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, Spring 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; $\diamond$: project mentor.

1. 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*, accepted in Journal of Computational Physics, 2024.
2. 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.
3. Yuan Gao, Wuchen Li$^\diamond$, Jian-Guo Liu. *Master equations for finite state mean field games with nonlinear activations*, accepted in Discrete and Continuous Dynamical Systems Series B, 2023.
4. Erhan Bayraktar, Qi Feng, Wuchen Li$^\diamond$. *Exponential Entropy dissipation for weakly self-consistent Vlasov-Fokker-Planck equations*, accepted in Journal of Nonlinear science, 2023.
5. Wuchen Li*. *Diffusion hypercontractivity via generalized density manifold*, accepted in Information Geometry, 2023.
6. Wuchen Li*, Siting Liu, Stanley Osher. *A kernel formula for regularized Wasserstein proximal operators*, accepted in Research in the Mathematical Sciences, 2023.
7. Xiangcheng Zheng, Zhiwei Yang, Wuchen Li$^\diamond$, Hong Wang. *A time-fractional mean field game modeling subdiffusive advective transport*, accepted in SIAM Journal on Scientific Computing, 2023.
8. Karthik Elamvazhuthi, Siting Liu, Wuchen Li$^\diamond$, Stanley Osher. *Optimal Transport of Nonlinear Control-Affine Systems*, accepted in Journal of Computational Dynamics, 2023.
9. 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.
10. 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.
11. Jiajia Yu, Rongjie Lai, Wuchen Li$^\diamond$, Stanley Osher. *A Fast Proximal Gradient Method and Convergence Analysis For Dynamic Mean Field Planning*, accepted in Mathematics of Computation, 2023.
12. Xinzhe Zuo, Stanley Osher, Wuchen Li*. *Primal-dual damping algorithms for optimization,* accepted in Annals of Mathematical Sciences and Applications, 2023.
13. Qi Feng, Wuchen Li$^\diamond$. *Entropy dissipation for degenerate stochastic differential equations via sub-Riemannian density manifold*, accepted in Entropy, 2023.
14. Jiajia Yu, Rongjie Lai, Wuchen Li$^\diamond$, Stanley Osher. *Computational Mean-field Games on Manifolds*, accepted in Journal of Computational Physics, 2023.
15. Wuchen Li*, Siting Liu, Stanley Osher. *Controlling conservation laws I: entropy–entropy flux*, accepted in Journal of Computational Physics, 2023.
16. Wuchen Li*, Jiaxi Zhao. *Wasserstein information matrix*, accepted in Information Geometry, 2023.
17. 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.
18. Wuchen Li, Javier Rubio Alvarez. *On a prior based on the Wasserstein information matrix*, accepted in Statistics and Probability Letters, 2022.
19. Wonjun Lee, Siting Liu, Wuchen Li*, Stanley Osher. *Mean field control problems for Vaccine distribution*, accepted in Research in the Mathematical Sciences, 2022.
20. Wuchen Li*, Wonjun Lee, Stanley Osher. *Computational Mean-field information dynamics associated with Reaction-diffusion equations*, accepted in Journal of Computational Physics, 2022.

