

Fei Cao

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Born: January 13, 1995 in Hubei (China)

Nationality: Chinese

Current position

Visiting Assistant Professor, University of Massachusetts Amherst, Amherst, MA, USA.

Research interests

- Interacting particle systems with applications to econophysics and sociophysics
- Probability theory and related fields (such as gradient-based optimization algorithms)
- Derivation of macroscopic models from microscopic interactions
- Applications of ordinary, partial, and stochastic differential equations

Employment

2022-2025 Visiting Assistant Professor at the University of Massachusetts Amherst
2017-2022 Teaching Assistant at Arizona State University

Education

2017-2022 PH.D in Applied Mathematics, Arizona State University.
2013-2017 BACHELOR in Applied Mathematics, Southwestern University of Finance and Economics.

Publications

2020 F. Cao, S. Motsch, A. Reamy, R. Theisen, *Asymptotic flocking for the three-zone model*, Mathematical Biosciences and Engineering, AIMS Press, 17 (6) (2020) 7692–7707.

- 2021 F. Cao, *K-averaging agent-based model: propagation of chaos and convergence to equilibrium*, Journal of Statistical Physics, Springer, 184 (2) (2021) 1–19.
- 2022 F. Cao, *Explicit decay rate for the Gini index in the repeated averaging model*, Mathematical Methods in the Applied Sciences, 46 (4) (2023) 3583–3596.
- 2023 F. Cao, P-E. Jabin, S. Motsch, *Entropy dissipation and propagation of chaos for the uniform reshuffling model*, Mathematical Models and Methods in Applied Sciences, 33 (4) (2023) 829–875.
- 2023 F. Cao, S. Motsch, *Derivation of wealth distributions from biased exchange of money*, Kinetic & Related Models, 16 (5) (2023) 764–794.
- 2023 F. Cao, S. Motsch, *Uncovering a two-phase dynamics from a dollar exchange model with bank and debt*, SIAM Journal on Applied Mathematics, 83 (5) (2023) 1872–1891.
- 2024 F. Cao, N. Marshall, *From the binomial reshuffling model to Poisson distribution of money*, Networks and Heterogeneous Media, 19(1) (2024) 24–43.
- 2024 F. Cao, R. Cortez, *Uniform propagation of chaos for a dollar exchange econophysics model*, European Journal of Applied Mathematics, (2024) 1–13.

PRE-PRINTS

- 2022 F. Cao, P-E. Jabin, *From interacting agents to Boltzmann-Gibbs distribution of money*, submitted (2022)
- 2023 F. Cao, S. Reed, *A biased dollar exchange model involving bank and debt with discontinuous equilibrium*, submitted (2023)
- 2024 F. Cao, X. Gong, *On the equivalence between Fourier-based and Wasserstein distances for probability measures on \mathbb{N}* , submitted (2024)
- 2024 F. Cao, S. Motsch, *Sticky dispersion on the complete graph: a kinetic approach*, submitted (2024)
- 2024 F. Cao, J. Yang, *Quantitative convergence guarantees for the mean-field dispersion process*, submitted (2024)
- 2024 F. Cao, S. Reed, *The iterative persuasion-polarization opinion dynamics and its mean-field analysis*, submitted (2024)
- 2024 F. Cao, R. Cortez, *Fractal opinions among interacting agents*, submitted (2024)

WORKING IN PROGRESS (INCOMPLETE LIST)

- 2024 J. Brust, M. Badal, F. Cao, S. Motsch, *Natural projected flow: PDE solvers using neural networks* (tentative title).
- 2024 F. Cao, K. Johnston, T. Laurent, J. Li, S. Motsch, *Reverse diffusion from a PDE perspective* (tentative title).

