Yifan Chen

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Updated Aug, 2024

Employment

Courant Institute, New York University — New York, NY
Assistant Professor/Courant Instructor — 2023/9–

Education

California Institute of Technology — Pasadena, California
Ph.D. in Applied and Computational Mathematics — 2018–2023
Advisors: Thomas Y. Hou, Houman Owhadi, Andrew M. Stuart

Tsinghua University — Bejing, China
B.S. in Pure and Applied Mathematics, GPA ranked 1st — 2014–2018

Research Interests

My research lies in the intersection of applied and computational mathematics, applied probability and statistics. I am interested in analysis and algorithms for heterogeneous and high-dimensional statistical and computational problems in physics and data science, with a focus on partial differential equations, multiscale and statistical numerical methods, and the sampling and learning of probability distributions.

Publications

Preprints

[1] Yifan Chen, Xiaoou Cheng, Jonathon Niles-Weed, Jonathon Weare. Convergence of Unadjusted Langevin in High Dimensions: Delocalization of Bias. *arxiv: 2408.13115*, 2024.

[2] José A. Carrillo, Yifan Chen, Daniel Zhengyu Huang, Jiaoyang Huang, Dongyi Wei. Fisher-Rao Gradient Flow: Geodesic Convexity and Functional Inequalities. *arxiv: 2407.15693*, 2024

[3] Yifan Chen, Daniel Zhengyu Huang, Jiaoyang Huang, Sebastian Reich, Andrew M. Stuart. Efficient, Multimodal, and Derivative-Free Bayesian Inference With Fisher-Rao Gradient Flows. *arxiv: 2406.17263*, 2024

[4] Zihui Wu, Yu Sun, Yifan Chen, Bingliang Zhang, Yisong Yue, Katherine L. Bouman. Principled Probabilistic Imaging using Diffusion Models as Plug-and-Play Priors. *arxiv: 2405.18782*, 2024

[5] Yifan Chen, Bamdad Hosseini, Houman Owhadi, Andrew M. Stuart. Gaussian Measures Conditioned on Nonlinear Observations: Consistency, MAP Estimators, and Simulation. *arxiv: 2405.13149* , 2024

[6] Huan Zhang, Yifan Chen, Eric Vanden-Eijnden, Benjamin Peherstorfer. Sequential-in-time training of nonlinear parametrizations for solving time-dependent partial differential equations. *arxiv: 2404.01145*, 2024

[7] Yifan Chen, Daniel Zhengyu Huang, Jiaoyang Huang, Sebastian Reich, Andrew M. Stuart. Sampling via Gradient Flows in the Space of Probability Measures. *arxiv: 2310.03597*, 2023

[8] Pau Batlle, Yifan Chen, Bamdad Hosseini, Houman Owhadi, Andrew M. Stuart. Error Analysis of Kernel/GP Methods for Nonlinear and Parametric PDEs. *arxiv: 2305.04962*, 2023.

[9] Yifan Chen, Daniel Zhengyu Huang, Jiaoyang Huang, Sebastian Reich, Andrew M. Stuart. Gradient flows for sampling: mean-field models, Gaussian approximations and affine invariance. *arxiv: 2302.11024*, 2023.

[10] Yifan Chen, Ethan N. Epperly, Joel A. Tropp, and Robert J. Webber. Randomly pivoted Cholesky: Practical approximation of a kernel matrix with few entry evaluations. *arXiv:2207.06503*, 2022.

Conference publications

[1] Yifan Chen, Mark Goldstein, Mengjian Hua, Michael S. Albergo, Nicholas M. Boffi, Eric Vanden-Eijnden. Probabilistic Forecasting with Stochastic Interpolants and Föllmer Processes. *Forty-first International Conference on Machine Learning*, 2024.

[2] Xinzhe Dai, Peichen Zhong, Bowen Deng, Yifan Chen, and Gerbrand Ceder. Inpainting crystal structure generations with score-based denoising. *Forty-first International Conference on Machine Learning Workshop AI4Science*, 2024.