21. Yifei Wang, Peng Chen, Wuchen Li$^{\diamond}$. *Projected Wasserstein gradient descent for high-dimensional Bayesian inference*, accepted in SIAM/ASA Journal on Uncertainty Quantification, 2022.
22. Wuchen Li*, Siting Liu, Stanley Osher. *Controlling conservation laws II: compressible Navier-Stokes equations*, accepted in Journal of Computational Physics, 2022.
23. Lisang Ding, Wuchen Li*, Stanley Osher, Wotao Yin. *A Mean-Field Game Inverse Problem*, accepted in Journal of Scientific Computing, 2022.
24. Shu Liu, Wuchen Li*, Hongyuan Zha, Haomin Zhou. *Neural Parametric Fokker-Planck equations*, accepted in SIAM Journal on Numerical Analysis, 2022.
25. Yifei Wang, Wuchen Li*. *Accelerated information gradient flow*, accepted in Journal of Scientific Computing, 2021.
26. Wuchen Li*. *Transport information Bregman divergences*, accepted in Information Geometry, 2021.
27. 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.
28. Wuchen Li*. *Transport information geometry: Riemannian calculus on probability simplex*, accepted in Information Geometry, 2021.
29. 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.
30. Siting Liu, Matt Jacobs, Wuchen Li$^{\circ}$, Levon Nurbekyan, Stanley Osher. *Computational methods for nonlocal mean field games with applications*, accepted in SIAM journal on Numerical Analysis, 2021.
31. 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.
32. 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.
33. Wuchen Li*. *Hessian metric via transport information geometry*, accepted in Journal of Mathematical Physics, 2021.
34. 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.
35. 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.
36. Wonjun Lee, Rongjie Lai, Wuchen Li*, Stanley Osher. *Generalized unnormalized optimal transport and its fast algorithm*, accepted in Journal of Computational Physics, 2020.
37. Simon Becker, Wuchen Li$^{\diamond}$, *Quantum statistical learning via Quantum Wasserstein natural gradient*, accepted in Journal of Statistical Physics, 2020.
38. Shui-Nee Chow, Wuchen Li*, Chenchen Mou, Haomin Zhou. *Dynamical Schrödinger bridge problems on graphs*, Journal of Dynamics and Differential Equations, 2020.
39. Flavien Leger, Wuchen Li$^{\diamond}$. *Hopf-Cole transform via generalized Schrödinger bridge problem*, Journal of Differential Equations, 2020.
40. 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.
41. 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.

42. Yifan Chen, Wuchen Li$^{\diamond}$, *Optimal transport natural gradient for statistical manifolds with continuous sample space*, Information Geometry, 2020.
43. Wuchen Li, Jiangfeng Lu, Li Wang. *Fisher information regularization schemes for Wasserstein gradient flows*, Journal of Computational Physics, 2020.
44. Lars Ruthottoa, 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.
45. Wuchen Li*, Guido Montufar. *Ricci curvature for parametric statistics via optimal transport*, Information Geometry, 2020.
46. Wuchen Li*, Lexing Ying. *Hessian transport gradient flows*, Research in the Mathematical Sciences, 2019.
47. 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.
48. Shui-Nee Chow, Wuchen Li*, Jun Lu, Haomin Zhou. *Equilibrium selection via Optimal transport*, SIAM Journal on Applied Mathematics, 2019.
49. Wilfrid Gangbo, Wuchen Li*, Stanley Osher, Michael Puthawala. *Unnormalized optimal transport*, Journal of Computational Physics, 2019.
50. Shui-Nee Chow, Wuchen Li*, Haomin Zhou. *Wasserstein Hamiltonian flows*, Journal of Differential Equations, 2019.
51. Yat-Tin Chow, Wuchen Li$^{\diamond}$, Wotao Yin, Stanley Osher. *Algorithm for Hamilton-Jacobi equations in density space via a generalized Hopf formula*, Journal of Scientific Computing, 2019.
52. 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.
53. Shui-Nee Chow, Wuchen Li*, Haomin Zhou. *A discrete Schrödinger equation via optimal transport on graphs*, Journal of Functional Analysis, 2019.
54. Yupeng Li, Wuchen Li*, Guo Cao. *Image Segmentation via L1 Monge-Kantorovich Problem*, Inverse problem and Imaging, 2019.
55. Wuchen Li*, Guido Montufar. *Natural gradient via optimal transport*, Information Geometry, 2018.
56. Shui-Nee Chow, Wuchen Li*, Jun Lu, Haomin Zhou. *Population games and Discrete optimal transport*, Journal of Nonlinear Science, 2018.
57. 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.
58. Ernest Ryu, Yongxin Chen, Wuchen Li, Stanley Osher. *Vector and Matrix Optimal Mass Transport: Theory, Algorithm, and Applications*, SIAM Journal on Scientific Computing, 2018.
59. Shui-Nee Chow, Wuchen Li*, Haomin Zhou. *Entropy dissipation on finite graphs*, Discrete and Continuous Dynamical Systems-Series A, 2018.
60. 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.
61. Ernest Ryu, Wuchen Li*, Penghang Yin, Stanley Osher. *Unbalanced and Partial L1 Monge-Kontorovich Problem: A Scalable Parallel First-Order Method*, Journal of Scientific Computing, 2017.
62. Wuchen Li*, Penghang Yin, Stanley Osher. *Computation of optimal transport distance with Fisher information regularization*, Journal of Scientific Computing, 2017.
63. Wuchen Li*, Ernest Ryu, Stanley Osher, Wotao Yin, Wilfrid Gangbo. *A parallel method for Earth Mover's distance*, Journal of Scientific Computing, 2017.