Teaching experience

- 2018 **Teaching Assistant**, *Applied Probability and Stochastic Processes*, Arizona State University
- 2019 **Recitation Instructor**, *Precalculus* (Math 171), Arizona State University
- 2020 **Teaching Assistant**, *Introduction into Deep Neural Networks*, Arizona State University
- 2021 **Teaching Assistant**, *Ordinary Differential Equations*, Arizona State University
- 2022 **Instructor**, *Calculus II*, University of Massachusetts Amherst

2023 **Instructor**, *Ordinary Differential Equations*, University of Massachusetts Amherst
 2024 **Instructor**, *Calculus I*, University of Massachusetts Amherst

Miscellaneous

2023 **Visiting Scholar** in the School of Mathematical and Statistical Sciences at Arizona State University (11/06/2023 - 11/10/2023), hosted by Associate Professor Sebastien Motsch.
 2022 **Visiting Scholar** in the Department of Mathematics at The Pennsylvania State University (02/02/2022 - 02/18/2022), hosted by Professor Pierre-Emmanuel Jabin.
 2022 **Graduate Student Research Award** awarded by School of Mathematical and Statistical Sciences at Arizona State University.
 2023 **REU mentor** during summer 2023, the undergraduate mentee Minh Le is guided to work on gradient descent and related optimization algorithms.

Skills

- **Computer:** \LaTeX
- **Programming:** Julia, Matlab, Python
- **Language:** English (fluent), Chinese (native language), Japanese (basic)

Referee Service for

- Mathematical Modelling of Natural Phenomena
- Methods and Applications of Analysis
- Networks and Heterogeneous Media
- SIAM Journal on Applied Mathematics

Invited Talks

Tufts Ergodic and Dynamical Systems Seminar *Fall 2023*
 Invited talk on November 28, 2023 at Tufts University, Boston, USA.

Conferences and Summer Schools

ICERM Topical Workshop “Robust Optimization and Simulation of Complex Stochastic Systems” *Fall 2024*

Three days workshop on optimization and simulation of stochastic systems at the Institute for Computational and Experimental Research in Mathematics, Rhode Island, USA.

Graduate Student Probability Conference 2024 *Fall 2024*

Two days conference on probability theory at University of Wisconsin–Madison, Madison, USA.

Advances in Probability Theory and Interacting Particle Systems *Summer 2024*

Three days workshop on probability theory and interacting particle systems at Harvard University, Boston, USA.

- 13th Cornell Probability Summer School** *Summer 2024*
Two weeks workshop on probability theory and related fields at Cornell University, Ithaca, USA.
- Recent Progress in Stochastic Analysis and its Applications** *Summer 2024*
One week workshop on stochastic analysis at Loyola University Chicago, Chicago, USA.
- Mathematical Problems in Industry (MPI) Workshop** *Summer 2024*
One week workshop on problems of interest to science and industry at the University of Vermont, Burlington, USA.
- The 52nd John H. Barrett Memorial Lectures** *Summer 2024*
Three days workshop on stochastic analysis and its application at the University of Tennessee, Knoxville, USA.
- ICERM Topical Workshop “Interacting Particle Systems: Analysis, Control, Learning and Computation”** *Spring 2024*
One week workshop on interacting particle systems at the Institute for Computational and Experimental Research in Mathematics, Rhode Island, USA.
- 49th Annual New York State Regional Graduate Mathematics Conference** *Spring 2024*
One day conference on mathematics focusing on graduate research at Syracuse University, Syracuse, USA.
- 2024 Seminar on Stochastic Processes** *Spring 2024*
Three days conference on stochastic processes at Rice University, Houston, USA.
- Probability and Algebra: New Expressions in Mathematics** *Summer 2023*
One week workshop in analysis and probability at Texas A&M University, Texas, USA.
- 21st International Conference on Random Structures & Algorithms** *Summer 2023*
One week conference on random structures and algorithms at Carnegie Mellon University, Pennsylvania, USA.
- Current Developments in Mathematics 2023** *Spring 2023*
Two days conference on mathematics at Harvard University, Boston, USA.
- 2023 Seminar on Stochastic Processes** *Spring 2023*
Three days conference on stochastic processes at University of Arizona, Tucson, USA.
- 2022 Fall Eastern Sectional Meeting** *Fall 2022*
Two days AMS sectional meeting at University of Massachusetts Amherst, Amherst, USA.
- 2022 PIMS-IFDS-NSF Summer School on Optimal Transport** *Summer 2022*
Two weeks summer school on optimal transport at Seattle, Washington, USA.
- 2022 MRC Conference: Data Science at the Crossroads of Analysis, Geometry, and Topology** *Summer 2022*
One week workshop on mathematics, statistics, and related fields at Beaver Hollow Conference Center, Java Center, NY, USA.
- 2022 Seminar on Stochastic Processes** *Spring 2022*
Three days conference on stochastic processes at Lehigh University, Pennsylvania, USA.
- 2021 Frontier Probability Days** *Fall 2021*
Three days conference on probability theory and related fields at University of Nevada, Las Vegas, USA.
- 2021 Blackwell Tapia Conference** *Fall 2021*
Three days conference focusing on diversity in mathematics at UCLA, California, USA.
- 2021 CRM-PIMS Summer School in Probability (Online)** *Summer 2021*
Four weeks graduate summer school at the Mathematical Sciences Research Institute (MSRI), Canada.
- 2021 Summer Program in Partial Differential Equations (Online)** *Summer 2021*