Journal publications

[1] Yu Sun, Zihui Wu, Yifan Chen, Berthy T. Feng, Katherine L. Bouman. Provable Probabilistic Imaging using Score-Based Generative Priors. *IEEE Transactions on Computational Imaging*, 2024.

[2] Yifan Chen, Houman Owhadi, Florian Schaefer. Sparse Cholesky Factorization for Solving Nonlinear PDEs via Gaussian Processes. *Mathematics of Computation*, 2024.

[3] Yifan Chen, Thomas Y. Hou, and Yixuan Wang. Exponentially convergent multiscale methods for 2D high frequency heterogeneous Helmholtz equations. *SIAM Multiscale Modeling & Simulation*, 21(3): 849–883, 2023.

[4] Yifan Chen, Thomas Y. Hou, and Yixuan Wang. Exponentially convergent multiscale finite element method. *Communications on Applied Mathematics and Computation*, 1–17, 2023.

[5] Yifan Chen and Thomas Y. Hou. Multiscale elliptic PDE upscaling and function approximation via subsampled data. *SIAM Multiscale Modeling & Simulation*, 20(1):188–219, 2022.

[6] Yifan Chen, Bamdad Hosseini, Houman Owhadi, and Andrew M. Stuart. Solving and learning nonlinear PDEs with Gaussian processes. *Journal of Computational Physics*, 447:110668, 2021.

[7] Yifan Chen, Houman Owhadi, and Andrew M. Stuart. Consistency of empirical Bayes and kernel flow for hierarchical parameter estimation. *Mathematics of Computation*, 90(332):2527–2578, 2021.

[8] Yifan Chen, Thomas Y. Hou, and Yixuan Wang. Exponential convergence for multiscale linear elliptic PDEs via adaptive edge basis functions. *SIAM Multiscale Modeling & Simulation*, 19(2):980–1010, 2021.

[9] Yifan Chen and Thomas Y. Hou. Function approximation via the subsampled Poincaré inequality. *Discrete & Continuous Dynamical Systems-A*, 41(1), 2021.

[10] Yifan Chen and Wuchen Li. Optimal transport natural gradient for statistical manifolds with continuous sample space. *Information Geometry*, 3(1):1–32, 2020.

[11] Yifan Chen, Yuejiao Sun, and Wotao Yin. Run-and-Inspect Method for nonconvex optimization and global optimality bounds for R-local minimizers. *Mathematical Programming*, 176(1): 39-67, 2019.

[12] Jing Chen, Yifan Chen, Hao Wu, and Dinghui Yang. The quadratic Wasserstein metric for earthquake location. *Journal of Computational Physics*, 373:188–209, 2018.

Teaching

Instructor at NYU Courant

- Discrete Mathematics — Fall 2023
- Discrete Mathematics — Spring 2024
- Numerical Analysis — Fall 2024

Teaching Assistant at Caltech

- ACM 109: Mathematical Modeling — Spring 2021
- ACM 118: Stochastic Processes and Regression — Winter 2020
- ACM 117: Probability and Stochastic Processes — Fall 2020
- ACM 109: Mathematical Modeling — Spring 2020

Industrial Experiences

Citadel Securities — Miami, Florida
Quantitative Research Intern — 6/2022-8/2022

- Project on Alpha Research: Predicting APAC Market Returns

Microsoft — (virtual) Redmond, Washington
Part Time Researcher, Mentor: Pengchuan Zhang — 9/2021-2/2022

- Project: Stablizing Large Scale Neural Network Training of Vision Transformers

Referee Services

- Reviewer for NeurIPS 2024
- Reviewer for Journal of Functional Analysis
- Reviewer for Mathematics of Computation
- Reviewer for Journal of Computational Physics
- Reviewer for SIAM on Uncertainty Quantification
- Reviewer for SIAM on Control and Optimization
- Reviewer for SIAM on Numerical Analysis
- Reviewer for SIAM on Multiscale Modeling and Simulation
- Reviewer for Linear Algebra and Its Applications
- Reviewer for Research in the Mathematical Sciences
- Reviewer for European Journal of Applied Mathematics
- Reviewer for Nature Machine Intelligence
- Reviewer for IMA Journal of Numerical Analysis
- Reviewer for Foundations of Data Science
- Reviewer for Computational Methods in Applied Mathematics
- Reviewer for International Journal of Computer Mathematics
- Reviewer for the 4th International Conference on Geometric Science of Information