64. 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.
65. Shui-Nee Chow, Wuchen Li*, Jun Lu, Haomin Zhou. *Method of evolving junctions: A new approach to optimal control with constraints*, Automatica, 2017.
66. 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.
67. 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$^\diamond$, 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$^\diamond$, 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$^\diamond$, 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$^\diamond$, 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$^\diamond$, Guido Montufar. *Kernelized Wasserstein Natural Gradient*, International Conference on Learning Representations (ICLR), Oral, 2020.
9. Alex Lin, Yonatan Dukler, Wuchen Li$^\diamond$, Guido Montufar. *Wasserstein Diffusion Tikhonov Regularization*, OTML Workshop NeurIPS, 2019.
10. Hao Gao, Wuchen Li$^\diamond$, 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$^\diamond$, Shu Liu, Hongyuan Zha, Haomin Zhou. *Parametric Fokker-Planck equation*, Geometric Science of Information (GSI), 2019.
13. Wuchen Li$^\diamond$, Alex Lin, Guido Montufar. *Affine natural proximal learning*, Geometric Science of Information (GSI), 2019.
14. Yonatan Dukler, Wuchen Li$^\diamond$, 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$^{\diamond}$. *Information Newton's flow: second-order optimization method in probability space.*
2. Qi Feng, Wuchen Li$^{\diamond}$. *Hypoelliptic entropy dissipation for stochastic differential equations (II).*
3. Yifei Wang, Peng Chen, Mert Pilanci, Wuchen Li$^{\diamond}$. *Optimal Neural Network Approximations of Wasserstein Gradient Direction via Convex Optimization.*
4. Wuchen Li$^{\diamond}$, 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. Wuchen Li*, Tryphon Georgiou. *Minimal Wasserstein Surfaces.*
8. Wuchen Li*. *Langevin dynamics for the probability of Markov jumping processes.*
9. Hong Ye Tan, Stanley Osher, Wuchen Li*. *Noise-Free Sampling Algorithms via Regularized Wasserstein Proximals.*
10. Yiqun Li, Hong Wang, Wuchen Li*. *A time-fractional optimal transport and mean-field planning: Formulation and algorithm.*
11. Wuchen Li$^{\diamond}$, Jiaxi Zhao. *Scaling Limits of the Wasserstein information matrix on Gaussian Mixture Models.*
12. Tingwei Meng, Wenbo Hao, Siting Liu, Stanley Osher, Wuchen Li*. *Primal-dual hybrid gradient algorithms for computing time-implicit Hamilton-Jacobi equations.*
13. Wonjun Lee, Li Wang, Wuchen Li$^{\diamond}$. *Deep JKO: time-implicit particle methods for general nonlinear gradient flows.*
14. Mo Zhou, Stanley Osher, Wuchen Li*. *A deep learning algorithm for computing mean field control problems via Forward-backward score dynamics.*
15. Fuqun Han, Stanley Osher, Wuchen Li*. *Tensor train based sampling algorithms for approximating regularized Wasserstein proximal operators.*
16. 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.*
17. Qi Feng, Xinzhe Zuo, Wuchen Li$^{\diamond}$. *Fisher information dissipation for time inhomogeneous stochastic differential equations.*
18. Benjamin Zhang, Siting Liu, Wuchen Li, M. Katsoulakis, Stanley Osher. Wasserstein proximal operators describe score-based generative models and resolve memorization.
19. Guosheng Fu, Hangjie Ji, Will Pazner, Wuchen Li*. *Mean field control of droplet dynamics with high order finite element computations.*
20. Xinzhe Zuo, Jiaxi Zhao, Shu Liu, Stanley Osher, Wuchen Li*. *Numerical analysis on Neural network projected schemes for approximating one dimensional Wasserstein Gradient flows.*
21. Tingwei Meng, Siting Liu, Wuchen Li$^{\diamond}$, Stanley Osher. *A Primal-dual hybrid gradient method for solving optimal control problems and the corresponding Hamilton-Jacobi PDEs.*
22. Arjun Vijaywargiya, Guosheng Fu, Stanley Osher, Wuchen Li$^{\diamond}$. *Efficient computation of mean field control based barycenters from reaction-diffusion systems.*

