



## Yunfan Huang 黄云帆, Doctor of Philosophy

Department of Engineering Mechanics, Tsinghua University

Year of Birth: 1997

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### Education Background

- |   |                 |                                                                                                                                  |                     |                                     |
|---|-----------------|----------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------|
| ➤ | 2019/08-2025/07 | <i>Doctor of Philosophy</i>                                                                                                      | Tsinghua University | Department of Engineering Mechanics |
|   |                 | ■ <b>Major:</b> Power Engineering and Engineering Thermal Physics (Admission by Recommendation)                                  |                     |                                     |
|   |                 | ■ <b>Dissertation:</b> Electrokinetic transport of immiscible liquid-liquid interface ( <b>Supervisor:</b> Prof. Moran Wang)     |                     |                                     |
| ➤ | 2018/10-2019/01 | <i>Visiting Student</i>                                                                                                          | Purdue University   | School of Mechanical Engineering    |
|   |                 | ■ <b>Project:</b> Optimization of pillar array distribution for rare cell analysis ( <b>Supervisor:</b> Prof. Steven T. Wereley) |                     |                                     |
| ➤ | 2015/08-2019/07 | <i>Bachelor of Engineering</i>                                                                                                   | Tsinghua University | Department of Engineering Mechanics |
|   |                 | ■ <b>Major:</b> Theoretical and Applied Mechanics (TEEP [Tsien Excellence Education Programme], Ranked 6/29)                     |                     |                                     |
|   |                 | ■ <b>Thesis:</b> Electron hydrodynamics in microscale low-dimensional materials ( <b>Supervisor:</b> Prof. Moran Wang)           |                     |                                     |

### Research Experiences

#### *Research Interests*

- Physicochemical hydrodynamics at micro-/nano-scale (e.g., electrokinetic transport)
- Quantum hydrodynamics in solids (e.g., electron hydrodynamics, phonon transport)
- Kinetic modeling and multiscale simulation of multi-physical transport

#### *Possible Engagement*

- **Physico-chemical hydrodynamics:** electrochemical energy conversion, collective behavior of soft/living matter
- **Quantum hydrodynamics in solids:** vortex hydrodynamics in electron transport, odd viscosity of electron fluid

#### *Academic Skills*

- **Theoretical kinetic modeling:** electron-phonon transport in solids, ion-fluid coupling transport in electrolyte solutions
- **Algorithm development:** particle mesoscopic methods (LBM), PDE solvers (DOM, FVM/FEM); in Matlab/Fortran/C
- **Numerical simulation:** COMSOL, ANSYS Fluent, ABAQUS, OpenFOAM; AutoCAD, SolidWorks, Origin, ParaView
- **Experiment platform setup:** microfluidic measurement system, including design, fabrication, test and data processing
- **Engineering system design:** optimization of complex bridge / heat exchangers, electrical and control system in CMG

#### *Academic Experiences*

- **Referee for:** Journal of Colloid and Interface Science (2026-)
- **Teaching Assistant:** 2021-2023/Fall, of *Heat and Mass Transfer* (Prof. Moran Wang), Tsinghua University
- **Programme Participant:** 2018 Summer, 1/40 in *Airbus Airnovation Summer Academy*, Cranfield University (UK)

## **Honors & Awards**

### ***In Research+***

- 2024.08 Tsinghua Doctoral Travel Grant for International Conferences (Top-Tier)
- 2021.12 Tsinghua Comprehensive Excellence Scholarship (1<sup>st</sup> Prize)
- 2019.07 Tsinghua “Future Scholar” Scholarship
- 2019.07 Bachelor’s Thesis with Honor (both in Tsinghua, and in Beijing)
- 2018.02 Honorable Mention in the Mathematical Contest in Modeling (MCM, held by SIAM)

### ***In Education+***

- 2025.06 Beijing Outstanding Graduate (Ph.D.)
- 2023.12 Excellent Teaching Assistant (in Dept.)
- 2021.12 Tsinghua Excellent Mentor for Undergraduate
- 2019.07 Tsinghua Outstanding Graduate (B.E.)
- 2016.10 National Scholarship
- 2015.10 Tsinghua Xuetao Scholarship (Outstanding Innovative Talent Cultivation Program)

### ***P.S. Hobbies***

- Music (Violin, Piano, Chorus)
- Sports (Badminton, Table tennis)
- Reading (Sci-Fi, Sci-Tech history)

