

Junming DUAN (段俊明)

HUMBOLDT RESEARCH FELLOW

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Academic Positions

October 2023 – September 2025	Humboldt Research Fellow Institut für Mathematik, Universität Würzburg, Germany <i>Host Professor: Prof. Dr. Christian Klingenberg</i>
September 2021 – September 2023	Postdoctoral Researcher MCSS, École Polytechnique Fédérale de Lausanne (EPFL), Switzerland <i>Mentor: Prof. Jan S. Hesthaven</i>

Education

September 2016 – July 2021	Ph.D. in Computational Mathematics Peking University, China <i>Entropy stable numerical methods for special relativistic (magneto)hydrodynamics</i> <i>Advisor: Prof. Huazhong Tang</i>
September 2012 – July 2016	B.Sc. in Information and Computing Science Peking University, China

Research Interests

- Numerical methods for hyperbolic conservation laws
- Computational fluid dynamics
- High-order accurate numerical methods
- Structure-preserving methods
- Moving mesh methods
- Active flux methods
- Model order reduction
- Reduced-order modeling
- Machine-learning-enhanced data-driven methods

Research Publications

PREPRINTS

21. **Junming Duan**, Wasilij Barsukow, and Christian Klingenberg, An asymptotic-preserving active flux scheme for the hyperbolic heat equation in the diffusive scaling, submitted, 2025. *arXiv:2508.05166*.
20. **Junming Duan**, Praveen Chandrashekar, and Christian Klingenberg, Active flux for ideal magnetohydrodynamics: A positivity-preserving scheme with the Godunov-Powell source term, submitted, 2025. *arXiv:2506.04857*.
19. **Junming Duan**, Bartul Kovacic, and Jan S. Hesthaven, Multi-GPU accelerated high-order schemes for hyperbolic conservation laws on adaptive moving meshes, *in preparation*.

JOURNAL ARTICLES

18. Jie Wang, Yao Zhou, **Junming Duan**, Zhiwei Ma, and Wei Zhang, Adaptive moving mesh CLT code for stellarator MHD simulations, *Computer Physics Communications*, 316: 109776, 2025.
17. **Junming Duan**^{*}, Wasilij Barsukow, and Christian Klingenberg, Active flux methods for hyperbolic conservation laws – flux vector splitting and bound-preservation, *SIAM Journal on Scientific Computing*, 47(2): A811-A837, 2025. *arXiv:2411.00065*.
16. Zhihao Zhang, Huazhong Tang, and **Junming Duan**^{*}, High-order accurate well-balanced energy stable finite difference schemes for multi-layer shallow water equations on fixed and adaptive moving meshes, *Journal of Computational Physics*, 517: 113301, 2024. *arXiv:2311.08124*.

15. **Junming Duan**, Qian Wang, and Jan S. Hesthaven, Machine-learning-enhanced aerodynamic forces prediction based on sparse pressure sensor inputs, *AIAA Journal*, 62(7): 2601-2621, 2024. *arXiv:2305.09199*.
14. **Junming Duan*** and Jan S. Hesthaven, Non-intrusive data-driven reduced-order modeling for time-dependent parametrized problems, *Journal of Computational Physics*, 497: 112621, 2024. *arXiv:2303.02986*.
13. Jie Wang, **Junming Duan**, Zhiwei Ma, and Wei Zhang, An adaptive moving mesh finite difference scheme for tokamak magneto-hydrodynamic simulations, *Computer Physics Communications*, 294: 108951, 2024.
12. Zhihao Zhang, **Junming Duan***, and Huazhong Tang, High-order accurate well-balanced energy stable adaptive moving mesh finite difference schemes for the shallow water equations with non-flat bottom topography, *Journal of Computational Physics*, 492: 112451, 2023. *arXiv:2303.06924*.
11. Shangting Li, **Junming Duan**, and Huazhong Tang, High-order accurate entropy stable adaptive moving mesh finite difference schemes for (multi-component) compressible Euler equations with the stiffened equation of state, *Computer Methods in Applied Mechanics and Engineering*, 399: 115311, 2022. *arXiv:2202.07989*.
10. **Junming Duan** and Huazhong Tang, High-order accurate entropy stable adaptive moving mesh finite difference schemes for special relativistic (magneto)hydrodynamics, *Journal of Computational Physics*, 456: 111038, 2022. *arXiv:2107.12027*.
9. **Junming Duan** and Huazhong Tang, An analytical solution of the isentropic vortex problem in the special relativistic magnetohydrodynamics, *Journal of Computational Physics*, 456: 110903, 2022. *arXiv:2107.01966*.
8. **Junming Duan** and Huazhong Tang, High-order accurate entropy stable finite difference schemes for the shallow water magnetohydrodynamics, *Journal of Computational Physics*, 431: 110136, 2021. *arXiv:2003.10081*.
7. **Junming Duan** and Huazhong Tang, Entropy stable adaptive moving mesh schemes for 2D and 3D special relativistic hydrodynamics, *Journal of Computational Physics*, 426: 109949, 2021. *arXiv:2007.12884*.
6. **Junming Duan** and Huazhong Tang, High-order accurate entropy stable nodal discontinuous Galerkin schemes for the ideal special relativistic magnetohydrodynamics, *Journal of Computational Physics*, 421: 109731, 2020. *arXiv:1911.03825*.
5. **Junming Duan** and Huazhong Tang, High-order accurate entropy stable finite difference schemes for one- and two-dimensional special relativistic hydrodynamics, *Advances in Applied Mathematics and Mechanics*, 12(1): 1-29, 2020. *arXiv:1905.06092*.
4. **Junming Duan** and Huazhong Tang, An efficient ADER discontinuous Galerkin scheme for directly solving Hamilton-Jacobi equation, *Journal of Computational Mathematics*, 38(1): 58-83, 2020. *arXiv:1901.10228*.
3. Dan Ling, **Junming Duan**, and Huazhong Tang, Physical-constraints-preserving Lagrangian finite volume schemes for one- and two-dimensional special relativistic hydrodynamics, *Journal of Computational Physics*, 396: 507-543, 2019. *arXiv:1901.10625*.
2. **Junming Duan** and Huazhong Tang, A second-order accurate scheme for a kinetic equation of two-dimensional Vicsek swarming model, *Natural Science Journal Xiangtan University*, 41(1): 1-14, 2019. (in Chinese)
1. **Junming Duan**, Yangyu Kuang, and Huazhong Tang, Model reduction of a two-dimensional kinetic swarming model by operator projections, *East Asian Journal on Applied Mathematics*, 8(1): 151-180, 2018. *arXiv:1701.02888*.

