RUICHEN XU

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ABOUT ME

I am a Ph.D. candidate in Computational Applied Mathematics at Stony Brook University, specializing in machine learning for PDEs, neural operators, and stochastic optimization. My work designs data-efficient operator-learning frameworks and optimization strategies (e.g., simulated annealing with RL guidance) that improve cross-resolution generalization and computational performance in scientific modeling.

EDUCATION

Stony Brook University, Stony Brook, NY, United States — Aug. 2022 – May. 2027 (Expected)
Ph.D. in Computational Applied Mathematics (4.0/4.0)

Courant Institute, New York University, New York, NY, United States — Sept. 2020 – May. 2022
M.S. in Mathematics (4.0/4.0)
Courses: Probability Theory I, II; Numerical Analysis I, II; Applied Stochastic Analysis; Ergodic Theory; Stochastic Modeling

University of California, Davis, Davis, CA, United States — Sept. 2019 – Jun. 2020
M.S. in Statistics (3.94/4.0)
Courses: Probability Theory; Statistical Methods for Research; Real Analysis

Beijing University of Chemical Technology, Beijing, China — Sept. 2015 – Jun. 2019
B.S. in Financial Mathematics (89.33/100)
Minor in Commercial Management
Courses: Ordinary Differential Equations; Stochastic Processes; Data Structures; Abstract Algebra

PAPERS IN PREPARATION

- **Reinforcement Learning-Guided Simulated Annealing: Adaptive Temperature Scheduling via Quasi-Equilibrium Constraints.**
  Manuscript in Preparation, 2025.
  Single-agent RL framework that tunes temperature schedules to maintain near-equilibrium sampling and accelerate convergence.
- **Physics-Informed Active Learning for Neural Operators.**
  Manuscript in Preparation, 2025.
  Physics-informed acquisition using simulated annealing to select high-uncertainty parameters and reduce data needs in neural operators.

UNDER REVIEW

- **Moving Strategy of Simulated Annealing: Moving One Coordinate is All You Need.**
  Manuscript in Preparation, 2025.
  Theoretical and empirical analysis showing that moving exactly one randomly chosen coordinate per iteration improves efficiency in high-dimensional optimization.

PUBLISHED PAPERS

- **Dynamic Schwartz-Fourier Neural Operator for Enhanced Expressive Power.**
  Transactions on Machine Learning Research (TMLR), 2025.
  Wenhan Gao, Jian Luo, **Ruichen Xu**, Yi Liu.
  Introduces dynamic Schwartz operators that induce frequency-domain interactions to enhance the expressive power of FNOs; improves performance on challenging physics tasks. (View Paper)

- **Discretization-Invariance? On the Discretization Mismatch Errors in Neural Operators.**
  International Conference on Learning Representations (ICLR), 2025.
  Wenhan Gao, **Ruichen Xu**, Yuefan Deng, Yi Liu.
  Defines discretization mismatch errors and proposes a Cross-Resolution Operator-learning Pipeline (CROP) for consistent cross-resolution learning in PDE applications (e.g., climate, fluids). (OpenReview) (ICLR Page)
- **Coordinate Transform Fourier Neural Operators for Symmetries in Physical Modelings.**
  Transactions on Machine Learning Research (TMLR), 2024.
  Wenhan Gao, **Ruichen Xu**, Haochun Wang, Yi Liu.
  Introduces coordinate-transform-based neural operators that preserve domain symmetries and improve consistency across coordinate systems. (View Paper)

PROFESSIONAL EXPERIENCE

Stony Brook University, Stony Brook, NY
Teaching Assistant Fall 2022 – Spring 2025

- **Courses:**
  - AMS 310 Probability & Statistics *(Fall 2022, Spring 2023)*
  - AMS 326 Numerical Analysis *(Spring 2024)*
  - AMS 510 Analytical Methods for Applied Mathematics *(Fall 2024; led recitations)*
  - AMS 595 Foundations of Computing *(Fall 2024)*
  - AMS 528 Numerical Methods *(Spring 2025)*
  - AMS 502 Differential Equations and Boundary Value Problems *(Spring 2025)*
- Conducted recitations and discussion sections (AMS 510); graded homework, projects, and exams; held office hours.

Instructor / Lecturer Winter 2023, Winter 2024, Summer 2024, **Summer 2025**

- **Courses Taught:**
  - AMS 394 Statistical Laboratory *(Winter 2023; Winter 2024; Summer 2024; **Summer 2025**)*
  - **AMS 326 Numerical Analysis *(Summer 2025)***
- Designed and delivered lectures; created/graded assignments, exams, and projects; mentored students individually.

NYU Courant, New York, NY Jan. 2021 – May. 2022
Recitation Leader

- **Courses:** Mathematics for Economics II *(Spring 2021, Spring 2022)*, Probability, Statistics, and Decision Making *(Fall 2021, Spring 2022)*.
- Led recitations, graded homework/exams, and held office hours.

Grader Fall 2020, Fall 2021

- **Courses:** Analysis *(Fall 2020)*, Special Topic *(Fall 2021)*.

MENTORSHIP & OUTREACH

- **Summer 2025:** Summer advisor for high school students. Guided research leading to **3 submissions to NYSDS** and **2 submissions to MIT URTC**; more details to be updated.

SKILLS & OTHERS

Languages	English (Professional), Chinese (Native)
Technical Skills	Python, Matlab, C++, R