

Kaiwen Zhang

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EDUCATION

Courant Institute, New York University (GPA 4.0/4.0)

Sep. 2024 – May 2029

Ph.D. Mathematics

Courses: real & functional analysis, probability, stochastic processes, PDEs, numerical methods, randomized algorithms.

Columbia University School of Engineering and Applied Science (GPA 4.18/4.00)

Sep. 2020 – May 2024

B.S. Applied Mathematics, *summa cum laude*

Courses: functional analysis, Fourier analysis, PDEs and numerical methods for PDEs.

RESEARCH AND READING EXPERIENCE

Interests: Markov Chain Monte Carlo methods, rare event simulation, and generative models. Application of probability and stochastic analysis to study their efficiency, stability, and convergence properties.

Delocalization of Bias in Langevin Monte Carlo

Sep. 2025 – Ongoing

Supervisor: Professor Jonathan Weare, Courant Institute, New York University

- Studied convergence and bias scaling of low-dimensional marginal distributions in overdamped Langevin Monte Carlo via a multi-step coupling estimate in a novel Wasserstein 2, ∞ distance.¹ Assisted in reviewing main proofs.
- Investigated convergence of overdamped Langevin in KL divergence by deriving a Fokker-Planck equation for iterate distribution and establishing stability estimate for the PDE². Seeking to generalize to Hamiltonian Monte Carlo.

Self-Similar Blowup Solutions to Partial Differential Equations

May 2025 – Aug. 2025

Supervisor: Professor Tristan Buckmaster, Courant Institute, New York University

- Presented expositions to group of 4 on techniques used to prove local and/or global existence for ODEs such as bootstrap argument, fixed point iterations.
- Experimented strategy for proving blowup for PDEs on Burgers equation, by transforming blowup to long-time stability problem using self-similar variable change, and showing stability of linearized operator in resulting dynamical system.

Numerical Solutions of the Allen-Cahn Equation

Apr. 2024 – May 2024

Supervisor: Professor Qiang Du, Dep't of Applied Physics and Applied Math, Columbia University

- Derived Euler in time and spectral in space numerical schemes for solving the Allen-Cahn equation with periodic boundary conditions, analyzed consistency in Fourier space and translating to physical domain via the discrete Fourier transform
- Investigated stability of semi-implicit spectral method by establishing the PDE as gradient flow of nonlinear energy, and seeking analogue energy estimate of numerical solution, compared with fully explicit and implicit methods, report [here](#)

Analysis of Time-Independent Schrödinger Equations (mentored by Jackson C. Turner)

Aug. 2023 – Feb. 2024

Supervisor: Professor Michael I. Weinstein, Dep't of Applied Physics and Applied Math, Columbia University

- Reviewed variational argument for existence in 1D linear Schrödinger equation by constructing weakly convergent sequence, verifying weak lower semicontinuity of energy, and concluding admissibility of weak limit
- Studied concentration behavior of large-mass minimizers of nonlinear Hartree functional³ using IMS localization formula and scaling properties of free energy, locating concentrated mass at potential wells, to apply results to 1D NLSE

Replica Exchange Stochastic Gradient Langevin Dynamics

Jan. 2023 – May 2023

Supervisor: Professor Kui Ren, Dep't of Applied Physics and Applied Math, Columbia University

- Examined efficiency of reSGLD methods by designing energy functions and developing customized visualization tool to view stage-wise learning behavior, presented illustrations and suggested potential improvements (link [here](#))
- Experimented numerically influence of parameters (e.g., temperature) and implementation schemes (e.g., finite difference with error, normally distributed gradient) on effectiveness of reSGLD algorithms; compiled 5 Python demos (link [here](#))

¹Reference: Y. Chen, X. Cheng, J. Niles-Weed and J. Weare. "Convergence of Unadjusted Langevin in High Dimensions: Delocalization of Bias".

²Reference: D. Lacker and F. Zhou. "A hierarchical entropy method for the delocalization of bias in high-dimensional Langevin Monte Carlo".

³Reference: W. Aschbacher, J. Fröhlich, G. Graf, K. Schnee, and M. Troyer. "Symmetry breaking regime in the nonlinear Hartree equation".

