

Yi Zhu (朱毅)

Curriculum Vitae

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Education

- 2003–2008 **Ph.D. in Mathematics**, *Tsinghua University*
1999–2003 **B.S. in Mathematics**, *Tsinghua University*

Academic Experience

- 2024–present **Professor**, *Yau Mathematical Sciences Center, Tsinghua University*
2024–present **Professor (adjunct)**, *Beijing Institute of Mathematical Sciences and Applications*
2021–2023 **Associate Professor (adjunct)**, *Beijing Institute of Mathematical Sciences and Applications*
2020–2023 **Associate Professor**, *Yau Mathematical Sciences Center, Tsinghua University*
2011–2019 **Associate Professor**, *Zhou Pei-Yuan Center for Applied Mathematics, Tsinghua University*
2008–2011 **Instructor & Postdoctoral Researcher**, *Department of Applied Mathematics, University of Colorado-Boulder*

Academic Services

- 2020–present **Studies in Applied Mathematics**, *Associate Editor*
2024–present **Journal of Nonlinear Waves**, *Associate Editor*

Grants and Awards

- PI National Natural Science Foundation of China, NSFC-DFG Joint Research Program, 2026-2029
PI National Key R&D Program of China, 2021-2026
2021 **National Youth Top Talent Program**, *China*
PI National Natural Science Foundation of China, 2019-2022
PI National Natural Science Foundation of China, 2013-2015
PI Tsinghua University Initiative Scientific Research Program, 2012-2015
Co-PI Tsinghua University Initiative Scientific Research Program, 2014-2016

Research Interest

I am broadly interested in applied mathematics, including

- Applied Analysis—mathematical modeling and analysis for topological materials, nonlinear optics, non-equilibrium thermodynamics, fluids etc.
- Scientific Computing—numerical methods for material sciences, wave motion, fluids etc.
- Machine Learning—numerical solver for direct and inverse problems based on artificial neural networks.

Publications

Published

- *Zero-energy Edge States of Tight-Binding Models for Generalized Honeycomb-Structured Materials* (with B. Miao), **Commun. Math. Phys.**, to appear
- *Nonlinear Tension Effects on an Infinite Elastic Plate Loaded with a Linear Shear Current* (with Y. Jiang, E. Parau and Z. Wang), **SIAM J. Appl. Math.**, to appear
- *STWCR: Weak collocation regression for revealing hidden stochastic dynamics from single trajectory data* (with Y. Jiang, Z. Zeng, W. Yang, L. Hong and P. Hu), **Appl. Math. Comput.** 521 (2026) 129958
- *Reconstruction of dynamical systems from data without time labels* (with Z. Zeng, P. Hu, C. Bao and Z. Shi), **Commun. Comput. Phys.**, 39 (2026) 941-968
- *Weak Collocation Networks: a deep learning approach to reconstruct stochastic dynamics from aggregate data* (with Z. Chen, Z. Zeng and P. Hu), **Commun. Nonlinear Sci. Numer. Simul.**, 152 (2026), 109360
- *Potential Score Matching: Debiasing Molecular Structure Sampling with Potential Energy Guidance* (with L. Guo, Z. Wang, C. Liu, J. Li, P. Hu), **Transactions on Machine Learning Research** 2025
- *Existence of three-fold Weyl points in generic admissible potentials* (with Y. Cao, H. Guo and Z. Ye), **J. Math. Phys.**, 66 (2025), 081505
- *Multi-Agent Relative Investment Games in a Jump Diffusion Market with Deep Reinforcement Learning Algorithm* (with L. Lu, R. Hu and X. Yang), **SIAM J. Financial Math.**, 16 (2025), 707–746
- *Weak Collocation Regression for Inferring Stochastic Dynamics with Levy Noise* (with L. Guo, L. Lu, Z. Zeng and P. Hu), **Commun. Comput. Phys.**, 37 (2025), 1277-1304
- *Edge states in super honeycomb structures with PT symmetric deformations* (with Y. Cao), **SIAM Math. Anal.**, 57 (2025), 2384–2415
- *Dissipative gap solitons and vortices in moiré optical lattices* (with L. Wang, Z. Yan, and J. Zeng), **National Science Open**, 3 (2024), 20240011
- *Temporal Difference Learning for High-Dimensional PIDEs with Jumps* (with L. Lu, H. Guo and X. Yang), **SIAM J. Sci. Comput.** 46 (2024), C349-C368