Conferences and Seminars

- Applied Mathematics Seminar, Nanyang Technology University, July, 2024
- International Conference on Scientific Computation and Differential Equations, National University of Singapore, July, 2024
- Conference on Multiscale Modeling based on Physics and Data, IPAM, UCLA, April, 2024
- Columbia applied math colloquium, January, 2024
- Workshop on Scientific Computing and Large Data, University of South Carolina, Dec, 2023
- Numerical Analysis Seminar (virtual), Hong Kong University, Dec, 2023
- Measure Transport, Diffusion Processes and Sampling Workshop, Flatiron, New York, Dec, 2023
- Yau Mathematical Science Center CAM seminar, Tsinghua University (virtual), Nov, 2023
- International Workshop on Recent Developments in Applied Mathematics and its Applications, Caltech, Nov, 2023
- Scientific machine learning seminar, Courant Institute, Oct, 2023
- 17th U. S. National Congress on Computational Mechanics, Albuquerque, New Mexico, July 2023
- Mathematical and Scientific Machine Learning, ICERM, Providence, June, 2023
- The AIMS Conference on Dynamical Systems, Differential Equations and Applications, Wilmington, North Carolina, May 2023
- Southern California Applied Mathematics Symposium, University of California, Irvine, April 2023
- Peking University applied math colloquium (virtual), Feb, 2023.
- Columbia applied math colloquium (virtual), January, 2023.
- The International Conference on New Trends in Computational and Data Sciences, Caltech, December 2022.
- Co-organizing the minisymposium "Recent Advances in Kernel Methods for Computing and Learning" in SIAM Mathematics of Data Science, San Diego, September, 2022.
- Southern California Applied Mathematics Symposium, Harvey Mudd College, May, 2022
- Rough Path Interest Group, The Alan Turing Institute (virtual), April, 2022
- SIAM Uncertainty Quantification Minisymposium "New Developments in Gaussian Processes", Atlanta, April 2022
- CMX Student and Postdoc Seminar, Caltech, November, 2020
- Second Symposium on Machine Learning and Dynamical Systems, Fields Institute (virtual), September, 2020
- Bernoulli-IMS One World Symposium (virtual), August, 2020
- Oberwolfach Seminar: Beyond Numerical Homogenization, June, 2019
- Machine Learning for Multiscale Model Reduction Workshop, Harvard University, March, 2019
- Mathematical Model and Computation of Nonlinear Problems, Tsinghua Sanya International Mathematics Forum, January, 2018
- Youth Forum in the 15th Annual Meeting of CSIAM, Qingdao, China, October, 2017

Scholarships and Awards

- The W.P. Carey and Co. Prize in Applied Mathematics, 2023, Caltech 2023
- Kortschak Scholars Program, Department of Computational and Mathematical Sciences, Caltech 2018–2023
- Tsinghua Xuetang Mathematics Program, Department of Mathematical Sciences, Tsinghua University 2015–2018
- Outstanding Undergraduate, Tsinghua University and Beijing 2018
- Baosteel Scholarship, Baosteel Corporation 2017
- Scholarship in Memory of the "12.9" Student Movement, Tsinghua University 2016
- Qualcomm Scholarship, Qualcomm Corporation 2016

- Scholarship in Memory of Mathematics Professor Ou Li, Tsinghua University 2016
- National Scholarship, Ministry of Education of China 2015

Computer Skills

Professional experiences in MATLAB, LaTeX, Python, Julia.

Languages

English (fluent), Chinese (native)