清华大学 清华学堂钱学森班 Tsien Excellence in Engineering Program

Yunfan Huang 黄云帆, PhD Candidate

Department of Engineering Mechanics, Tsinghua University

Date of Birth: 1997/03 **Websites**: ResearchGate, Google Scholar; Group, LinkedIn; Gitee

Place of Birth: Liao-Ning Province **Contact Info**: xungeer2311@gmail.com, yf-huang19@foxmail.com

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)
  - **Field of Research:** Electrokinetic transport in liquid-liquid multiphase flow (**Supervisor**: Prof. Moran Wang)
  - **Dissertation**: Spontaneous charging and electrokinetic multiphase flow of immiscible liquid-liquid interface
  - **Applications**: Enhanced oil recovery with low-salinity waterflooding, Electrolyte filling in rechargeable batteries
- **2018/10-2019/01** ***Visiting Student*** Purdue University School of Mechanical Engineering
  - **Project:** Optimization of the pillar array distribution for rare cell analysis (**Supervisor:** Prof. Steven T. Wereley)
  - **Applications**: Reaction efficiency enhancement in point-of-care fluidics for rare cell analysis
- **2015/08-2019/07** ***Bachelor of Engineering*** Tsinghua University Department of Engineering Mechanics
  - **Major**: Theoretical and Applied Mechanics (Tsien Excellence in Engineering Program, TEEP) (Ranked 6/29, GPA 3.78/4.00)
  - **Field of Research:** Hydrodynamic effect in low-temperature electron transport (**Supervisor**: Prof. Moran Wang)
  - **Thesis:** Electron hydrodynamics in micro/nanoscale low-dimensional materials
  - **Applications**: Super-ballistic electron transport in 2D materials, Thermal management of electronic devices

Research Experiences

Research Interests

- Electrokinetic flows, micro-/nano-fluidics, complex flows
- Hydrodynamic effect in electron and phonon transport
- Kinetic modeling and multiscale simulation of multiphysical transport

Research Projects (See Supplementals for more)

- **2019-2025** ***Doctoral dissertation***, also supported by NSFC & NKRD Tsinghua University
  - Project: Electrokinetic multiphase flow in porous media & Multiphysical microflow simulation software development
- **2021/07-08** Internship (in Company) DORIGHT
  - Project: Review and simulation of flow and heat transfer in a high-temperature air preheater with helical baffles
- **2017-2019** ***Bachelor's thesis*** & Open Research for Innovative Challenges TEEP
  - Project: Mechanism of electron transport in two-dimensional materials based on electron hydrodynamics
- **2018-2019** Senior Undergraduate Research Fellowship Purdue University - TEEP
  - Project: Optimization of the pillar array distribution for rare cell analysis in point-of-care diagnostics
- **2018/07-08** Internship (in Institute) Beijing CSRC
  - Project: Implementation of Zoltan interface for mesh partitioning in high-precision CFD software
- **2017-2018** Advanced Placement Course (Finite element method) TEEP
  - Project: Development of complex elements and multifunctional finite element programs for cable-stayed bridges

Possible Engagement

- **Physico-chemical hydrodynamics**: electrochemical energy conversion, soft matter, collective behavior of 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, Teaching Assistant of *Heat and Mass Transfer* (Prof. Moran Wang), Tsinghua University
- 2018/07, Participant (1/40) in Airbus Airnovation Summer Academy, Cranfield University (UK)

Social Practices and Hobbies

- 2020/11, Technology Industry Survey of Hangzhou, TEEP, Tsinghua University
- 2017-2018/Winter, Industrial Survey of Hong Kong/Singapore, 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+

- 2023.12 Excellent Teaching Assistant (Eng. Mech. Dept.)
- 2021.12 Tsinghua Excellent Mentor for Undergraduate
- 2019.07 Tsinghua Outstanding Graduate (Bachelor)
- 2016.10 National Scholarship
- 2015.10 Tsinghua Xuetang Scholarship (Outstanding Innovative Talent Cultivation Program)

Supplemental materials

A. Publication Lists

B. Project Details

A. Publication Lists

Publications in Journal (topical review)