- *Generalized Honeycomb-Structured Materials in the Subwavelength Regime* (with B. Miao), **SIAM J. Appl. Math.** 84 (2024), 1116-1139
- *Weak Collocation Regression method: fast reveal hidden stochastic dynamics from high-dimensional aggregate data* (with L. Lu, Z. Zeng, Y. Jian and P. Hu), **J. Comp. Phys.** 502 (2024), 112799
- *Fundamental and dipole gap solitons and their dynamics in the cubic–quintic fractional nonlinear Schrödinger model with a PT -symmetric lattice* (with L. Wang and J. Zeng), **Physica D** 465 (2024) , 134144
- *Entropy structure informed learning for solving inverse problems of differential equations* (with Y. Jiang, W. Yang and L. Hong), **Chaos, Solitons & Fractals** 175 (2023) 114057
- *Double Conical degeneracy on the band structure of periodic Schrödinger operators* (with Y. Cao), **(SIAM) Multiscale. Model. Simul.** 21 (2023) 1147–1169
- *Traveling edge states in massive Dirac equations along slowly varying edges* (with P. Hu and P. Xie), **IMA J. Appl. Math.** 88 (2023), 455–471
- *Integrable nonlocal derivative nonlinear Schrödinger equations* (with M. Ablowitz, X. Luo and Z. Musslimani), **Inverse Problems** 38 (2022), 065003
- *Three-fold Weyl points in the Schrödinger operator with periodic potentials* (with H. Guo and M. Zhang), **SIAM Math. Anal.** 54 (2022), 3654-3695
- *Revealing hidden dynamics from time-series data by ODENet* (with P. Hu, W. Yang, L. Hong), **J. Comp. Phys.**, 465(2022), 111203
- *Unfitted Nitsche’s method for computing wave modes in topological materials* (with H. Guo and X. Yang), **J. Sci. Comput.** 88 (2021), 24
- *Unfitted Nitsche’s method for computing band structures in phononic crystals with impurities* (with H. Guo and X. Yang), **Comput. Methods Appl. Mech. Engrg.** 380 (2021), 113743
- *Wave packets in the fractional nonlinear Schrödinger equation with a honeycomb potential* (with P. Xie), **(SIAM) Multiscale. Model. Simul.** 19 (2021), 951-979
- *When machine learning meets multiscale modeling in chemical reactions* (with W. Yang, L. Peng and L. Hong), **J. Chem. Phys.** 153 (2020), 094117, **Featured & Cover Article**
- *Linear and nonlinear wave dynamics in modulated honeycomb media* (with P. Hu and L. Hong), **Stud. Appl. Math.** 144 (2020), 18-45
- *Wave-packet dynamics in slowly modulated photonic graphene* (with P. Xie), **J. Differential Equations** 267 (2019), 5775-5808
- *Elliptic operators with honeycomb symmetry: Dirac points, edge states and applications to photonic graphene* (with J. P. Lee-Thorp and M. I. Weinstein), **Arch. Rational Mech. Anal.** 232 (2019), 1-63
- *Bloch theory-based gradient recovery method for computation of edge mode in photonic graphene* (with H. Guo and X. Yang), **J. Comp. Phys.** 379 (2019), 403-420
- *Generalized Onsager’s reciprocal relations for the master and Fokker-Planck equations* (with L. Peng and L. Hong), **Phys. Rev. E** 97 (2018), 062123