Major Awards & Honors

Humboldt Research Fellowship Alexander von Humboldt Foundation	July 2023
Outstanding Graduate of Peking University Peking University	July 2021
National Scholarship for Graduate Student Ministry of Education of P.R. China	December 2020
The First Prize in Outstanding Youth Paper Award Beijing Society of Computational Mathematics	August 2020
BICMR Scholarship for Graduate Student Beijing International Center for Mathematical Research	2019–2020
President Scholarship for PhD Student Peking University	2018–2020
Founder Scholarship Peking University	September 2019
DTZ Cushman & Wakefield Scholarship Peking University	September 2017
Outstanding Undergraduate of Peking University Peking University	July 2016

Conferences & Talks

Numerical Methods for Hyperbolic Problems, NumHyp Darmstadt, Germany <i>Poster: On An Asymptotic-Preserving Active Flux Scheme</i>	June 09-13, 2025
Mobility Innovation eXchange in Aero/Acoustics (MIXA) The Ohio State University, USA (online) <i>Keynote Speaker: Machine-learning-enhanced aerodynamic forces prediction based on sparse pressure sensor inputs</i>	May 06, 2025
High-Order NONlinear numerical Methods for evolutionary PDEs: theory and applications, HONOM Chania, Crete Island, Greece <i>Talk: On limiting for the Active Flux methods for hyperbolic conservation laws</i>	September 08-13, 2024
Lecture Series of Modern Computational Methods Beijing Institute of Applied Physics and Computational Mathematics (online) <i>Talk: Entropy stable schemes for hyperbolic conservation laws</i>	July 27, 2024
Seminar Talk Southern University of Science and Technology, Shenzhen, China <i>Talk: Bound-preserving active flux methods for one-dimensional hyperbolic conservation laws and flux vector splitting for point value update</i>	March 21, 2024
Development of High-Order Methods for Hyperbolic PDEs Southern University of Science and Technology, Shenzhen, China	March 15-19, 2024
Simultaneously used Point values, Averages and Moments and their Inter-Relation: Active Flux, Multi-Moment Method, Virtual Finite Elements and related numerical methods Maxwell Center, Cambridge, UK (online) <i>Talk: Flux-vector splitting for point value update in active flux methods and limiting</i>	March 06-08, 2024
XVII. Würzburg Workshop on Stellar Astrophysics Heidelberg Institute for Theoretical Studies (HITS), Heidelberg, Germany <i>Plenary talk: Adaptive moving mesh methods in hydrodynamics</i>	December 18-19, 2023
CAM Seminar Southern University of Science and Technology, Shenzhen, China <i>Talk: Machine learning based non-intrusive reduced-order modeling and aerodynamic forces prediction</i>	July 01, 2023
ECCOMAS YIC 2023: 7th Young Investigators Conference University of Porto, Porto, Portugal <i>Talk: Non-intrusive data-driven reduced-order modeling for time-dependent parametrized problems</i>	June 19-21, 2023
Swiss Numerics Day 2023 Universität Bern, Bern, Switzerland <i>Talk: Machine learning enhanced aerodynamic forces prediction based on sparse pressure sensor inputs</i>	June 07, 2023
Oberseminar hosted by Prof. Christian Klingenberg (online) <i>Talk: Data-driven reduced-order modeling for time-dependent parametrized problems</i>	November 17, 2022
MultiMat 2022: 10th International Conference on Numerical Methods for Multi-Material Fluid Flow Universität Zürich, Zürich, Switzerland <i>Talk: High-order accurate entropy stable adaptive moving mesh methods</i>	August 22-26, 2022
Symposium on High-Fidelity Numerical Simulation of Fluid Problems Peking University, Beijing, China <i>Talk: Entropy stable schemes for RHD</i>	June 05-07, 2021
Forum of Numerical Methods and Applications in Fluids Xiangtan University, Xiangtan, China <i>Talk: Entropy stable adaptive moving mesh schemes for RHD</i>	December 11-13, 2020
Annual Meeting on High Resolution Method for Multi-Material Hydrodynamics of Science Challenge Project Xiamen University, Xiamen, China <i>Talk: PCP Lagrangian scheme for RHD</i>	November 29-December 01, 2019
Workshop on Numerical Methods for Complex Physical Problems Nanjing University of Aeronautics and Astronautics, Nanjing, China <i>Talk: High-order entropy stable finite difference schemes for RHD</i>	August 28-30, 2019
The 12th National Annual Meeting of Computational Mathematics Harbin, China <i>Talk: High-order entropy stable finite difference schemes for RHD</i>	July 31-August 04, 2019
Annual Meeting of Science Challenge Project Jilin University, Changchun, China <i>Talk: PCP Lagrangian scheme for RHD (with Dan Ling), selected as one of the five best posters</i>	November 17-19, 2018

