynamical system, Georgia Tech, Atlanta, Aug 10, 2017.
100. Invited talk: *Optimal transport with applications*, Topology seminar, Southwest Jiaotong University, Chengdu, June 20, 2017.
101. Invited talk: *Population games via optimal transport*, International Conference on Topological Nonlinear Analysis, Guangzhou, June 15, 2017.
102. Invited talk: *Optimal transport with Fisher information regularization*, SOCAMS, UC Irvine, June 6, 2017.
103. Invited talk: *Discrete Schrödinger equation via optimal transport*, Working Group for Problems in Transport and Related Topics in Graphs, Georgia Tech, Atlanta, May 6, 2017.
104. Home talk: *Optimal transport on finite graphs with applications*, Applied math colloquium, UCLA, March 2017.
105. Invited talk: *Optimal transport on finite graphs with applications*, Applied math seminar, Claremont Colleges, Feb 2017.
106. Home talk: *Fast algorithms for Earth Mover's distance*, Level set seminar, UCLA, Jan 2017.
107. Home talk: *Optimal transport and Entropy dissipation on finite graphs*, Level set seminar, UCLA, Aug 29, 2016.
108. Invited talk: *A new model for realistic random perturbations of stochastic oscillators*, AIMS Orlando conference, Orlando, Florida, July 3, 2016.
109. Invited talk: *A new approach to optimal control with constraints*, AIMS Orlando conference, Orlando, Florida, July 1, 2016.
110. Home talk: *A study of stochastic differential equations and Fokker-Planck equations with applications*, Applied and computational math seminars, Georgia Tech, Atlanta, April 4, 2016.
111. Invited talk: *Method of evolving junctions*, University of Georgia, Athens, Georgia, 2016.
112. Invited talk: *Method of evolving junctions: A new approach to optimal control with constraints*, SIAM student conference, Georgia Tech, Atlanta, April 11, 2015.
113. Poster section: *Newton-like algorithm for the shortest path based on the method of evolving junctions*, Georgia Scientific Computing Symposium, Georgia Tech, Atlanta, Feb 28, 2015.

Reviewers

Funding agencies

- NSF, ARO, AFOSR.

Journals

- Journal of Scientific Computing;
- Journal of Computational Physics;
- Research in the Mathematical Sciences;
- ESAIM: Mathematical Modelling and Numerical Analysis;
- Mathematical Programming;
- Journal of Machine Learning Research;
- Journal of Physics A: Mathematical and Theoretical;
- Journal of Differential Equations;
- Annals of Statistics;
- Algebraic Statistics;
- SIAM Journal on Applied Mathematics;
- SIAM Journal of Scientific Computing;
- SIAM/ASA Journal on Uncertainty Quantification;
- SIAM Journal on Optimization;
- SIAM Journal on Control and Optimization;
- SIAM Journal of Mathematical Analysis;
- SIAM on Numerical Analysis;
- SIAM Journal on Applied Dynamical Systems;
- Studies in applied mathematics;
- Probability and related fields;
- Archive for Rational Mechanics and Analysis;
- Physics D: Nonlinear Phenomena;
- Nonlinearity;
- Information Geometry;
- Differential Geometry and its Applications;
- Inverse problems;
- Entropy;
- Information and Inference: A journal of the IMA;
- Science report;
- Dynamical Games and Applications;
- IEEE Signal Processing Letters;
- Journal of Optimization Theory and Applications;
- Communications on Pure and Applied Analysis;
- Mathematical methods in applied sciences;
- Notices of the AMS;

- La Matematica;
- Symmetry;
- Journal of Applied Mathematics and Computing;
- Qualitative Theory of Dynamical Systems;
- Journal of Finance and Data Science;
- Communications in Mathematical Sciences;
- Taiwanese Journal of Mathematics;
- Communications on Applied Mathematics and Computation;

Conferences

- ICLR (International Conference on Learning Representations) 2019, 2020, 2021, 2022, 2023, 2024;
- NeurIPS (Conference on Neural Information Processing Systems) 2020, 2023;
- ICML (International Conference on Machine Learning) 2021, 2022, 2023, 2024;
- AISTATS (International Conference on Artificial Intelligence and Statistics), 2024;
- GSI (Geometric Science of Information) 2019, 2021;
- Mathematical and Scientific Machine Learning 2021, 2022;
- IEEE Global Communications Conference 2020;
- MTNS (International Symposium on Mathematical Theory of Networks and Systems) 2020;

Seminar

- Co-organizer: NSF RTG seminar, Mathematical foundations of data science and machine learning, fall 2023, spring 2024.
- Organizer: Optimal transport and Mean field games seminar, 2019 summer, 2020 spring, fall, 2021 spring, summer, fall, 2022 spring, summer.
- Organizer: Mathematical aspects of data science and deep learning, 2020 fall, 2021 spring, summer, fall, DASIV center.

