Zirui Xu

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EDUCATION

Columbia University, Fu Foundation School of Engineering and Applied Science · New York, NY
Ph.D. in Applied Mathematics · Sep 2018 – Oct 2024
- GPA: 4.08/4.33 · Distinction in doctoral qualifying exam: scoring 192/200
- Coursework: dynamical system, stochastic process, machine learning and high-dimensional data

Peking University, School of Mathematical Sciences · Beijing, China
B.Sc. in Computational Mathematics · Sep 2014 – Jul 2018
- GPA: 3.79/4.00 · Ranking in department: 2/19 · Ranking in school: 10/190
- Coursework: optimization method, stochastic simulation, partial differential equation, numerical analysis, numerical algebra, machine learning, deep learning, big data analysis

EXPERIENCE

BestEx Research, Research and Engineering Team · Stamford, Connecticut
Quantitative Trading Researcher · Jan 2025 – Present
- Conducting in-depth quantitative research on historical market data to improve short-term price and liquidity prediction, with rigorous backtesting of model performance in trading simulations
- Designing and developing high-performance, low-latency trading execution strategies in C++, adapting algorithms to the unique market structure of each instrument to optimize order placement and routing, effectively minimizing transaction costs

Columbia University, Department of Applied Physics and Applied Mathematics · New York, NY
Graduate Research Assistant advised by Qiang Du · Sep 2018 – Oct 2024
- Employed efficient optimization algorithms (e.g., convex splitting) to study pattern formation due to competing interactions between many particles (in a self-consistent mean-field theory). Conducted extensive numerical simulations on high-performance computing clusters with GPU acceleration in MATLAB. Studied asymptotics of energy minimizers using mathematical analysis. Successfully explained self-assembly phenomena in a wide range of material, physical, and biological systems
- Studied a fractional stochastic process and solved the initial value problem of its generator using a representation similar to the Feynman–Kac formula. Solved the exit problem (and numerically verified it using Monte Carlo simulations with importance sampling), thereby establishing the connection between this stochastic process and a new type of time-fractional diffusion

Peking University, Elite Undergraduate Training Program in Applied Math & Stats · Beijing, China
Undergraduate Research Assistant advised by Lei Zhang and An-Chang Shi · Jun 2016 – Jul 2018
- Simulated the most probable transition path of bilayer membrane fusion, using a density functional theory with high-dimensional gradient flow dynamics. Employed efficient numerical methods such as the fast Fourier transform and the string method (the latter is widely used to study rare events)

AWARDS & EXTRACURRICULARS

Best Presentation in Applied Mathematics of Graduate Research Symposium	$200	Apr 2023
NYCRUNS Brooklyn Half Marathon Finisher with Columbia University Road Runners (CURR)		Apr 2022
Mentor of Columbia undergraduate teams for Mathematical Contest in Modeling (MCM)		Jan 2021
Cohost of Mid-Autumn Festival Party by Columbia University Chinese Association (CUCSSA)		Sep 2019
Golden Bunny Award for Best Creative Scenes in the computer animation course		Dec 2018
National Scholarship + National Southwest Associated University Scholarship	¥8000 + ¥8000	Oct 2017
Merit Student Pacesetter (twice)		Oct 2016, Oct 2017

Samsung Scholarship	¥7000	Oct 2016
First Prize in China Undergraduate Mathematical Modeling Contest		Sep 2016
First Prize in China Undergraduate Physics Contest		Dec 2015
Tung OOCL Scholarship	¥5000	Oct 2015
Merit Student		Oct 2015

SKILLS

Matlab, Mathematica, C++, Python, LaTeX, Linux

PUBLICATIONS

[d] denotes supplementary data set. In some publications, authors are listed in alphabetical order.

[5] Qiang Du, James M. Scott, Zirui Xu. Ohta–Kawasaki energy for amphiphiles: asymptotics and phase-field simulations. *Nonlinear Analysis* **250**: 113665 (2025)

[d] Qiang Du, James M. Scott, Zirui Xu. Degenerate Ohta–Kawasaki energy for amphiphiles. *Open Science Framework* (2024)

[4] Zirui Xu, Qiang Du. Bifurcation and fission in the liquid drop model: a phase-field approach. *Journal of Mathematical Physics* **64**(7): 071508 (2023)

[d] Zirui Xu, Qiang Du. Numerics of liquid drop model. *Open Science Framework* (2023)

[3] Zirui Xu, Qiang Du. On the ternary Ohta–Kawasaki free energy and its one-dimensional global minimizers. *Journal of Nonlinear Science* **32**(5): 61 (2022)

[2] Qiang Du, Lorenzo Toniazzi, Zirui Xu. Censored stable subordinators and fractional derivatives. *Fractional Calculus and Applied Analysis* **24**(4): 1035–1068 (2021)

[1] Yucen Han, Zirui Xu, An-Chang Shi, Lei Zhang. Pathways connecting two opposed bilayers with a fusion pore: a molecularly-informed phase field approach. *Soft Matter* **16**(2): 366–374 (2020)

RECENT PROJECTS

- Implemented deep Q-network for reinforcement learning in Open AI's lunar landing environment. Successfully trained the agent to land on the moon with high scores 235~325 (according to Open AI's gym documentation, "an episode is considered a solution if it scores at least 200 points"). Snapshots shown below, more details at https://ziruixu.github.io/blog/lunar-lander-dqn