1. 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]
2. **Y.F. Huang** and M. Wang*. Electrokinetics at liquid-liquid interfaces: physical models and transport mechanisms. ***Advances in Colloid and Interface Science*** (under review)
3. **Y.F. Huang** and M. Wang*. Electrokinetic multiphase hydrodynamics, from fundamental physics to advanced methods. ***Applied Physics Reviews*** (under review)
4. **Y.F. Huang** and M. Wang*. Electrokinetics at liquid-liquid interfaces: mechanisms and applications. ***Chinese Journal of Theoretical and Applied Mechanics*** (under review) [in Chinese]
5. **Y.F. Huang**, Y.K. Yang, A. Alizadeh, H.Y. Chen, M. Wang*. Electrokinetic transport in saturated and unsaturated porous media: physics, methods and applications. ***Advances in Colloid and Interface Science*** (in preparation)

Publications in Journal (research paper - first (co-)author)

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[#], **Y.F. Huang**[#], 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[#], **Y.F. Huang**[#], 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
10. **Y.F. Huang** and M. Wang*. Electrophoresis of charged dielectric droplet with ion concentration polarization effect. ***Journal of Fluid Mechanics*** (under review)
11. **Y.F. Huang** and M. Wang*. Electrokinetic transport regulation at liquid-infused surface by liquid depletion and ion partition. ***Physical Review Fluids*** (under review)

Publications in Journal (education paper - first author)

12. **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]
13. **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]

Publications in Journal (research paper - others)

14. 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
15. W. Liu, **Y.F. Huang**, M. Wang*. Extended space charge and transport near ion-selective surfaces. *International Journal of Mechanical Science*, **287**: 109933, 2025
16. 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

17. 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
18. 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
19. W. Liu, **Y.F. Huang**, M. Wang*. Flow transition triggered by strong capacitive charging near polarizable metal interfaces. (in revision)
20. X.K. Lu, Q.Q. Li, G. Yang, **Y.F. Huang**, M. Wang*. Inertial accumulation effect on particle transport under low Stokes number and preferential flow control in disordered media. *Physical Review Fluids* (under review)

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
3. **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]
4. **Y.F. Huang**, M. Wang*. Hydrodynamics of low dimensional electron transport at micro-nanoscales (Oral & Paper). *CCTAM 2019*. Hangzhou, China. 2019.08 [in Chinese]

Patents (Chinese)

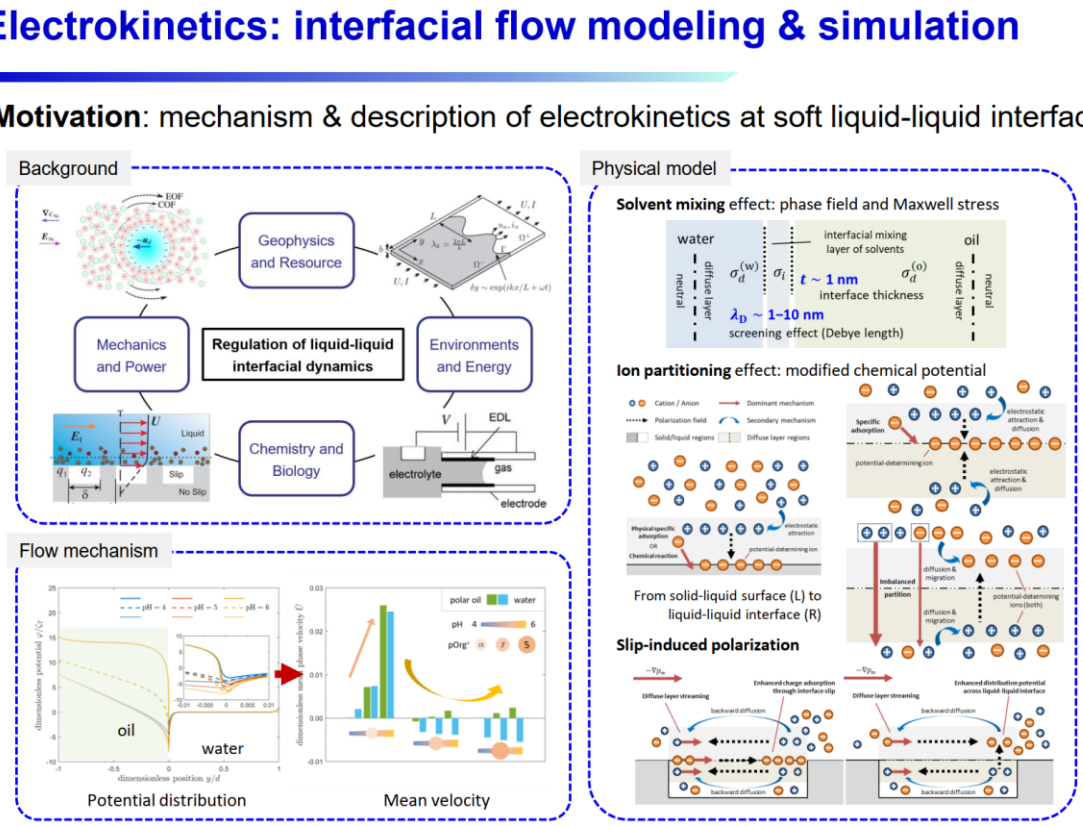
1. M. Wang, **Y.F. Huang** and F.L. Liu. A method and apparatus for measuring the charge density at the liquid-liquid interface, patent number ZL 2021 1 1448254.6, authorization number CN 114216950 B, 2024.
2. M. Wang, **Y.F. Huang**. A method, device, and system for in-situ measurement of the charge density at the immiscible liquid interface, application number 012434465, 2024.