Two weeks of concentrated study of topics in analysis at graduate level, USA.

2021 AMS Short Course on Mathematical and Computational Methods for Complex Social Systems (Online) *Spring 2021*
 Three days short course at the American Mathematical Society (AMS), USA.

2020 Introduction to water waves graduate summer school (Online) *Summer 2020*
 Two weeks graduate summer school at the Mathematical Sciences Research Institute (MSRI), Berkeley, USA.

2020 Summer School: Ergodic Theory via Continued Fractions (Online) *Summer 2020*
 One week graduate summer school at the University of North Carolina Greensboro, North Carolina, USA.

2020 Hot Topics: Optimal transport and applications to machine learning and statistics (Online) *Summer 2020*
 One week workshop at the Mathematical Sciences Research Institute (MSRI), Berkeley, USA.

45-th Annual New York State Regional Graduate Mathematics Conference (Online) *Spring 2020*
 One day conference on mathematics focusing on graduate research at Syracuse University, Syracuse, USA.

2020 Seminar on Stochastic Processes *Spring 2020*
 Three days seminar on stochastic processes at the Michigan State University, Michigan, USA.

2019 AARMS Summer School on Dynamical Systems, Differential Equations, and Special Functions *Summer 2019*
 Four weeks summer school on dynamical systems, differential equations, and special functions at Charlottetown, Prince Edward Island, Canada.

2019 RMMC Summer School on Inverse Problems in Imaging *Summer 2019*
 One week summer school on inverse problems at Laramie, Wyoming, USA.

2019 Interacting Particle Systems, Statistical Mechanics and Related Topics *Spring 2019*
 Three days conference on interacting particle systems at UCLA, California, USA.

2018 Advances in Asymptotic Probability *Winter 2018*
 One week conference on theory of Asymptotic Probability at Stanford, California, USA.

2018 Institute for Advanced Study *Summer 2018*
 IAS/PCMI 2018: Harmonic Analysis, Park City, Utah, USA.

2018 Boston City Limits *Summer 2018*
 Two weeks summer School on Mathematical General Relativity and the Geometric Analysis of Waves of Fluids at MIT, Boston, USA.

Short Course on Free Boundary Problems *Summer 2017*
 Free boundary problems in mathematical finance, Cheng Du, China.

References

Professor Pierre-Emmanuel Jabin

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Professor Nicolas Lanchier

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Associate Professor Sebastien Motsch (Ph.D advisor)

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