Upcoming presentations

- Invited talk, "Information Gamma calculus: Convexity analysis for time dependent stochastic differential equations", Caltech, May 13-17, 2024.
- Invited talk, Interacting Particle Systems: Analysis, Control, Learning and Computation, May 6-10, 2024.

Presentations

1. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, Financial/Actuarial Mathematics seminar, University of Michigan, Ann Arbor, April 2-4, 2024.
2. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, University of North Carolina at Chapel Hill, March 28, 2024.
3. Invited talk, *Transport information scientific computing*, Mathematical Advances in Scientific Machine Learning, AMS Spring 2024 Southeastern Sectional Meeting. Florida State University, March 23-24, 2024.
4. Invited talk, *Information Gamma calculus: Convexity analysis for stochastic differential equations*, Optimal transport - machine learning/optimization - dynamical systems", Berlin, Germany, March 11th - 15th, 2024.
5. Invited talk, *Calculus of score functions*, 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.
6. 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.
7. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, Applied and Computational Math Seminar, UC Irvine, Nov 6, 2023.
8. Invited talk, *Transport Information Geometric Computations*, SIAM+ Applied Numerical Math Seminar, University of Florida, Gainesville, Oct 27, 2023.
9. Invited talk, *Information Gamma calculus: Convexity analysis for stochastic differential equations*, SIAM-NNP, NJ, October 20-22, 2023.
10. Organization lectures, *Transport Information Geometric Sampling in Inverse problems*, SQuaRE, AIMS, Caltech, LA, Oct 9-Oct 13, 2023.
11. 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.
12. 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.
13. Invited talks, *Transport Information Geometric Computations*, AFOSR review meeting, Aug 7-Aug 11, VA, 2023.
14. Invited talk, *Information Gamma calculus: Convexity analysis for stochastic differential equations*, Applied and Computational Differential Geometry and Geometric PDEs, BIRS, Canada, July 31, 2023.
15. 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.
16. 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.
17. Invited talk, *Controlling conservation laws via entropy-entropy flux pairs*, "Optimal Transport in Data Science", ICERM, Brown university, May 8-May 12, 2023.
18. Organization talk, *Optimal Ricci curvature Markov chain Monte Carlo on finite states*, RTG seminar, U of SC, March 3, 2023.
19. Invited talk, *Controlling conservation laws via entropy-entropy flux pairs*, CAM seminar, Iowa state university, Feb 27, 2023.