Software copyrights (Chinese)

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

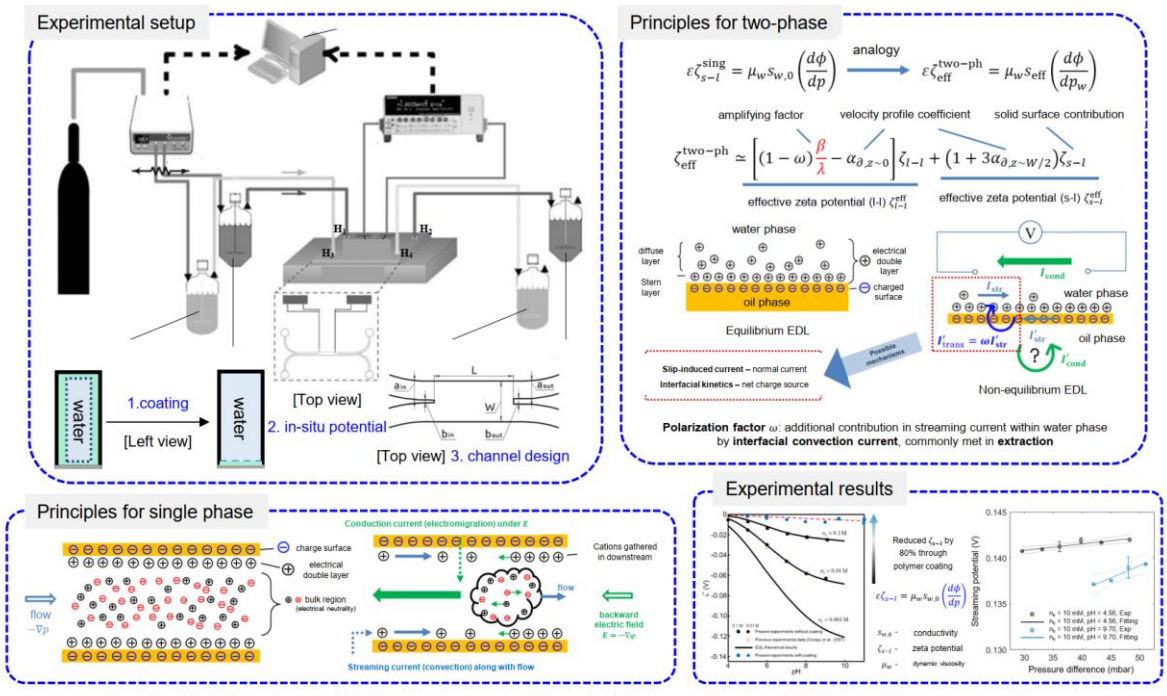
B. Project Details

Doctor dissertation (RETURN): Spontaneous charging and electrokinetic multiphase flow of immiscible liquid-liquid interface (I)



Y.F. Huang and M. Wang*. *PRFluids*, 2024 (**Editors' Suggestion**); *PRFluids* (to be submitted); Software copyrights * 1 (μ^3-Flows)

Doctor dissertation: Spontaneous charging and electrokinetic multiphase flow of immiscible liquid-liquid interface (II)

