



Zhongjian Wang

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Self introduction: For the first thirty years of my life, I am keen on modeling real-world phenomena with math models and developing accurate numerical algorithms to recover and predict them. Now I am seeking a life-changing opportunity to work on more practical math applications in the area of economics, financial markets, and engineering.

EMPLOYMENT

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- **The University of Chicago, Department of Statistics and CCAM** Chicago
William H. Kruskal Instructor, Mentor: Prof. Guillaume Bal 2020-present

EDUCATION

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- **The University of Hong Kong, Department of Mathematics** Hong Kong
Doctor of Philosophy - Supervisor: Prof. Zhang Zhiwen 2016-2020
 - **Tsinghua University, Department of Mathematical Sciences** Beijing
Bachelor of Science 2012-2016

VISITING

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- **Tsinghua University** Beijing
Visiting Ph.D. Student, hosted by Professor Steven Shing Tung Yau 2018.11-19.1
 - **California Institute of Technology** Pasadena
Visiting Ph.D. Student, hosted by Professor Thomas Hou 2018.4-5
 - **Ecole Normale Supérieure** Paris
For Bachelor Thesis, supervised by Professor Espen Robstad Jakobsen 2016.1-6
 - **University of Oxford** Oxford
Tsinghua University Distinguished Newcomer Student Leadership Program 2013.7

AWARDS

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- **Best PhD thesis Award** Hong Kong Mathematical Society 2021
 - **Student Travel Award for UQ20** Department of Mathematics, HKU 2019
 - **Student Travel Award for CSE19** Society for Industrial and Applied Mathematics 2019
 - **Pilot Scheme on International Experience** Faculty of Science, HKU 2017
 - **IPAM Student Travel Support** Institute for Pure & Applied Mathematics, UCLA 2017
 - **Hong Kong Ph.D. Fellowship** Research Grants Council of HK 2016
 - **Scholarship for Academic Excellence** Tsinghua University 2013
 - **Gold Medalist** China Mathematics Olympiad 2012

SERVICES

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- **Captain** UChicago Chinese soccer team 2022
 - **Faculty Sponsor** CAM Grad Student Seminar Chicago, 2021.1-3
 - **Co-organizer** Big Data Challenges for Predictive Modeling of Complex Systems HK, 2018.11
 - **Student Representative** Lap Chee College of HKU HK, 2018-2020
 - **Founding Captain** CSSA HKU soccer team 2018
 - **Journal Referee** Computers and Mathematics with Applications
 - **Memberships** IEEE, SIAM

SKILLS

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- **Language:** Chinese, native speaker; English, proficient; Cantonese, beginner.
 - **Programming:** proficient in Matlab, Python, R; beginner in C++.
 - **Business:** Word, Excel, Powerpoint, LaTeX

PROJECTS

Here I will list some of my research projects that have real world applications.

- **Inverse Problems**

since 2020

Role: theoretic analysis, programming.

The project aims to find initial condition / source of parabolic PDE. Our studies give the optimal choice of regularization factor during inversion. The methodologies applies to any time evolution models that need to find starting (or intermediate) state from noisy observation of final state.

Main collaborator: Wenlong Zhang at SusTech.

- **Machine Learning Algorithms**

since 2018

Role: model development, algorithm development, programming.

There are several projects on this topic. The common goal of these projects is to utilize the newly introduced machine learning algorithms to solve math problems. We are interested in developing a new network that best fits the inherent structures preserved by the models. Related real-world models include the Cucker-Smale model which describes the flocking behaviors of sheep and people; the Keller Segel model to describe the formulation of the tumor, etc.

Collaborators: Jack Xin at UCI, Zhiwen Zhang at HKU, Yuehaw Khoo at UChicago

- **Non-Linear Filtering**

since 2017

Role: algorithm development, programming

The name of non-linear filtering comes from the non-linearity of the dynamics and the observations. The posterior of the state is no longer Gaussian and hence we cannot use two statistics (mean and standard derivation) to fully describe it. Zakai equation is a PDE of the posterior density function. Our projects are to design fast algorithms to solve it in a real-time manner. These projects find applications in the real-time detection of the signal, especially when the observation is non-linear.

Collaborators: Stephen Shing-Tung Yau at Tsinghua

- **Monte Carlo simulation**

since 2015

Role: theoretic analysis, programming.

This is the main line of my research ever since my undergrad. I am interested in the accuracy of the long-time Monte Carlo simulation. The theme of every project is to develop SDE schemes that can simulate dynamics for infinite time without accumulation of error. In this way, we can characterize features of dynamic flows without solving PDEs.

Applications of Monte Carlo simulation include, option pricing, weather prediction, etc.

Collaborators: Jack Xin at UCI, Zhiwen Zhang at HKU

PUBLICATIONS

(Names in Math papers are arranged in alphabetical order.)

1. Li, S., Wang, Z., Yau, S. S. T., Zhang, Z., Tensor train method for high-dimensional nonlinear filtering problems, IEEE Transactions on Automatic Control, 2023.
2. Wang, Z., Xin, J., Zhang, Z., DeepParticle: learning invariant measure by a deep neural network minimizing Wasserstein distance on data generated from an interacting particle method, Journal of Computational Physics (2022): 111309.
3. Wang, Z., Xin, J., Zhang, Z., Computing effective diffusivities in 3D time-dependent chaotic flows with a convergent Lagrangian numerical method, ESAIM: M2AN 56 (2022) 15211544
4. Lyu, J., Wang, Z., Xin, J., Zhang, Z., A convergent interacting particle method and computation of KPP front speeds in chaotic flows, SIAM Journal on Numerical Analysis, 2022, 60(3): 1136-1167
5. Wang, Z., Xin, J., Zhang, Z., Sharp uniform in time error estimate on a stochastic structure-preserving Lagrangian method and computation of effective diffusivity in 3D chaotic flows, Multiscale Model and Simulation, 19 (2021), no. 3, 11671189
6. Lyu, J., Wang, Z., Xin, J., Zhang, Z., Convergence of stochastic structure-preserving schemes for computing effective diffusivity in random flows, SIAM Journal on Numerical Analysis, 58 (2020), no. 5, 30403067. .
7. Wang, Z., Zhang, Z., A new mesh-free method for PDE with discontinuous coefficients using the deep learning approach, Journal of Computational Physics (2020): 108963.
8. Wang, Z. Luo, X., Yau, S. S. T., Zhang, Z., Proper orthogonal decomposition method to nonlinear filtering problems in medium-high dimension, IEEE Transactions on Automatic Control, 65 (2020), no. 4, 16131624.
9. Wang, Z., Xin, J., Zhang, Z., Computing Effective Diffusivity of Chaotic and Stochastic Flows Using Structure-Preserving Schemes. SIAM Journal on Numerical Analysis, 56(4), 2322-2344.