# Junming DUAN (段俊明)


Humboldt Research Fellow

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## Academic Positions

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

## Education

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|---|---|
| September 2016 - July 2021 | **Ph.D. in Computational Mathematics**<br>Peking University, China<br>*Entropy stable numerical methods for special relativistic (magneto)hydrodynamics*<br>*Advisor: Prof. Huazhong Tang* |
| September 2012 - July 2016 | **B.Sc. in Information and Computing Science**<br>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-ordel modeling
- Machine-learning-enhanced data-driven methods

## Research Publications

### Preprints

20. **J.M. Duan***, W. Barsukow, and C. Klingenberg, Active flux methods for hyperbolic conservation laws – flux vector splitting and bound-preservation: Two-dimensional case, submitted to ***SIAM J. Sci. Comput.***, 2024. *arXiv:2407.13380*.
19. J. Wang, Y. Zhou, **J.M. Duan**, Z.W. Ma, and W. Zhang, Adaptive moving mesh CLT code for stellarator MHD simulations, submitted to ***Comput. Phys. Commun.***, 2024.
18. **J.M. Duan***, W. Barsukow, and C. Klingenberg, Active flux methods for hyperbolic conservation laws – flux vector splitting and bound-preservation: One-dimensional case, submitted to ***SIAM J. Sci. Comput.***, 2024. *arXiv:2405.02447*.
17. **J.M. Duan**, B. Kovacic, and J.S. Hesthaven, Multi-GPU accelerated high-order schemes for hyperbolic conservation laws on adaptive moving meshes, ***in preparation***.

### Journal Articles

16. Z.H. Zhang, H.Z. Tang, and **J.M. Duan***, High-order accurate well-balanced energy stable finite difference schemes for multi-layer shallow water equations on fixed and adaptive moving meshes, ***J. Comput. Phys.***, 517: 113301, 2024. *arXiv:2311.08124*.
15. **J.M. Duan**, Q. Wang, and J.S. Hesthaven, Machine-learning-enhanced aerodynamic forces prediction based on sparse pressure sensor inputs, ***AIAA J.***, 62(7): 2601-2621, 2024. *arXiv:2305.09199*.

14. **J.M. Duan**[*] and J.S. Hesthaven, Non-intrusive data-driven reduced-order modeling for time-dependent parametrized problems, ***J. Comput. Phys.***, 497: 112621, 2024. *arXiv:2303.02986*.
13. J. Wang, **J.M. Duan**, Z.W. Ma, and W. Zhang, An adaptive moving mesh finite difference scheme for tokamak magneto-hydrodynamic simulations, ***Comput. Phys. Commun.***, 294: 108951, 2024.
12. Z.H. Zhang, **J.M. Duan**[*], and H.Z. Tang, High-order accurate well-balanced energy stable adaptive moving mesh finite difference schemes for the shallow water equations with non-flat bottom topography, ***J. Comput. Phys.***, 492: 112451, 2023. *arXiv:2303.06924*.
11. S.T. Li, **J.M. Duan**, and H.Z. Tang, High-order accurate entropy stable adaptive moving mesh finite difference schemes for (multi-component) compressible Euler equations with the stiffened equation of state, ***Comput. Methods Appl. Mech. Engrg.***, 399: 115311, 2022. *arXiv:2202.07989*.
10. **J.M. Duan** and H.Z. Tang, High-order accurate entropy stable adaptive moving mesh finite difference schemes for special relativistic (magneto)hydrodynamics, ***J. Comput. Phys.***, 456: 111038, 2022. *arXiv:2107.12027*.
9. **J.M. Duan** and H.Z. Tang, An analytical solution of the isentropic vortex problem in the special relativistic magnetohydrodynamics, ***J. Comput. Phys.***, 456: 110903, 2022. *arXiv:2107.01966*.
8. **J.M. Duan** and H.Z. Tang, High-order accurate entropy stable finite difference schemes for the shallow water magnetohydrodynamics, ***J. Comput. Phys.***, 431: 110136, 2021. *arXiv:2003.10081*.
7. **J.M. Duan** and H.Z. Tang, Entropy stable adaptive moving mesh schemes for 2D and 3D special relativistic hydrodynamics, ***J. Comput. Phys.***, 426: 109949, 2021. *arXiv:2007.12884*.
6. **J.M. Duan** and H.Z. Tang, High-order accurate entropy stable nodal discontinuous Galerkin schemes for the ideal special relativistic magnetohydrodynamics, ***J. Comput. Phys.***, 421: 109731, 2020. *arXiv:1911.03825*.
5. **J.M. Duan** and H.Z. Tang, High-order accurate entropy stable finite difference schemes for one- and two-dimensional special relativistic hydrodynamics, ***Adv. Appl. Math. Mech.***, 12(1): 1-29, 2020. *arXiv:1905.06092*.
4. **J.M. Duan** and H.Z. Tang, An efficient ADER discontinuous Galerkin scheme for directly solving Hamilton-Jacobi equation, ***J. Comput. Math.***, 38(1): 58-83, 2020. *arXiv:1901.10228*.
3. D. Ling, **J.M. Duan**, and H.Z. Tang, Physical-constraints-preserving Lagrangian finite volume schemes for one- and two-dimensional special relativistic hydrodynamics, ***J. Comput. Phys.***, 396: 507-543, 2019. *arXiv:1901.10625*.
2. **J.M. Duan** and H.Z. Tang, A second-order accurate scheme for a kinetic equation of two-dimensional Vicsek swarming model, ***Nat. Sci. J. Xiangtan Univ.***, 41(1): 1-14, 2019. (in Chinese)
1. **J.M. Duan**, Y.Y. Kuang, and H.Z. Tang, Model reduction of a two-dimensional kinetic swarming model by operator projections, ***East Asian J. Appl. Math.***, 8(1): 151-180, 2018. *arXiv:1701.02888*.