- *The Markov process admits a consistent steady-state thermodynamic formalism* (with L. Peng and L. Hong), **J. Math. Phys.** 59 (2018), 013302
- *Local bifurcation of electrohydrodynamic waves on a conducting fluid* (with Z. Lin and Z. Wang), **Phys. Fluids** 29 (2017), 032107
- *Transport properties in the photonic super-honeycomb lattice—a hybrid fermionic and bosonic system* (with H. Zhong, Y. Zhang, et al), **Ann. Phys.** 529 (2017), 1600258
- *Novel dissipative properties of the master equation* (with L. Hong, J. Chen and W.-A. Yong), **J. Math. Phys.** 57 (2016), 103303
- *PT symmetry in a fractional Schrödinger equation* (with Y. Zhang, H. Zhong, M. R. Belic et al), **Laser Photon. Rev.** 10(2016), 526-531
- *A novel construction of thermodynamically compatible models and its correspondence with Boltzmann-equation-based moment-closure hierarchies* (with L. Hong, Z. Yang and W.-A. Yong), **J. Non-Equil Thermodynamics** 40 (2015), 247-256
- *Conservation-dissipation formalism for non-equilibrium thermodynamics* (with L. Hong, Z. Yang and W.-A. Yong), **J. Non-Equil Thermodynamics** 40 (2015), 67-74
- *Dynamics in PT-symmetric honeycomb lattices with nonlinearity* (with C. W. Curtis), **Stud. Appl. Math.** 135 (2015), 139-170
- *Unveiling pseudospin and angular momentum in photonic graphene* (with D. Song, V. Paltoglou et al), **Nat. Commun.** 6 (2015), 6272
- *Direct observation of pseudospin-mediated vortex generation in photonic graphene* (D. Song, L. Tang, S. Liu, et al), In **CLEO:EELS Fundamental Science**, 2014
- *Nonlinear wave packets in deformed honeycomb lattices* (with M. J. Ablowitz), **SIAM J. Appl. Math.** 73 (2013), 1959-1979
- *Nonlinear Dynamics of Bloch Wave Packets in Honeycomb Lattices* (with M. J. Ablowitz), in book "Spontaneous Symmetry Breaking, Self-Trapping, and Josephson Oscillations" **Progress in Optical Science and Photonics** 1 (2013), 1-26
- *Localized nonlinear edge states in honeycomb lattices* (with M. J. Ablowitz and C. W. Curtis), **Phys. Rev. A** 88 (2013), 13850.
- *Unified orbital description of the envelope dynamics in two-dimensional simple periodic lattices* (with M. J. Ablowitz), **Stud. Appl. Math.** 131 (2013), 41-71
- *Nonlinear dynamics of wave packets in parity-time-symmetric optical lattices near the phase transition point* (with S.D. Nixon and J. Yang), **Opt. Lett.** 37 (2012), 4874-4876
- *On Tight binding approximations in optical lattice* (with M. J. Ablowitz and C. W. Curtis), **Stud. Appl. Math.** 129 (2012), 362-388
- *Nonlinear waves in shallow honeycomb lattices* (with M. J. Ablowitz), **SIAM J. Appl. Math.** 72 (2012) 240-260
- *Scalable Misbehavior Detection in Online Video Chat Services* (with X. Xing, Y. Liang, et al), **Proceedings of the 18th ACM SIGKDD international conference on Knowledge discovery and data mining** 2012, 552-560

