Zhongjian Wang

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Employment

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

Education

- **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*

Research Interests

Applied analysis and computational methods for physics and engineering problems, including but not limited to,

- **structure preserving schemes:** Lagrangian approach for effective diffusivities, KPP front wave speed; scattering in topological insulators;
- **neuron net models:** transport maps, multiscale physic problems, scattering matrices;
- **data-driven model reduction:** conditional density function in filtering, uniform accuracy schemes in time integration, inverse problems.

Awards and Scholarships

- **Best PhD thesis Award** Hong Kong Mathematical Society *2021*
- **Student Travel Award for UQ20** Society for Industrial and Applied Mathematics *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*

Publications

- **Published and Accepted**

1. Li, S., Wang, Z., Yau, S. S. T., Zhang, Z.,Tensor train method for high-dimensional nonlinear filtering problems *(IEEE TAC, to appear)*
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 coeffcients 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.

- **Preprints and Under-preparation**

1. Wang, Z., Zhang W., Zhang Z., A data-driven model reduction method for parabolic inverse source problems and its convergence analysis *(arXiv:2110.07676)*

2. Wang, Z., T. Hou, Zhang, Z.A class of robust numerical methods for solving dynamical systems with multiple time scales *(arXiv:1909.04289)*
3. Bal, G., Hoskins, J.G., Wang Z., Transport in Dirac models for topological insulators *(arXiv:2206.08847)*
4. Wang, Z., Xin, J., Zhang Z.,A DeepParticle method for learning and generating aggregation patterns in multi-dimensional Keller-Segel chemotaxis systems *(arXiv:2209.00109)*
5. Cui, T., Wang, Z., Zhang, Z., A variational neural network approach for glacier modelling with nonlinear rheology *(arXiv:2209.02088)*
6. Chen, B., Bal, G., Wang, Z. One Dimensional Mixed Type Generalized Kimura Type Operator *(arXiv:2210.10037)*
7. Xie, Y., Wang, Z., Zhang, Z., Random block coordinate descent methods for computing optimal transport and convergence analysis *(arXiv:2212.07046)*
8. Wang, Z., Zhang W., Zhang Z., Stochastic convergence of regularized solutions for backward heat conduction problems
9. Non-convergence tests for trajectory averages of ergodic Markov chains and diffusions

- **Dissertations**
  1. Robust Lagrangian Numerical Schemes in Computing Effective Diffusivities for Chaotic and Random Flows, *Ph.D. Thesis, advisor: Prof. Zhiwen Zhang at HKU*
  2. Convergence analysis of strong approximation to stochastic differential equation, *Bachelor Thesis, advisor: Prof. Espen Robstad Jakobsen at ENS*

Names in Math papers are arranged in alphabetical order. For the most recent updates, please refer to the Google Scholar or ORCiD: 0000-0002-5954-2483.

Teaching Experiences

- **The University of Chicago**
  Lecturer of undergraduate and graduate courses *2020-present*
  - **STAT31120 Numerical Methods for Stochastic Differential Equations**
    20/21 Spring, 21/22 Winter, 21/22 Autumn
  - **STAT251 Introduction to Probabilities**
    20/21 Autumn, 21/22 Spring
  - **MATH185 Mathematical Methods in the Physical Sciences (III, ODE)**
    21/22 Winter
- **The University of Hong Kong**
  Tutor of undergraduate courses *2016-2020*
  - **Certificate** I was awarded the Certificate of Teaching and Learning in Higher Education from HKU Center of the Enhancement of Teaching and Learning in 2016.
  - **MATH3601 Numrical analysis:** 18/19 Fall, 19/20 Fall
  - **MATH4602 Scientific computing:** 17/18 Spring, 18/19 Spring
  - **MATH2014 Multivariable calculus and linear algebra:** 17/18 Fall
  - **MATH1009 Basic mathematics for business and economics:** 16/17 Fall, 17/18 Fall
- **Co-Supervising Students**
  - **Boyi Hu** with Zhiwen Zhang
  - **Raphaël Terrine** with Guillaume Bal
  - **Tan Zhang** with Zhiwen Zhang
  - **Binglu Chen** with Guillaume Bal

Visiting Experiences

- **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 Superieure** 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*

Research Presentations

- **DeepParticle: learning measure by a deep neural network minimizing Wasserstein distance on data generated from interacting particle methods**
  - Special Research Seminar, NUS *Singapore, 2022.12*
  - Research Seminar, NTU *Singapore, 2022.12*
  - Young Mathematician Workshop on Computational and Applied Mathematics, BiCMR *Remote, 2022.11*
  - CAM Research Seminar, YMSC *Remote, 2022.11*
  - Applied Mathematics Seminar, IIT *Chicago, 2022. 7*
  - Applied Mathematics Seminar, SusTech *Remote, 2022. 7*
- **Tensor train method for high-dimensional nonlinear filtering problems**
  - SIAM Conference on Uncertainty Quantification (UQ22) *Atlanta, 2022. 4*
- **A convergent interacting particle method and computation of KPP front speeds**
  - CCAM Seminar, Purdue University *IN, 2021.11*
  - Applied Math Seminar, BUAA *Beijing, 2021.11*
- **A Robust Lagrangian Scheme in Computing Effective Diffusivities**
  - Applied Mathematics Seminar, IIT *Chicago, 2020.12*
  - CAM Colloquium, UChicago *Chicago, 2020.10*
  - Applied Mathematics Seminar, Cermics ENPC *Paris, 2020. 3*
  - Special Applied Mathematics Colloquium, Columbia University *New York, 2020. 1*
  - posters: International Congress on Industrial and Applied Mathematics (ICIAM 2019), Valencia, 2019. 7; SIAM Conference on Computational Science and Engineering (CSE19), Spokane, 2019.2; The 12th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Taibei, 2018.7; IPAM Workshop IV of Complex High-Dimensional Energy Landscape, Los Angeles, 2017.11
- **POD method to nonlinear filtering problems in medium-high dimension**
  - The 8th International Congress of Chinese Mathematicians (ICCM 2019) *Beijing, 2019. 6*
- **A new mesh-free method for PDE with discontinuous coeffcients using the deep learning approach**
  - poster: Big Data Challenges for Predictive Modeling of Complex Systems, Hong Kong, 2018.11

Professional Service

- **Faculty Sponsor** CAM Grad Student Seminar *Chicago, 2021.1-3*
- **Co-organizer** Big Data Challenges for Predictive Modeling of Complex Systems *HK, 2018.11*
- **Journal Referee** Computers and Mathematics with Applications, Journal of Computational Physics
- **Memberships** IEEE, SIAM

Reference letters

- **Guillaume Bal** University of Chicago, guillaumebal@uchicago.edu
- **Jeremy Hoskins** University of Chicago, jeremyhoskins@uchicago.edu
- **Thomas Hou** California Institute of Technology, hou@cms.caltech.edu
- **Mary Silber** University of Chicago, msilber@uchicago.edu *(teaching)*
- **Jack Xin** University of California, Irvine, jxin@math.uci.edu
- **Zhiwen Zhang** University of Hong Kong, zhangzw@hku.hk