Zheng **Ma**

Tenure-track Associate Professor of Mathematcs

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Positions

Shanghai Jiao Tong University — *Shanghai, China*

Tenure-track Associate Professor of Mathematics — *Sep. 2020 – Present*

- Joint with Institute of Natural Sciences

Purdue University — *West Lafayette, USA*

Golomb Visiting Assistant Professor of Mathematics — *Aug. 2017 – Jul. 2020*

- Mentor: Jingwei Hu

University of Wisconsin Madison — *Madison, USA*

Visiting Scholar of Mathematics Department — *Feb. 2015 – Dec. 2015*

- Collaborator: Shi Jin

Education

Shanghai Jiao Tong Univeristy — *Shanghai, China*

Ph.D. in Computational Mathematics — *Sep. 2012 – July. 2017*

- Dissertation: Numerical Methods for Transport Equations and Wave Propagations with Multiple Scales and Uncertainty
- Advisor: Prof. Shi Jin

Zhiyuan College, Shanghai Jiao Tong Univeristy — *Shanghai, China*

B.S. in Mathematics and Applied Mathematics — *Sep. 2008 – July. 2012*

- Minor: Applied Physics
- Thesis: The WENO Scheme for Liouville Equation of Geometrical Optics with Discontinuous Local Wave Speeds
- Advisor: Prof. Shi Jin

Awards

Academic Related

2019 **Best Article Awards**, Celebrating the 5th anniversary of Research in the Mathematical Sciences

Others

2017 **Outstanding Ph.D. Graduates Awards**, Shanghai Jiao Tong University

Publications

Journal Articles

[1] **Phase Diagram for Two-layer ReLU Neural Networks at Infinite-width Limit**
T. Luo, Z.-Q. J. Xu, Z. Ma, Y. Zhang
Jounral of Machine Learning Research 22 (2021) pp. 1–47. 2021.

[2] **A Linear Frequency Principle Model to Understand the Absence of Overfitting in Neural Networks**
Y. Zhang, T. Luo, Z. Ma, X. Z.-Q. John
Chinese Physical Letters 38 (2021). 2021.

[3] **Fourier-domain Variational Formulation and Its Well-posedness for Supervised Learning**
T. Luo, Z. Ma, Z. Wang, Z.-Q. J. Xu, Y. Zhang
Preprint, 2020.

[4] **On the exact computation of linear frequency principle dynamics and its generalization**
T. Luo, Z. Ma, Z.-Q. J. Xu, Y. Zhang
Preprint, 2020.

[5] **Frequency Principle: Fourier Analysis Sheds Light on Deep Neural Networks**
Z.-Q. J. Xu, Y. Zhang, T. Luo, Y. Xiao, Z. Ma
Communications in Computational Physics (CiCP) 28.5 (2020) pp. 1746–1767. 2020.

[6] **Uniformly accurate machine learning-based hydrodynamic models for kinetic equations**
J. Han, C. Ma, Z. Ma, W. E
Proceedings of the National Academy of Sciences (PNAS) 116.44 (2019) pp. 21983–21991. 2019.

[7] **A Fast Spectral Method for the Inelastic Boltzmann Collision Operator and Application to Heated Granular Gases**
J. Hu, Z. Ma
Journal of Computational Physics 385 (2019) pp. 119–134. 2019.

[8] **Theory of the Frequency Principle for General Deep Neural Networks**
T. Luo, Z. Ma, Z.-Q. J. Xu, Y. Zhang
Preprint, 2019.

[9] **The Discrete Stochastic Galerkin Method for Hyperbolic Equations with Non-smooth and Random Coeffi cients**
S. Jin, Z. Ma
Journal of Scientific Computing 74.1 (Jan. 2018) pp. 97–121. 2018.

[10] **Uniform Spectral Convergence of the Stochastic Galerkin Method for the Linear Transport Equations with Random Inputs in Diffusive Regime and a Micro-Macro Decomposition-Based Asymptotic-Preserving Method**
S. Jin, J.-G. Liu, Z. Ma
Research in the Mathematical Sciences 4.1 (Aug. 2017) p. 15. 2017.

[11] **Explicit and Implicit TVD Schemes for Conservation Laws with Caputo Derivatives**
J.-G. Liu, Z. Ma, Z. Zhou
Journal of Scientific Computing 72.1 (July 2017) pp. 291–313. 2017.

[12] **An Improved Semi-Lagrangian Time Splitting Spectral Method for the Semi-classical Schrödinger Equation with Vector Potentials Using NUFFT**
Z. Ma, Y. Zhang, Z. Zhou
Applied Numerical Mathematics 111 (2017) pp. 144–159. 2017.

Conference Proceedings

[1] **A type of generalization error induced by initialization in deep neural networks**
Y. Zhang, Z.-Q. J. Xu, T. Luo, Z. Ma
Proceedings of The First Mathematical and Scientific Machine Learning Conference (MSML), 2020, Princeton University, Princeton, NJ, USA.

[2] **Explicitizing an Implicit Bias of the Frequency Principle in Two-layer Neural Networks**
Z.-Q. J. Xu, Y. Zhang, T. Luo, Z. Ma
Preprint, 2019.

Talks

The Second Young Researcher Workshop on the Mathematic Foundation of Machine Learning — *Beijing, China*
BAAI Workshop — *Dec. 2020*
- Title: Uniformly accurate machine learning-based hydrodynamic models for kinetic equations

Mathematic Foundation and Applications of Deep Learning — *Changsha, China*
CSIAM 2020 — *Oct. 2020*
- Title: Uniformly accurate machine learning-based hydrodynamic models for kinetic equations

Innovative Trends in the Numerical Analysis & Simulation of Kinetic Equations — *Oberwolfach, Germanny*
Oberwolfach Mini-Workshop — *Dec. 2018*
- Title: A Fast Spectral Method for the Inelastic Boltzmann Collision Operator

The 10th International Conference on Computational Physics — *Macao, China*
Mini-Symposium on Numerical Simulation and Mathematical Modeling of Kinetic Equations — *Jan. 2017*
- Title: Uncertainty Quantification for Linear Transport Equation with Random Inputs: Analysis and Numerics

XVI International Conference on Hyperbolic Problems: Theory Numerics, Applications — *Aachen, Germanny*
Session on UQ/Stochastic — *Aug. 2016*
- Title: Uncertainty Quantification for Conservation Laws: A Discrete Stochastic Galerkin Approach

Teaching

MA303 (Differential Equations and Partial Differential Equations for Engineering and the Sciences)

Purdue University

Instructor

Fall 2019

- Textbook: Differential Equations and Boundary Value Problems C & M

MA266 (Ordinary Differential Equations)

Purdue University

Instructor

Fall 2017 – Spring 2019

- Textbook: Differential Equations and Boundary Value Problems