### ***P.S. Social Practices***

- 2020 Fall, Technology Industry Survey of Hangzhou, TEEP, Tsinghua University
- 2018 Winter, Industrial Survey of Singapore, Student Association for Sci & Tech, Tsinghua University
- 2017 Summer, Industrial Survey of Shenzhen and Hong Kong, Student Association for Sci & Tech, Tsinghua University
- 2017 Winter, Industrial Survey of Hainan Province, Student Association for Sci & Tech, Tsinghua University

## **Supplemental materials**

### ***A. Publication Lists***

### ***B. Intellectual Property Rights***

### ***C. Research Project List***

## **A. Publication Lists**

### ***Review papers***

1. **Y.F. Huang**, Z.G. Tian, H.Y. Chen, W. Liu, M. Wang\*. Electrokinetic transport in saturated and unsaturated porous media: A pore-scale view. *Advances in Colloid and Interface Science*, **349**: 103755, 2026.
2. **Y.F. Huang** and M. Wang\*. Electrokinetic multiphase hydrodynamics. *Applied Physics Reviews*, **12**: 031322, 2025.
3. **Y.F. Huang** and M. Wang\*. Electrokinetics at liquid-liquid interfaces: Physical models and transport mechanisms. *Advances in Colloid and Interface Science*, **342**: 103518, 2025.
- ◆ **Y.F. Huang** and M. Wang\*. Electrokinetics at liquid-liquid interfaces: Mechanisms and applications. *Chinese Journal of Theoretical and Applied Mechanics*, **57**: 2680, 2025. [in Chinese]
- ◆ B. Liu, **Y.F. Huang**, M. Wang\*. Physics and modeling of phonon wave behaviors in nanoscale heat conduction. *Chinese Journal of Computational Physics*, **41**: 746, 2024. [in Chinese]

### ***Research papers ((co-)first author)***

4. **Y.F. Huang** and M. Wang\*. Electrophoresis of charged dielectric droplet with ion concentration polarization effect. *ELECTROPHORESIS*, **47**: 724–743, 2026.
5. **Y.F. Huang** and M. Wang\*. Electrokinetic transport regulation at liquid-infused surface by liquid depletion and ion partition. *Physical Review Fluids*, **6**: 063702, 2026.
6. **Y.F. Huang** and M. Wang\*. Solvent mixing and ion partitioning effects in spontaneous charging and electrokinetic flow of immiscible liquid-liquid interface. *Physical Review Fluids*, **9**: 103701, 2024 (Highlighted as **Editors' Suggestion**)
7. A. Alizadeh<sup>#</sup>, **Y.F. Huang**<sup>#</sup>, F.L. Liu, H. Daiguji, M. Wang\*. A streaming-potential-based microfluidic measurement of surface charge at immiscible liquid-liquid interface. *International Journal of Mechanical Sciences*, **247**: 108200, 2023
8. X. Ran<sup>#</sup>, **Y.F. Huang**<sup>#</sup>, M. Wang\*. A hybrid Monte Carlo-discrete ordinates method for phonon transport in micro/nanosystems with rough interfaces. *International Journal of Heat and Mass Transfer*, **201**: 123634, 2023
9. **Y.F. Huang** and M. Wang\*. Nonnegative magnetoresistance in hydrodynamic regime of electron fluid transport in two-dimensional materials. *Physical Review B*, **104**: 155408, 2021
- ◆ **Y.F. Huang**, M. Wang\*. Merging of mechanics and mathematical physics: A brief discussion on similarity method. *Mechanics in Engineering*, **46**: 868-875, 2024 [in Chinese]
- ◆ **Y.F. Huang**. Relationship between the two loci of instant center of rigid body in plane motion. *Mechanics in Engineering* **3**: 306, 2017 [in Chinese]

### ***Research papers (others)***

10. W. Liu, **Y.F. Huang**, M. Wang\*. Flow instability and scaling transition near strongly polarised surfaces. *Journal of Fluid Mechanics*, **1024**: A8, 2025.
11. X.K. Lu, Q.Q. Li, G. Yang, **Y.F. Huang**, M. Wang\*. Geometry-mediated particle accumulation driven by nonhydrodynamic viscosity effect with flow control implications in porous media. *Physical Review Fluids*, **10**: 093304, 2025
12. M.B. Zhang, Z.G. Tian, **Y.F. Huang**, M. Wang\*. Gas flow regimes and transition criteria in porous media. *Physical Review Fluids*, **10**: 024303, 2025
13. W. Liu, **Y.F. Huang**, M. Wang\*. Extended space charge and transport near ion-selective surfaces. *International Journal of Mechanical Science*, **287**: 109933, 2025
14. Z.G. Tian, **Y.F. Huang**, M. Wang\*. Analytical solution of inertia effect in high-speed flows through disordered porous media. *Physical Review Fluids*, **9**: L102101, 2024
15. Q.Q. Li, G. Yang, **Y.F. Huang**, X.K. Lu, J. Min and M. Wang\*. Lattice Boltzmann method for particulate multiphase flow system. *International Journal of Mechanical Sciences*, **273**: 109217, 2024

