



# Yunfan Huang 黄云帆, Doctor of Philosophy

Department of Engineering Mechanics, Tsinghua University

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# **Education Background**

> 2019/08-2025/07 Doctor of Philosophy Tsinghua University Department of Engineering Mechanics

■ Major: Power Engineering and Engineering Thermal Physics (Admission by Recommendation)

■ <u>Dissertation</u>: Electrokinetic transport of immiscible liquid-liquid interface (**Supervisor**: Prof. Moran Wang)

▶ 2018/10-2019/01 *Visiting Student* Purdue University School of Mechanical Engineering

■ **Project:** Optimization of pillar array distribution for rare cell analysis (**Supervisor:** Prof. Steven T. Wereley)

2015/08-2019/07 Bachelor of Engineering Tsinghua University Department of Engineering Mechanics

■ Major: Theoretical and Applied Mechanics (TEEP<sup>[1]</sup>; Ranked 6/29)

■ Thesis: Electron hydrodynamics in microscale low-dimensional materials (Supervisor: 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

#### Research Projects

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

### 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

# **Other Experiences**

#### 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

- ➤ 2021-2023/Fall, <u>Teaching Assistant</u> of *Heat and Mass Transfer* (Prof. Moran Wang), Tsinghua University
- > 2018 Summer, Programme Participant (1/40) in Airbus Airnovation Summer Academy, Cranfield University (UK)

#### Social Practices and Hobbies

- ➤ 2020 Fall, <u>Technology Industry Survey</u> 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
- **Hobbies:** Music (Violin, Piano, Chorus), Sports (Badminton, Table tennis), Reading (Sci-Fi, Sci-Tech history)

### **Honors & Awards**

#### In Research+

- ➤ 2024.08 Tsinghua Doctoral Travel Grant for International Conferences (Top-Tier)
- ➤ 2021.12 Tsinghua Comprehensive Excellence Scholarship (1st 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 Xuetang Scholarship (Outstanding Innovative Talent Cultivation Program)

#### Supplemental materials

- A. Publication Lists
- B. Intellectual Property Rights

### **A. Publication Lists**

### Review papers

- ❖ Y.F. Huang, Z.G. Tian, H.Y. Chen, W. Liu, M. Wang\*. Electrokinetic transports in saturated and unsaturated porous media.
  Advances in Colloid and Interface Science, 2025. Under review
- 1. Y.F. Huang and M. Wang\*. Electrokinetic multiphase hydrodynamics. *Applied Physics Reviews*, 12: 031322, 2025.
- 2. **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*, 2025. *In revision* [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)

- ❖ Y.F. Huang and M. Wang\*. Electrokinetic transport regulation at liquid-infused surface by liquid depletion and ion partition.
  <u>Physical Review Fluids</u>, 2025. In revision
- ♦ Y.F. Huang and M. Wang\*. Electrophoresis of charged dielectric droplet with ion concentration polarization effect. <u>Physical Review Fluids</u>, 2025. *In revision*
- 3. **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**)
- A. Alizadeh<sup>#</sup>, Y.F. Huang<sup>#</sup>, F.L. Liu, H. Daiguji, M. Wang<sup>\*</sup>. A streaming-potential-based microfluidic measurement of surface charge at immiscible liquid-liquid interface. *International Journal of Mechanical Sciences*, 247: 108200, 2023
- 5. X. Ran<sup>#</sup>, Y.F. Huang<sup>#</sup>, M. Wang<sup>\*</sup>. 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
- 6. **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. <u>Mechanics in Engineering</u> 3: 306, 2017 [in Chinese]

# Research papers (others)

- W. Liu, Y.F. Huang, M. Wang\*. Instability and scaling transition near strongly polarized surfaces. 2025. <u>Journal of Fluid Mechanics</u>, <u>Under review</u>
- 7. 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*, In Press, 2025
- 8. 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
- W. Liu, Y.F. Huang, M. Wang\*. Extended space charge and transport near ion-selective surfaces. <u>International Journal of Mechanical Science</u>, 287: 109933, 2025
- 10. 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

- 11. 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
- 12. Y.R. Li, **Y.F. Huang**, X.K. Lu, M. Wang\*. Criterions 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). *NCFluid 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)

- ♦ 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 2025 X XXXXXXXXX, authorization number CN XXXXXXXXX B, 2025. (*In Process*)
- 1. 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)

2. 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.