Conferences & Talks (continued)

Beijing Seminar on Computational Fluid Dynamics | Beijing Institute of Applied Physics and Computational Mathematics, Beijing, China November 11, 2018
Talk: PCP Lagrangian scheme for RHD

Teaching Assistant

Analysis III | École Polytechnique Fédérale de Lausanne Fall 2022
Advanced Analysis I | École Polytechnique Fédérale de Lausanne Fall 2021
Numerical Methods of Partial Differential Equations | Peking University Fall 2019
Linear Algebra B | Peking University Fall 2018
Advanced Algebra II | Peking University Spring 2018
Linear Algebra B | Peking University Fall 2017
Mathematical Modeling | Peking University Spring 2017
Partial Differential Equations | Peking University Fall 2016

Supervision

Master thesis: Reduced order modeling for time dependent parametrized problems coupled with uncertainty quantification | Andrea Lörke, University of Wuerzburg, with Prof. Christian Klingenberg Fall, 2023 - Fall, 2024
Master thesis: GPU-accelerated numerical simulations of hyperbolic conservation laws using entropy stable schemes and adaptive moving mesh method | Bartul Kovacic, EPFL, with Prof. Jan S. Hesthaven Fall, 2023
Semester project: Scalable implementation of high-order entropy stable finite difference schemes | Bartul Kovacic, EPFL, with Prof. Jan S. Hesthaven Fall, 2022
Master thesis: High-order entropy stable discontinuous Galerkin schemes using artificial viscosity | Louis Vincent Marie Jaugey, EPFL, with Prof. Jan S. Hesthaven Fall, 2022
Master thesis: Investigation of the aerosol evolution and delivery into the upper airway under transient conditions | Filippo Zacchei, EPFL, with Prof. Jan S. Hesthaven Fall, 2022

Research Grants & Projects

New Efficient Structure-Preserving Numerical Methods for the Multi-dimensional Euler Equations: design efficient adaptive moving mesh methods and reduced-order models with structure preservation for solving the multi-dimensional Euler equations 2023-2025
PI | Supported by Alexander von Humboldt-Stiftung
Sense Dynamics: construct precise surrogate models of transient nonlinear physical phenomena related to aerodynamics 2021-2022
PI: Dr. Doytchinov Iordan | Supported by Swiss Data Science Center
High-Order Accurate Adaptive Moving Mesh Methods for Compressible Fluid Flows: design and verification of high-order accurate adaptive moving mesh methods for solving the Euler and Navier-Stokes equations in 2D and 3D 2021-2022
PI: Prof. Huazhong Tang | Supported by National Numerical Windtunnel Project
Computational Methods for the Interface and Elastoplastic Fracture in Fluid Mechanics: design and verification of high-order accurate adaptive moving mesh methods for solving multi-material flows 2019-2020
PI: Prof. Huazhong Tang | Supported by Science Challenge Project
High-Order Accurate Robust Numerical Schemes for Multi-Material Implosion Hydrodynamics: research on high-order accurate Lagrangian schemes for solving compressible hydrodynamics 2016-2018
PI: Prof. Huazhong Tang | Supported by Science Challenge Project

Professional Services

- Reviewer/Referee for: AMS Mathematical Reviews, Journal of Computational Physics, Journal of Computational and Applied Mathematics, Communications in Nonlinear Science and Numerical Simulation, International Journal for Numerical Methods in Engineering, East Asian Journal on Applied Mathematics, Communications in Computational Physics, Journal of Scientific Computing, International Journal of Computational Methods, Computational Geosciences, Numerical Methods for Partial Differential Equations, AIAA Journal

Other Information

- Programming skills: C, C++, Python, Julia, MATLAB, Fortran, MPI, PyTorch, OpenFOAM, PETSc, Linux shell, \LaTeX , . . .
- Languages: English (proficient), Chinese (native)

References

Prof. Dr. Huazhong Tang

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