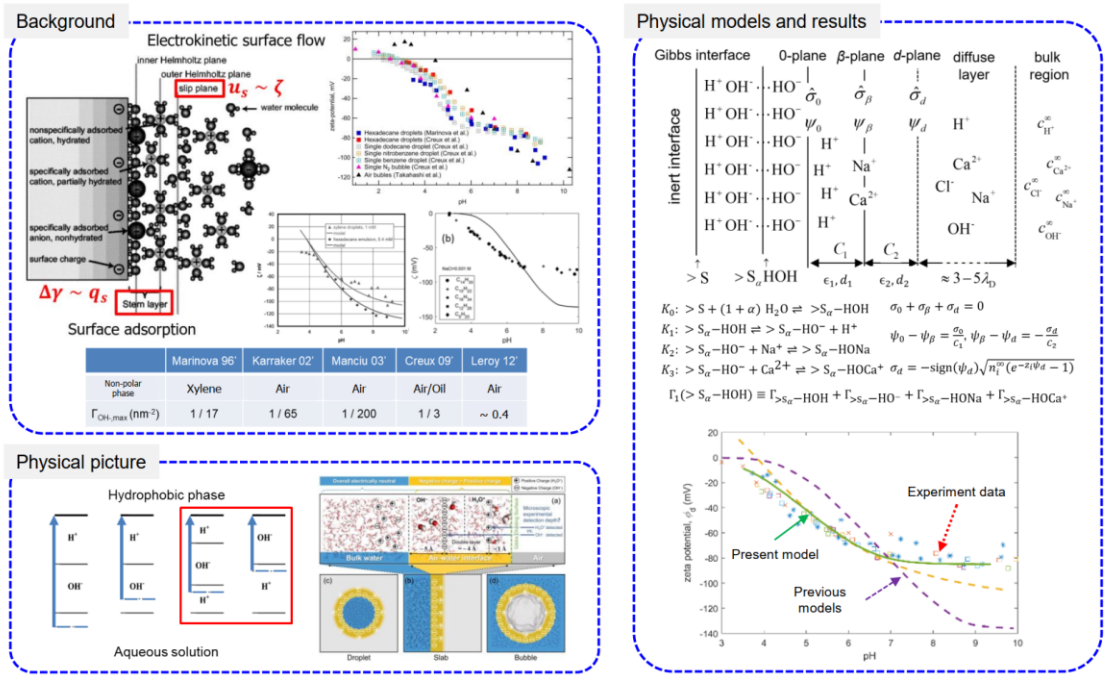


A. Alizadeh#, **Y.F. Huang**#, … and M. Wang*. *International Journal of Mechanical Sciences*, 2023; Patents * 2 (measurement)

Doctor dissertation: Spontaneous charging and electrokinetic multiphase flow of immiscible liquid-liquid interface (III)

Electrokinetics: interfacial charging modeling

Motivation: to describe dependency of interface charging to solution property



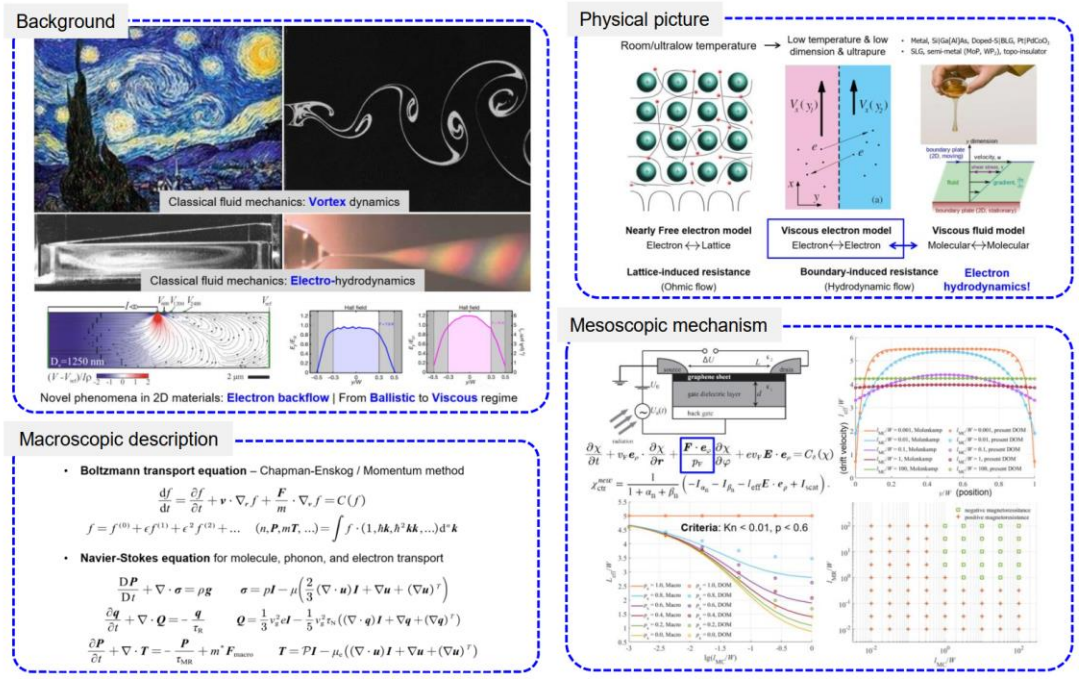
	Marinova 96'	Karraker 02'	Manciu 03'	Creux 09'	Leroy 12'
Non-polar phase	Xylene	Air	Air	Air/Oil	Air
$\Gamma_{OH,max}$ (nm^{-2})	1 / 17	1 / 65	1 / 200	1 / 3	~ 0.4