- *Nonlinear diffraction in photonic graphene* (with M. J. Ablowitz), **Opt. Lett.** 36 (2011), 762-3764
- *Nonlinear wave dynamics: from lasers to fluids* (with M. J. Ablowitz, T. S. Haut, T. P. Horikis and S. D. Nixon), **Discrete Contin. Dyn. Syst. S** 4 (2011), 923 - 955
- *Evolution of Bloch-mode envelopes in two-dimensional generalized honeycomb lattices* (with M. J. Ablowitz), **Phys. Rev. A** 82 (2010), 013840
- *Conical diffraction in honeycomb lattices* (with M.J. Ablowitz and S. D. Nixon), **Phys. Rev. A** 79 (2009), 053830
- *Asymptotic analysis of pulse dynamics in mode-locked lasers* (with M. J. Ablowitz, T. P. Horikis and S. D. Nixon), **Stud. Appl. Math.** 122 (2009), 411-425
- *Separatrix map analysis for fractal scatterings in weak solitary wave interactions* (with J. Yang and R. Haberman), **Stud. Appl. Math.** 122 (2009), 449-483
- *A universal separatrix map for weak interactions of solitary waves in generalized nonlinear Schrödinger equations* (with J. Yang and R. Haberman), **Physica D** 237 (2008), 2411-2422
- *Universal map for fractal structures in weak interactions of solitary waves* (with J. Yang and R. Haberman), **Phys. Rev. Lett.** 100(2008), 143901
- *Universal fractal structures in the weak interaction of solitary waves in generalized nonlinear Schrödinger equations* (with J. Yang), **Phys. Rev. E** 75 (2007), 036605

Preprints

- *Deep-Picard Iteration for Space-time Fractional Diffusion PDEs* (with Z. Zeng, Z. Chen and L. Qin) arXiv:2605.00456
- *Neural Continuous-Time Markov Chain: Discrete Diffusion via Decoupled Jump Timing and Direction* (with J. Li, X. Jiang, F. Wen, W. Liu, R. Luo, Z. Shi and P. Hu) arXiv:2604.15694
- *An Actor-Critic Framework for Continuous-Time Jump-Diffusion Controls with Normalizing Flows* (with L. Guo, R. Hu and X. Yang), arXiv:2604.05398
- *A Tight-binding Approach for Computing Subwavelength Guided Modes in Crystals with Line Defects* (with H. Ammari, E. Hiltunen, P. Liu and B. Miao) arXiv:2512.05370
- *A thermodynamics-based turbulence model for isothermal compressible flows* (with Z. Ma and W.-A. Yong) arXiv:2504.18755
- *Pseudo-magnetic Fields and Effective Dynamics in Strained Honeycomb Structures* (with C. Zhang and B. Miao) arXiv: 2511.15152
- *Identification of hydrodynamic instability by convolutional neural networks* (with W. Yang, L. Peng and L. Hong), arXiv:2006.01446
- *Generalized hydrodynamics and the classical hydrodynamic limit* (with Z. Yang and W.-A. Yong), arXiv: 1809.01611
- *A rigorous derivation of multicomponent diffusion laws* (with Z. Yang and W.-A. Yong), arXiv:1502.03516

Teaching Experience

Teaching at Tsinghua University

- Scientific Computing (2025 Spring)
- Introduction to Partial Differential Equations (2021-2023 Spring)
- Introduction to Partial Differential Equations (2021-2023 Fall)
- Asymptotic analysis (2013-2018 Spring, 2023-2025 Fall)

Teaching at University of Colorado-Boulder

- Differential Equations with Linear Algebra (2008-2009 Fall, 2009-2011 Spring)
- Matrix Methods (2010 Fall)

Group members

Former

Postdoc Li Wang (2021-2023), Shuo Yang (2021-2023), Tahereh Eftekhari (2023-2025)

Ph.D. Pipi Hu (2020), Peng Xie (2020), Wuyue Yang (2022), Haimo Guo (2022), Chengyuan Wu (2024), Ying Cao (2025), Borui Miao (2025), Liwei Lu (2025), Yan Jiang (2025)

Master Zifan Ye (2025), Lin Qin (2026)

Current

Postdoc Wangyang Zhao (2026-)

Graudate Zhitong Chen (2022-), Liya Guo (2022-), Zhijun Zeng (2022-), Chengyu Zhang (2023-), Yunqi Jiang (2023-), Yimi Ai (2024-), Xiaoyi Jiang (2025-)

Undergraduate Rui Li (2025-), Yuchong Tang (2025-)