Zexi Fan

Personal Homepage | Google Scholar | GitHub | LinkedIn

Email: 2200010816@stu.pku.edu.cn

Education

Columbia University Aug 2026 –
Ph.D., Applied Mathematics

Peking University (PKU) Sep 2022 – Jun 2026
B.S., Computational Mathematics
Selected high-grade courses (score): Abstract Algebra (93), Statistical Learning (93), Combinatorics (92), Advanced Algebra II (90).

Publications & Preprints

Z. Fan, Y. Sun, S. Yang, Y. Lu. *Physics-Informed Inference Time Scaling via Simulation-Calibrated Scientific Machine Learning.* ICLR 2026. arXiv:2504.16172.

Z. Fan, B. Li, J. Lu. *Sharp hypocoercive convergence estimates for underdamped Langevin dynamics via the modified L^2 method.* arXiv:2604.10068.

Research Experience

Sharp Hypocoercive Convergence Estimates for Nonequilibrium Dynamics Jul 2025 – Present
Advisors: Prof. Jianfeng Lu, Prof. Bowen Li Duke University & CityU

- Designed a novel gapped-DMS method to derive sharp hypocoercive convergence rate estimates for nonequilibrium dynamics; established explicit square-root and perturbation thresholds.
- Extended framework to general non-equilibrium settings and validated convergence accelerations via numerical experiments.

SCaSML: Simulation-Calibrated Algorithm for High-Dimensional PDEs Jun 2024 – Apr 2025
Advisors: Prof. Yiping Lu, Dr. Yan Sun Northwestern & Georgia Tech

- Established theoretical guarantees for a calibration pipeline combining PINN/Gaussian surrogates, randomized MLMC and Multilevel Picard iterations to correct surrogate bias for high-dimensional semilinear PDEs.
- Demonstrated improved complexity scaling on 100d+ benchmarks; released code and benchmarks: SCaSML.

Continuous-State Contextual Bandit with Pessimism Regularization Aug 2024 – Nov 2025
Advisor: Prof. Ying Jin Harvard University

- Extended pessimism regularization to continuous state/action settings; designed a practical algorithm with confidence penalties adapted to compact action spaces.
- Proved regret guarantees removing the uniform-overlap requirement; developed concentration bounds for continuous policies.

Flow-Calibrated Stochastic Control for Transition Path Sampling Feb 2024 – Jun 2024
Advisors: Prof. Yiping Lu, Dr. Dinghuai Zhang NYU Courant & Mila

- Recast transition-path sampling as a Schrödinger-bridge problem; developed continuous SAC / GFlowNet variants and validated on model SDEs.

Unbiased Square-Root Convergent Estimator for High-Dimensional PDEs Sep 2023 – Feb 2024
Advisor: Prof. Yiping Lu NYU Courant

- Constructed an unbiased estimator using Multilevel Picard and randomized MLMC; proved bounded variance and improved statistical cost scaling.

Selected Coursework & Academic Activities

Graduate-level: High-Dimensional Probability; Applied Stochastic Analysis; Optimization Methods; Mathematical Processing; Statistical Learning.

Seminars: Stochastic Optimal Control; LLMs & Scientific Computing; Blowup in Fluid Equations.

Summer school: "Beauty of Theoretical Computer Science" (NJU), Summer 2024.

Technical Skills

Programming: Python, MATLAB, LaTeX, Bash, Markdown.

Libraries & Tools: PyTorch, JAX, NumPy, SciPy, DeepXDE, Weights & Biases.

Numerical methods & Solvers: Multilevel Picard, MLMC; optimization solvers: Gurobi, Mosek.

Mathematical tools: Stochastic analysis, hypocoercivity, concentration inequalities, optimal transport.

Languages: Mandarin (native); English (fluent).

Service & Leadership

Academic & Innovation Dept., SMS Student Union — Spring 2023
English Debate Club — Summer 2024

Memberships & Invitations

Member, OpenAI Emerging Talent Community.

Member, Valence Lab Community.

Invited reviewer / contributor for *Pure and Applied Mathematics Journal*, *Conference on Applied Mathematics and Information Technology*, *Conference on Computer, Communication and Control Engineering*, *Molecules*, and *World Journal of Mathematics and Statistics*.

Invited participant, Cerebras × Cline Vibe Coder Hackathon, Supervised Program for Alignment Research (SPAR).

Available upon request: references, code links, and extended publication list.