Y.F. Huang and M. Wang*. *Langmuir* (in preparation)

Undergraduate thesis (RETURN): Electron hydrodynamics in micro/nanoscale low-dimensional materials

Quantum kinetics: electron hydrodynamics

Motivation: mechanism & description of super-ballistic viscous electron transport

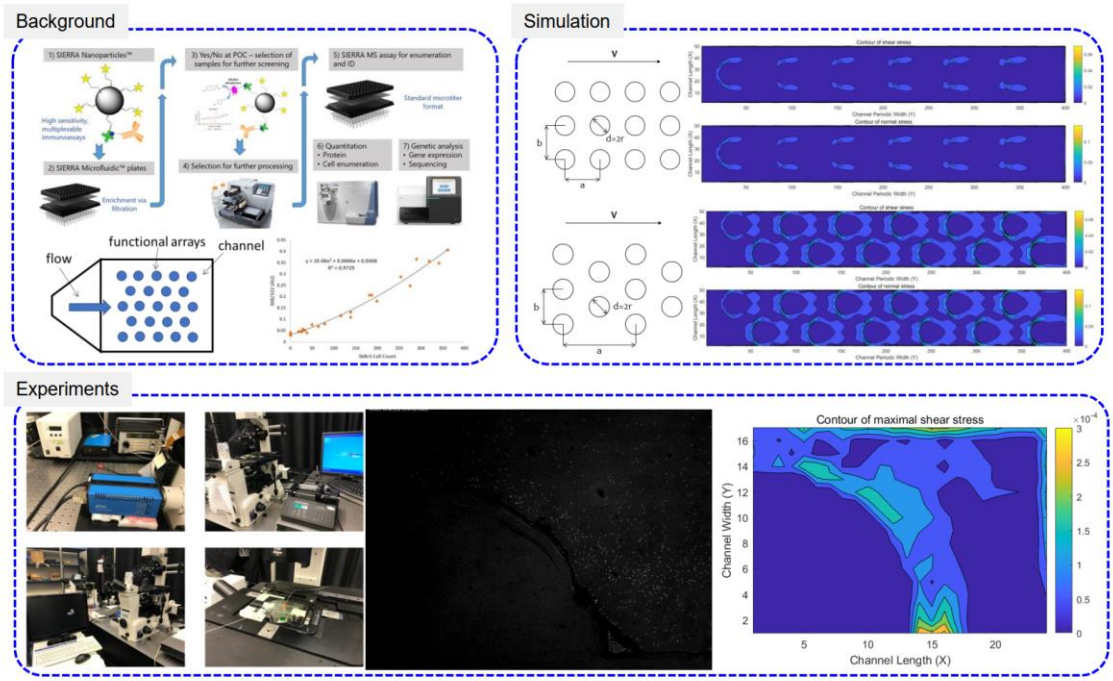


Y.F. Huang and M. Wang*. *Physical Review B*, 2021; Bachelor thesis with honor

TEEP-SURF (RETURN): Optimization of the pillar array distribution for rare cell analysis in point-of-care diagnostics

Supplement: micro-PIV for rare-cell analysis optimization

Motivation: to achieve better reaction efficiency by optimizing pillar array structure



TEEP-APC (RETURN): Development of complex elements and multifunctional finite element programs for cable-stayed bridges

Supplement: finite element method for bridge problem

Motivation: to incorporate elements and functions into prescribed C++ program