Conference

- Organizer: Workshop on Scientific Computing and Large Data, USC, Columbia, Dec 16-Dec 22, 2023.
- Co-organizer: Variational and Information Flows in Machine Learning and Optimal Transport, Oberwolfach seminar, Oberwolfach Germany, Nov 19- Nov 25, 2023.
- Co-organizer: Transport Information Geometric Sampling in Inverse problems, SQuaRE, AIM, Caltech, LA, Oct 9-Oct 13, 2023.
- Co-Chair: Optimal transport and Mean field games with applications in data science and Biology, Tokyo, Japan, ICIAM, Aug 20-25, 2023
- Co-organizer: Optimal transport and Mean field games with applications and computations, AIMS conference at Wilmington, May 31-June 4, 2023.
- Co-organizer: Ricci Curvatures of Graphs and Applications to Data Science, AMS Mathematics Research Communities, Beaver Hollow Conference Center, Java Center, New York, May 28-June 3, 2023.
- Co-organizer: Transport Information Geometric Sampling in Inverse problems, SQuaRE, AIM, San Jose, Oct 10-Oct 14, 2022.

- Co-organizer: Deep Learning via Optimal Control in Data space, SIAM Conference on Mathematics of Data Science, San Diego, CA, Sep 20-Sep 26, 2022.
- Co-organizer: MURI mean field games Review meeting, BRICC, DC, Aug 1-Aug 2, 2022.
- Co-organizer: Optimal transport: Theory, Computation, and Biology. UC Irvine, June 3-June 4, 2022.
- Chair: Transport Information Geometry, Geometry science of information (GSI), France, 2019, 2021.
- Co-organizer: DASIV Spring School Series, Columbia, SC, April 8-April 10, 2021.
- Co-organizer: Deep learning via optimal control in data space, SIAM Conference on Mathematics of Data Science, Ohio, June 17-18, 2020.
- Co-organizer: Optimal transport for nonlinear problems in Spain, ICIAM 2019.
- Co-organizer: Mean field games MURI kickoff meeting, UCLA, 2018.

Summer school

- Co-organizer: Research Experience for Undergraduates (REU): Summer School on Mathematical Foundation of Data Science 2022. Project: Probability and Optimization, U of SC, June 6-July 15, 2022, June 4-July 14, 2023.

Service

1. Faculty Hiring Committee, U of SC, 2021-2022, 2023-2024.
2. Hiring committee for the smart state chair, U of SC, 2022-2023.
3. Mathematics Colloquium Committee, U of SC, 2021-2024.
4. Research Experiences for Undergraduates, U of SC, 2021-2023.
5. Qualify exam, U of SC, 2022-2023, 2023-2024.
6. High School Mathematics Competition, U of SC, 2022-2024.

Academic activities

- Lectures in Transport information geometry: current and future, April, IPAM, 2020.
- Lectures in Transport information geometry, Dec, Tsinghua university, 2019.
- Lectures in Mean field games, June, Los Angeles, 2017, 2018.
- AIMS Orlando conference, July 1-July 5, Orlando, Florida, 2016.
- Evolutionary Game Theory, April 27-May 1, MBI, Ohio State University, 2014.
- Georgia Scientific Computing Symposium, 2012-2015.
- MSRI Summer school, July 07-July 18, MSRI, University of California, Berkeley, 2014.
- Houston Summer School, May 20-May 28, University of Houston, 2014.
- Research assistant, Georgia Institute of Technology, Fall 2014, Fall 2015.

Supervision and Co-supervision of postdocs

Co-supervised with Stanley Osher:
 Siting Liu, UCLA, 2022-
 Shu Liu, UCLA, 2022-
 Mo Zhou, UCLA, 2023-
 Fuqun Han, UCLA, 2023-

Supervision and Co-supervision of graduate students

Yiqun Li, U of SC, 2019-, Co-advised with Hong Wang at 2023.
Yupei Li, U of SC, 2021-, Co-advised with Linyuan Lu at 2022.
Xinzhe Zuo, UCLA, 2020-, Co-advised with Stanley Osher at 2022.

Supervision of visiting postdocs and graduate students

Hong Ye Tan, Cambridge university, 2023 summer.
Hansol Park, Seoul national university, 2021-2022.

Supervision of undergraduate students

Yifan Chen, Tsinghua university, 2018-2019, now at Caltech;
Yifei Wang, Peking university, 2019-, now at Stanford;
Jiaxi Zhao, Peking university, 2019-, now at NUS;
Lisang Ding, Zhejiang university, 2019-; now at UCLA.
Junyi Wu, UCAS, 2023-;