20. Invited talk, *Transport Optimization Methods for Bayesian sampling problems*, Mathematical Sciences Colloquium, Rensselaer Polytechnic Institute, Troy, New York, Jan 19, 2023.
21. 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.
22. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, CNA seminar, Carnegie Mellon University, Pittsburgh, Oct 27 to Oct 28, 2022.
23. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, Analysis seminar, Clemson University, Clemson, SC, Oct 21, 2022.
24. 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.
25. 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.
26. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, Applied math seminar, The George Washington University, Sep 30, 2022.
27. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, Numerical analysis seminar, North Carolina State University, Sep 27, 2022.
28. Plenary talk, *Transport information Bregman divergences*, "Information Geometry in Data Science", Hamburg University of Technology, Germany, Sep 21, 2022.
29. Invited talk, *Controlling conservation laws via entropy-entropy flux pairs*, Applied math seminar, University of Notre Dame, Sep 15, 2022.
30. Invited talk, *Mean-Field Games for Scalable Computation and Diverse Applications*, Applied math seminar, Duke University, Durham, NC, Sep 6, 2022.
31. Organization talk. *Computational Mean-field information dynamics associated with Reaction-diffusion equations.* "MURI mean field game review conferences", DC, Aug 1-2, 2022.
32. 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.
33. Invited talk, *Transport information Newton's flows*, "Sampling via Variational Methods", SIAM Conference on Uncertainty Quantification, Atlanta, Georgia, April 12-14, 2022.
34. Invited participates, "Socio-Math Workshop", Basic Research Innovation Collaboration Center (BRICC), Arlington, VA, April 11-12, 2022.
35. Organization talk, *Transport information flows for Bayesian sampling problems*, U of SC RTG seminar, March 4, 2022.
36. Invited talk, *Wasserstein information matrix and its estimation properties*, Statistics Seminar, Imperial College, March 4, 2022.
37. Invited talk, *Computational Mean-field information dynamics associated with Reaction-diffusion equations*, High Dimensional Hamilton-Jacobi PDEs Reunion, IPAM, UCLA, LA, Jan 13, 2022.
38. Invited talk, *Transport information flows for Bayesian sampling problems*, Applied math seminar, Illinois institute of Technology, Dec 17, 2021.
39. Organization talk, *Controlling conservation laws via entropy–entropy flux pairs*, Optimal transport and Mean field game seminar, U of SC/UCLA, Dec 15, 2021.
40. 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.
41. Invited talk, *Neural computational mean field games*, Mathematical finance seminar, UC Berkeley, Nov 5, 2021.
42. Invited talk, *Transport information dynamics for sampling problems*, Mathematical data science seminar, Purdue University, Nov 1, 2021.

43. 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.
44. 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.
45. Organization talk, *Transport information Hessian distances*, Transport information geometry/Divergence statistics, Geometric Science of Information, July 21 to July 23, 2021.
46. Invited talk, *Transport information Bregman divergences*, Analysis of nonlinear wave models, SIAM Conference on Applications of Dynamical Systems (DS21), May 23 to 27, 2021.
47. Invited talk, *Transport information Bregman divergences*, One World Seminar Series on the Mathematics of Machine Learning, May 12, 2021.
48. Invited talk, *Entropy dissipation via Information Gamma calculus*, Analysis Seminar at the Center of Mathematics, University of Coimbra, Portugal, April 9, 2021.
49. Invited talk, *Free Wasserstein manifold*, Probabilistic operator algebra seminar, UC Berkeley, Feb 22, 2021.
50. Invited talk, *Learning via transport information geometry*, Applied math seminar, Auburn university, Feb 19, 2021.
51. Home talk, *Transport information dynamics with applications*, Applied math seminar, University of South Carolina, Jan 22, 2021.
52. Invited talk, *Mean field games with applications*, Gatsby Seminar, University College London, Jan 13, 2021.
53. 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.
54. Invited talk, *Transport information flows for Bayesian sampling problems*, "Mathematics in Imaging, Data and Optimization", Rensselaer Polytechnic Institute, Dec 9, 2020.
55. Invited talk, *Transport information flows for Bayesian sampling problems*, Applied Math/PDE seminar, UC Santa Barbara, Nov 13, 2020.
56. Invited talk, *Mean field games with applications*, UC SOUTHERN HUB: Frontiers in Machine Learning for the Physical Sciences, UC Irvine, Oct 26, 2020.
57. Invited talk, *Controlling Propagation of epidemics via mean-field games*, Math and deep learning collective, Iowa State University, Sep 11, 2020.
58. Invited talk, *Transport information geometric learning*, workshop on computation and applications of PDEs based on machine learning, July 14, 2020.
59. Invited talk, *Wasserstein information matrix*, Optimal Transport: Regularization and Applications, July 7-8, 2020, Columbia university.
60. 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.
61. Invited talk, *Transport information Newton's flow*, Optimal Transport minisymposium, SIAM Conference on Mathematics of Data Science, May 29, 2020.
62. Invited talk, *Transport information geometric computation: Mean field games*, Math and deep learning (MDL) collective, Iowa State University, May 8, 2020.
63. Invited talk, *Transport information geometric computation: Neural Fokker-Planck equations*, Data science seminar, Shanghai Jiao Tong university, May 4, 2020.
64. Invited talk, *Accelerated information gradient flow*, Workshop II: PDE and Inverse Problem Methods in Machine Learning, IPAM, LA, April 23, 2020.
65. Invited talk, *Transport information Newton's flow*, Computational and Applied Mathematics Seminar, Carnegie Mellon University, Pittsburgh, April 14, 2020.