16. Y.R. Li, **Y.F. Huang**, X.K. Lu, M. Wang\*. Criteria of distribution transitions in dispersed multiphase systems based on an extended lattice model. *Langmuir*, **39**: 17021, 2023

## Conferences

1. **Y.F. Huang**, W. Liu, M. Wang\*. Electrokinetic multiphase flow at spontaneously charged liquid-liquid interface: a diffuse interface model with adsorption-induced interface charge (Oral & Long abstract). *ICTAM 2024*. Daegu, Korea. 2024.08
2. **Y.F. Huang**, A. Alizadeh, F.L. Liu, M. Wang\*. Measurement of surface charge at immiscible liquid-liquid interface using streaming-potential-on-microfluidics (Oral). *InterPore 2023*. Edinburgh, UK. 2023.05
- ◆ **Y.F. Huang**, M. Wang\*. Ion concentration polarization effect in electrophoresis of highly charged dielectric droplet (Oral). *CCTAM 2025*. Changsha, China. 2025.08. *Accepted* [in Chinese]
- ◆ **Y.F. Huang**, M. Wang\*. Measurement of liquid-liquid interfacial charge based on streaming potential (Oral). *NCFI 2022*. Xi'an, China. 2022.11 [in Chinese]
- ◆ **Y.F. Huang**, M. Wang\*. Hydrodynamics of low dimensional electron transport at micro-nanoscales (Oral & Paper). *CCTAM 2019*. Hangzhou, China. 2019.08 [in Chinese]

## B. Intellectual Property Rights

### Patents (in Chinese)

1. M. Wang, **Y.F. Huang**. A method, device, and system for in-situ measurement of the charge density at the immiscible liquid interface, patent number ZL 2024 1 0986033.1, authorization number CN 118707205 B, 2025.
2. M. Wang, **Y.F. Huang**, F.L. Liu. A method and apparatus for measuring the charge density at the liquid-liquid interface, patent number ZL 2021 1 1448254.6, authorization number CN 114216950 B, 2024.

### Software copyrights (in Chinese)

3. M. Wang, G. Yang, H.Y. Chen, **Y.F. Huang**. Multi-physics, multi-phase, multi-scale flow simulation software ( $\mu^3$ -Flows), registration number 2024SR0160474, 2024.

## C. Research Projects

|   |                   |                                                                                                                                                                  |
|---|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ➤ | <b>2019-2025</b>  | Electrokinetic multiphase flow in porous media & Multiphysical microflow simulation software                                                                     |
|   |                   | <i>Doctoral dissertation</i> (supported by NSFC <sup>[2]</sup> ) @Tsinghua University<br>→ <u>Apps</u> : Battery Electrolyte filling, Low-salinity waterflooding |
| ➤ | <b>2017-2019</b>  | Mechanism of electron transport in two-dimensional materials based on electron hydrodynamics                                                                     |
|   |                   | <i>Bachelor's thesis</i> & ORIC <sup>[1]</sup> (in TEEP) @TEEP<br>→ <u>Apps</u> : Super-ballistic electron transport, Thermal management                         |
| ✧ | <b>2021/07-08</b> | Simulation of flow and heat transfer in a high-temperature air preheater with helical baffles                                                                    |
|   |                   | Internship (in Company) @DORIGHT                                                                                                                                 |
| ✧ | <b>2018-2019</b>  | Optimization of pillar array distribution for reaction efficiency enhancement in point-of-care fluidics                                                          |
|   |                   | SURF <sup>[1]</sup> (in TEEP) @Purdue University - TEEP                                                                                                          |
| ✧ | <b>2018/07-08</b> | Implementation of Zoltan interface for mesh partitioning in high-precision CFD software                                                                          |
|   |                   | Internship (in Institute) @Beijing CSRC                                                                                                                          |
| ✧ | <b>2017-2018</b>  | Finite element programs for cable-stayed bridges with complex elements & multi-functions                                                                         |
|   |                   | APC <sup>[1]</sup> (Finite element method) @TEEP                                                                                                                 |

[1] ORIC, Open Research for Innovative Challenges; SURF: Senior Undergraduate Research Fellowship; APC, Advanced Placement Course.

[2] NSFC, National Science Foundation of China.