PROJECTS AND ARTICLES

Report: Numerical Simulations of the Allen-Cahn Equation

May 2024

Supervisor: Professor Qiang Du, Dep't of Applied Physics and Applied Math, Columbia University

- Analyzes stability of semi-implicit and fully-implicit spectral methods for simulating phase transitions; link [here](#)

Presentation: Cloaking via Change of Variables (with A. Mazhar and S. Qiu)

Oct. 2023

Supervisor: Professor Christopher H. Wiggins, Dep't of Applied Physics and Applied Math, Columbia University

- Discusses cloaking via change of variable in electrostatics, for applied math senior seminar; link to [presentation](#)

Presentation: Replica Exchange SGLD Methods: General ideas and numerics

Apr. 2023

Supervisor: Professor Kui Ren, Dep't of Applied Physics and Applied Math, Columbia University

- Illustrates the idea and performance of reSGLD, for spring 23 applied math research; links to [code](#) and [presentation](#)

COMMUNITY ENGAGEMENT

Teaching Assistantships:

- Discrete Math, Honors Theory of Probability (Recitation Leader)

Fall 2025

Courant Student Analysis Seminar

Sep. 2025 – Ongoing

Founding co-organizer (with Grayson Davis)

- Created the seminar series to fill in a blank in PDE, geometry, and applied analysis-focused platform for student presentations, reached out to potential speakers, link to seminar [here](#).
- Coordinated logistics and assisted in scheduling of 7 seminars in fall 2025; around 15 participants each time.

Columbia Global China Connection

Sep. 2020 – May 2024

Senior Advisor (06/2023 – 05/2024), President (05/2022 – 05/2023), Staff (09/2020 – 04/2022)

- Initiated campus events post-COVID, optimized budget use, coordinated 40 members; organized Mid-Autumn and Spring Festival celebrations, and comedy show, 100+ participants each event, total revenue 3000 USD (700% of budget)
- Upscaled outreach to support campus events by expanding external relations team two-fold and connecting with 3 student clubs, sponsors now include Chowbus, Weee, Fantuan, and 10 local businesses
- Established procedure to review external advertisement requests to avoid excessive use of club's social media, increased average reads of articles by 75%

The Eye (Columbia's School Magazine)

Sep. 2020 – Feb. 2021

Staff Writer

- Interviewed 2 sources and transcribed interviews, investigated school's diversity, equity and inclusion campaign, co-wrote 2000+ word feature on a professor's anti-racism efforts and published on 9th issue of magazine, link [here](#)

INDUSTRY EXPERIENCE

Deloitte Canada, Toronto, Canada

May 2023 – Aug. 2023

Financial Engineering and Modeling Intern

- Co-directed assessment on quality of client database used to develop anti-money laundering (AML) models by brainstorming assessment goals with team of 4, examining data with Python and SQL, and communicating findings with client; identified 5 previously unnoticed issues leading to further investigation on client side
- Validated 3 AML models by analyzing model design and replicating tuning process of quantitative alert generation thresholds using Python, reported concerns to client prompting risk assessment; wrote 80-page analysis for each model
- Perfected and accelerated internal revenue management by developing original data-processing script in Visual Basic and authoring user instructions, increased efficiency by 30%
- Researched AI strategy of a potential client and matched to Deloitte's AI resources to prepare 2-day info session, produced 10-page notes and deck for internal reference

- Analyzed Tencent's business model by collecting financial data across 13 quarters, identifying key business components, researching Chinese social apps, cloud, and gaming markets, and assessing company's strengths and weaknesses; produced 10-page internal report to support portfolio evaluation
- Established internal reference for evaluating option trading strategies in asset managers by compiling 10-page pamphlet on basic stock options trading and profitability principles
- Evaluated ESG (Environment, Society, and Governance) integration in Chinese financial market by transcribing 3 interviews with asset owners and collecting info from company websites

HONORS AND AWARDS

Applied Mathematics Faculty Award, Columbia University	2024
Dean's List, Columbia University School of Engineering and Applied Science	Fall 2020, Fall 2022, Fall 2023
Andy Grove Scholarship, Intel, one-time award	2021

SKILLS AND INTERESTS

- **Computer Skills:** Python, MATLAB, Java, LaTeX, SQL, Visual Basic, Microsoft Office
- **Languages:** Chinese (Native), English (Natively Fluent), French (Elementary), Korean (Elementary)
- **Extracurricular Interests:** Tennis, volleyball, traveling, war history, movies: *Intouchables*, *Green Book*, *Mission Impossible*, collecting airplane models