66. Invited talk, *Transport information Newton's flow*, probability and statistics seminar, University of Southern California, LA, April 10, 2020.
67. Invited talk, *Transport information geometry: current and future*, IPAM, UCLA, March 26 and April 6, 2020.
68. Joint Stochastic and Applied Math Seminar talk: *Accelerated information gradient flow*, The University of Utah, Salt Lake City, Jan 22, 2020.
69. Colloquia talk: *Transport information geometric learning*, The University of Utah, Salt Lake City, Jan 21, 2020.
70. Invited talk: *Accelerated information gradient flow*, Applied Math Youth Forum, Peking university, Dec 22, 2019.
71. Lecture series: *Transport information geometry with applications in data science, statistics and data-driven scientific computing*, Tsinghua university, Dec 19–23, 2019.
72. Invited talk: *Wasserstein information matrix*, SIAM Conference on Analysis of Partial Differential Equations, session: PDEs in machine learning, La Quinta, Dec 14, 2019.
73. 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.
74. Colloquia talk: *Transport information geometric learning*, University of South Carolina, Columbia, Dec 6, 2019.
75. Invited talk: *Transport information geometric learning*, Applied and Computational Mathematics, UCI, Irvine, Nov 4, 2019.
76. Invited talk: *Accelerated Information Gradient flow*, Applied Math seminar, Stanford university, San Jose, Oct 23, 2019.
77. Invited talk: *Wasserstein information geometric learning*, CAM seminar, Iowa state university, Iowa, Ames, Sep 16, 2019.
78. Plenary talk: *Learning via Wasserstein information geometry*, Peter G. Hall Conference: Statistics and Machine Learning, UC Davis, May 10, 2019.
79. Invited talk: *Wasserstein information geometric learning*, SOCAMS, Caltech, Pasadena, April 27, 2019.
80. Invited talk: *Wasserstein information geometric learning*, Applied Math seminar, Stanford University, San Jose, April 17, 2019.
81. Invited talk: *Wasserstein information geometric learning*, Special seminar on optimal transport and information geometry, UCLA, April 10, 2019.
82. Invited talk: *Wasserstein information geometric learning*, Deep learning kickoff conference, Max-Planck institute, Leipzig, Germany, March 29, 2019.
83. Invited talk: *Wasserstein information geometric learning*, Applied Math seminar, University of California, Santa Cruz, March 4, 2019.
84. Invited talk: *Wasserstein information geometric learning*, Special seminar, Courant Institute of Mathematical Sciences , New York, Feb 21, 2019.
85. Invited talk: *Wasserstein information geometric learning*, Special seminar, New Jersey Institute of Technology, New Jersey, Feb 20, 2019.
86. Invited talk: *Wasserstein information geometric learning*, Optimal transport seminar, Caltech, Pasadena, Jan 2019.
87. Invited talk: *Learning via Wasserstein information geometry*, Applied mathematics and Statistics Youth Forum, Peking university, Dec 2018.
88. Organization talk: *Mean field games and Optimal transport*, Mean field games kickoff conference, UCLA, Dec 2018.
89. Invited talk: *Optimal transport on graph with applications*, Special event, University of Minnesota, Nov 2018.

