

Zheng Ma

TENURE-TRACK ASSOCIATE PROFESSOR OF MATHEMATICS

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Positions

Shanghai Jiao Tong University

TENURE-TRACK ASSOCIATE PROFESSOR OF MATHEMATICS

- Joint with Institute of Natural Sciences

Shanghai, China

Sep. 2020 – Present

Purdue University

GOLOMB VISITING ASSISTANT PROFESSOR OF MATHEMATICS

- Mentor: Jingwei Hu

West Lafayette, USA

Aug. 2017 – Jul. 2020

University of Wisconsin Madison

VISITING SCHOLAR OF MATHEMATICS DEPARTMENT

- Collaborator: Shi Jin

Madison, USA

Feb. 2015 – Dec. 2015

Education

Shanghai Jiao Tong University

PH.D. IN COMPUTATIONAL MATHEMATICS

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

Shanghai, China

Sep. 2012 – July. 2017

Zhiyuan College, Shanghai Jiao Tong University

B.S. IN MATHEMATICS AND APPLIED MATHEMATICS

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

Shanghai, China

Sep. 2008 – July. 2012

Publications

PREPRINTS

- [1] A Micro-Macro Decomposition-Based Asymptotic-Preserving Random Feature Method for Multiscale Radiative Transfer Equations**
J. CHEN, Z. MA, K. WU
arXiv: 2411.04643, 2024.
- [2] ODE-DPS: ODE-based Diffusion Posterior Sampling for Inverse Problems in Partial Differential Equation**
E. JIANG, J. PENG, Z. MA, X.-B. YAN
arXiv: 2404.13496, 2024.
- [3] Capturing Shock Waves by Relaxation Neural Networks**
N. ZHOU, Z. MA
arXiv: 2404.01163, 2024.
- [4] An Unsupervised Deep Learning Approach for the Wave Equation Inverse Problem**
X.-B. YAN, K. WU, Z.-Q. J. XU, Z. MA
arXiv: 2311.04531, 2023.
- [5] Explicitizing an Implicit Bias of the Frequency Principle in Two-layer Neural Networks**
Z.-Q. J. XU, Y. ZHANG, T. LUO, Z. MA
arXiv: 1905.10264, 2019.

JOURNAL ARTICLES

- [1] Bayesian Inversion with Neural Operator (BINO) for modeling subdiffusion: Forward and inverse problems**
X.-B. YAN, Z.-Q. J. XU, Z. MA
Journal of Computational and Applied Mathematics 454 (2025) p. 116191. 2025.
- [2] Asymptotic-Preserving Neural Networks for Multiscale Kinetic Equations**
S. JIN, Z. MA, K. WU

- [3] **Asymptotic-Preserving Neural Networks for Multiscale Vlasov-Poisson-Fokker-Planck System in the High-Field Regime**
S. JIN, Z. MA, T.-A. ZHANG
Journal of Scientific Computing 99.3 (2024) p. 61. 2024.
- [4] **Capturing the diffusive behavior of the multiscale linear transport equations by Asymptotic-Preserving Convolutional DeepONets**
K. WU, X.-B. YAN, S. JIN, Z. MA
Computer Methods in Applied Mechanics and Engineering 418 (2024) p. 116531. 2024.
- [5] **Laplace-fPINNs: Laplace-Based Fractional Physics-Informed Neural Networks for Solving Forward and Inverse Problems of a Time Fractional Equation**
X.-B. YAN, Z.-Q. J. XU, Z. MA
East Asian Journal on Applied Mathematics 14.4 (2024) pp. 657–674. 2024.
- [6] **Asymptotic-Preserving Neural Networks for Multiscale Time-Dependent Linear Transport Equations**
S. JIN, Z. MA, K. WU
Journal of Scientific Computing 94.3 (2023) p. 57. 2023.
- [7] **Heat flux estimation of the cylinder in hypersonic rarefied flow based on neural network surrogate model**
D. DING, H. CHEN, Z. MA, B. ZHANG, H. LIU
AIP Advances 12.8 (2022) p. 085314. 2022.
- [8] **On the Exact Computation of Linear Frequency Principle Dynamics and Its Generalization**
T. LUO, Z. MA, Z.-Q. J. XU, Y. ZHANG
SIAM Journal on Mathematics of Data Science 4.4 (2022) pp. 1272–1292. 2022.
- [9] **MOD-Net: A Machine Learning Approach via Model-Operator-Data Network for Solving PDEs**
L. Z. L. ZHANG, T. L. T. LUO, Y. Z. Y. ZHANG, W. E. W. E, Z.-Q. J. X. Z.-Q. J. XU, Z. M. Z. MA
Communications in Computational Physics 32.2 (2022) pp. 299–335. 2022.
- [10] **Theory of the Frequency Principle for General Deep Neural Networks**
T. LUO, Z. MA, Z.-Q. J. XU, Y. ZHANG
CSIAM Transactions on Applied Mathematics 2.3 (2021) pp. 484–507. 2021.
- [11] **Phase Diagram for Two-layer ReLU Neural Networks at Infinite-width Limit**
T. LUO, Z.-Q. J. XU, Z. MA, Y. ZHANG
Journal of Machine Learning Research 22 (2021) pp. 1–47. 2021.
- [12] **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.
- [13] **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.
- [14] **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.
- [15] **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.
- [16] **The Discrete Stochastic Galerkin Method for Hyperbolic Equations with Non-smooth and Random Coefficients**
S. JIN, Z. MA
Journal of Scientific Computing 74.1 (Jan. 2018) pp. 97–121. 2018.
- [17] **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.
- [18] **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.
- [19] **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

CONFERENCE PROCEEDINGS

[1] **An Upper Limit of Decaying Rate with Respect to Frequency in Deep Neural Network**

T. LUO, Z. MA, Z. WANG, Z.-Q. J. XU, Y. ZHANG

Proceedings of Mathematical and Scientific Machine Learning, 2022.

[2] **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.

BOOK CHAPTERS

[1] **Recent Development in Kinetic Theory of Granular Materials: Analysis and Numerical Methods**

J. A. CARRILLO, J. HU, Z. MA, T. REY

Trails in Kinetic Theory: Foundational Aspects and Numerical Methods, 2021, Cham.

Postdocs and Ph.D. Students

FORMER

Xiongbin Yan

Shanghai Jiao Tong University

POSTDOC

Sep. 2022 – Jun. 2024

- First position after postdoc: School of Mathematics and Statistics, Lanzhou University

Keke Wu

Shanghai Jiao Tong University

PH.D.

Sep. 2021 – Jun. 2024

- First position after Ph.D.: Suzhou Institute for Advanced Research, University of Science and Technology of China

CURRENT

Yekun Zhu

Shanghai Jiao Tong University

PH.D.

Sep. 2021 – Present

Chen Min

Shanghai Jiao Tong University

PH.D.

Sep. 2022 – Present

Nan Zhou

Shanghai Jiao Tong University

PH.D.

Sep. 2022 – Present

Teaching

Scientific Computing, Numerical Analysis, Introduction to Machine Learning

Shanghai Jiao Tong University

INSTRUCTOR

Fall 2020 –

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

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