## Major Awards & Honors

**Humboldt Research Fellowship for Postdoctoral Researchers** | Alexander von Humboldt Foundation — July 2023
**Outstanding Graduate of Peking University** | Peking University — July 2021
**National Scholarship for Graduate Student** | Ministry of Education of the 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

**High-Order NOnlinear numerical Methods for evolutionary PDEs: theory and applications, HONOM** | Chania, Crete Island, Greece — September 08-13, 2024
*Talk: On limiting for the active flux methods for hyperbolic conservation laws*

**Lecture Series of Modern Computational Methods** | Beijing Institute of Applied Physics and Computational Mathematics (online) — July 27, 2024
*Talk: Entropy stable schemes for hyperbolic conservation laws*

## Conferences & Talks (continued)

**Seminar Talk** | Southern University of Science and Technology, Shenzhen, China — March 21, 2024
*Talk: Bound-preserving active flux methods for one-dimensional hyperbolic conservation laws and flux vector splitting for point value update*

**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 — March 06-08, 2024
*Talk: Flux-vector splitting for point value update in active flux methods and limiting*

**Network Meeting of the Alexander von Humboldt Foundation** | Universität Konstanz, Konstanz, Germany — February 21-23, 2024

**XVII. Würzburg Workshop on Stellar Astrophysics in Heidelberg** | Heidelberg Institute for Theoretical Studies (HITS), Heidelberg, Germany — December 18-19, 2023
*Plenary talk: Adaptive moving mesh methods in hydrodynamics*

**CAM Seminar** | Southern University of Science and Technology, Shenzhen, China — July 01, 2023
*Talk: Machine learning based non-intrusive reduced-order modeling and aerodynamic forces prediction*

**ECCOMAS YIC 2023: 7th Young Investigators Conference** | University of Porto, Porto, Portugal — June 19-21, 2023
*Talk: Non-intrusive data-driven reduced-order modeling for time-dependent parametrized problems*

**Swiss Numerics Day 2023** | Universität Bern, Bern, Switzerland — June 07, 2023
*Talk: Machine learning enhanced aerodynamic forces prediction based on sparse pressure sensor inputs*

**Oberseminar** | host by Prof. Christian Klingenberg, online — November 17, 2022
*Talk: Data-driven reduced-order modeling for time-dependent parametrized problems*

**MultiMat 2022: 10th International Conference on Numerical Methods for Multi-Material Fluid Flow** | Universität Zürich, Zürich, Switzerland — August 22-26, 2022
*Talk: High-order accurate entropy stable adaptive moving mesh methods*

**Symposium on High-Fidelity Numerical Simulation of Fluid Problems** | Peking University, Beijing, China — June 05-07, 2021
*Talk: Entropy stable schemes for RHD*

**Forum of Numerical Methods and Applications in Fluids** | Xiangtan University, Xiangtan, China — December 11-13, 2020
*Talk: Entropy stable adaptive moving mesh schemes for RHD*

**Annual Meeting on High Resolution Method for Multi-Material Hydrodynamics of Science Challenge Project** | Xiamen University, Xiamen, China — November 29-December 01, 2019
*Talk: PCP Lagrangian scheme for RHD*

**Workshop on Numerical Methods for Complex Physical Problems** | Nanjing University of Aeronautics and Astronautics, Nanjing, China — August 28-30, 2019
*Talk: High-order entropy stable finite difference schemes for RHD*

**The 12th National Annual Meeting of Computational Mathematics** | Harbin, China — July 31-August 04, 2019
*Talk: High-order entropy stable finite difference schemes for RHD*

**Annual Meeting of Science Challenge Project** | Jilin University, Changchun, China — November 17-19, 2018
*Talk: PCP Lagrangian scheme for RHD (with Dan Ling), selected as one of the five best posters*

**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

## Teaching Assistant (continued)

**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: 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

## Other Information

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

## References

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