90. Invited talk: *Wasserstein statistical manifold*, AIM conference on Restricted Boltzmann machine, San Jose, Sep 2018.
91. Plenary talk: *Machine learning via Wasserstein statistical manifold*, A first conference in Machine learning and optimal control, Shenzhen, July 2018.
92. Plenary talk: *Dynamics in Wasserstein statistical manifold*, International conference on infinite dimensional dynamical systems, Sichuan University, Chengdu, July 2018.
93. Lecture series: *Mean field games via probability manifold I, II*, IPAM lectures, UCLA, Los Angeles, June 2018.
94. Invited talk: *Wasserstein Natural gradient*, Level set seminar, UCLA, Los Angeles, June 2018.
95. Invited talk: *Wasserstein statistical manifold*, Level set seminar, UCLA, Los Angeles, April 2018.
96. Invited talk: *Optimal transport on graphs with applications*, Applied Math/PDE seminar, UCSB, Santa Barbara, Feb 2018.
97. *Optimal transport on graphs with applications*, Level set seminar, UCLA, Los Angeles, Feb 2018.
98. Plenary talk: *Schrödinger equation on graphs via optimal transport*, ICMC Differential equations, USP, Sao Calos, Brazil, Feb 2018.
99. Invited talk: *Entropy dissipation on finite graphs*, 10 to 60 conference, Georgia Tech, Atlanta, Dec 2017.
100. Invited talk: *Discrete Schrödinger equation via optimal transport*, AIMS, UC riverside, Nov 2017.
101. Invited talk: *Fokker-Planck equations on finite graphs*, Probability and Statistics seminar, USC, Sep 1, 2017.
102. Home talk: *Optimal control problems in density space*, Level set seminar, UCLA, Aug 29, 2017.
103. Invited talk: *Dynamical system in density manifold for finite graphs*, Workshop in dynamical system, Georgia Tech, Atlanta, Aug 10, 2017.
104. Invited talk: *Optimal transport with applications*, Topology seminar, Southwest Jiaotong University, Chengdu, June 20, 2017.
105. Invited talk: *Population games via optimal transport*, International Conference on Topological Nonlinear Analysis, Guangzhou, June 15, 2017.
106. Invited talk: *Optimal transport with Fisher information regularization*, SOCAMS, UC Irvine, June 6, 2017.
107. 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.
108. Home talk: *Optimal transport on finite graphs with applications*, Applied math colloquium, UCLA, March 2017.
109. Invited talk: *Optimal transport on finite graphs with applications*, Applied math seminar, Claremont Colleges, Feb 2017.
110. Home talk: *Fast algorithms for Earth Mover's distance*, Level set seminar, UCLA, Jan 2017.
111. Home talk: *Optimal transport and Entropy dissipation on finite graphs*, Level set seminar, UCLA, Aug 29, 2016.
112. Invited talk: *A new model for realistic random perturbations of stochastic oscillators*, AIMS Orlando conference, Orlando, Florida, July 3, 2016.
113. Invited talk: *A new approach to optimal control with constraints*, AIMS Orlando conference, Orlando, Florida, July 1, 2016.
114. 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.
115. Invited talk: *Method of evolving junctions*, University of Georgia, Athens, Georgia, 2016.

116. Invited talk: *Method of evolving junctions: A new approach to optimal control with constraints*, SIAM student conference, Georgia Tech, Atlanta, April 11, 2015.
117. 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;
- Annuals of Statistics;
- Algebric 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;
- SIAM Journal on Mathematics of Data Science;
- 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, Phd in Caltech, now in NYU;
Yifei Wang, Peking university, 2019-, Phd in Stanford;
Jiaxi Zhao, Peking university, 2019-, Phd in NUS;
Lisang Ding, Zhejiang university, 2019-; Phd in UCLA.
Junyi Wu, UCAS, 2023-;