



## 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](#)

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### Education Background

➤ **2019/08-(2025)** *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 (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+***

- 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 (first author)***

1. **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 (**Editors' Suggestion**)
2. **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; education]
3. 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
4. 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
5. **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
6. **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; education]
7. **Y.F. Huang** and M. Wang\*. Review of spontaneous charging and electrokinetic flow at liquid-liquid interface (I): historical overview and applications. (to be submitted)
8. **Y.F. Huang** and M. Wang\*. Review of spontaneous charging and electrokinetic flow at liquid-liquid interface (II): essential physics and typical phenomena. (to be submitted)
9. **Y.F. Huang** and M. Wang\*. Review of spontaneous charging and electrokinetic flow at liquid-liquid interface (III): theory, simulation and experiment. (to be submitted)
10. **Y.F. Huang** and M. Wang\*. Reduced streaming potential within electrolyte-solution-infused surface induced by interface concentration polarization. (to be submitted)

### ***Publications in Journal (others)***

11. 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
12. B. Liu, **Y.F. Huang**, M. Wang\*. Physics and modeling of phonon wave behaviors in nanoscale heat conduction. *Chinese Journal of Computational Physics*, In Press, 2024 [in Chinese]
13. 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
14. 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
15. W. Liu, **Y.F. Huang**, M. Wang\*. Extended space charge in electroconvective flow near ion-selective surfaces. *IJMS* (under review)
16. W. Liu, **Y.F. Huang**, M. Wang\*. Flow transition triggered by strong capacitive charging near polarizable metal interfaces. (under review)
17. M.B. Zhang, Z.G. Tian, **Y.F. Huang**, M. Wang\*. Flow regimes and criteria of gas flow in porous media by experiments. *PRF* (under review)
18. 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. *JFM* (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). *NCFIuid 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)***

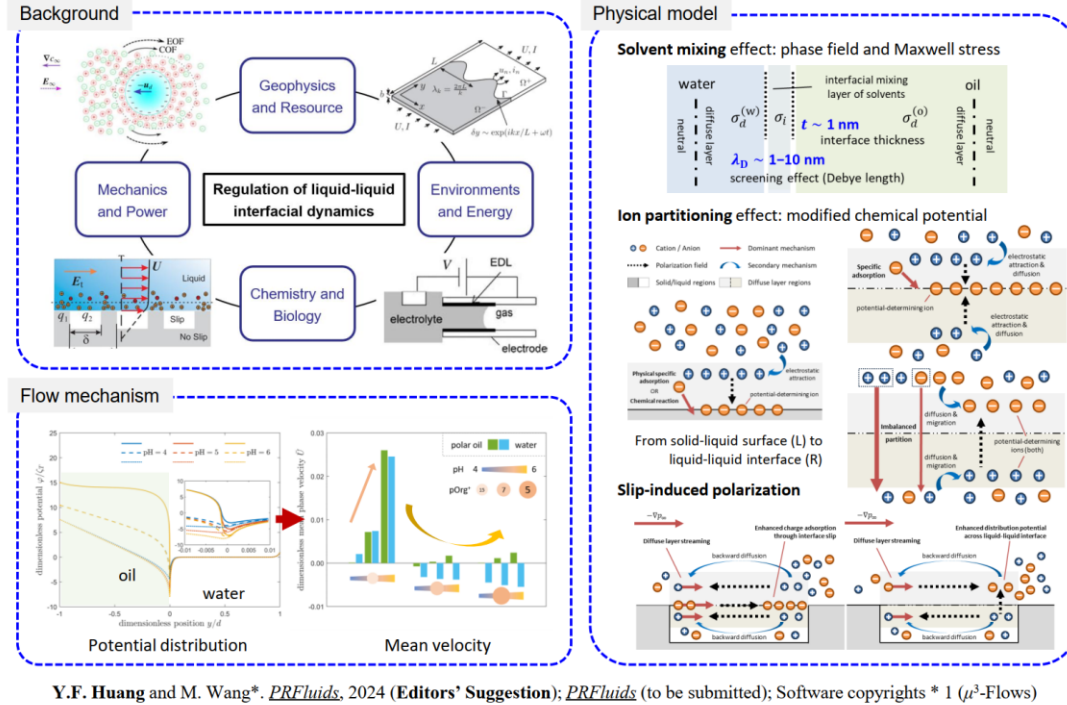
3. M. Wang, G. Yang, H.Y. Chen, and **Y.F. Huang**. Multi-physics, multi-phase, multi-scale flow simulation software ( $\mu^3$ -Flows), registration number 2024SR0160474, 2024.

## B. Project Details

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

## Electrokinetics: interfacial flow modeling & simulation

**Motivation:** mechanism & description of electrokinetics at soft liquid-liquid interface

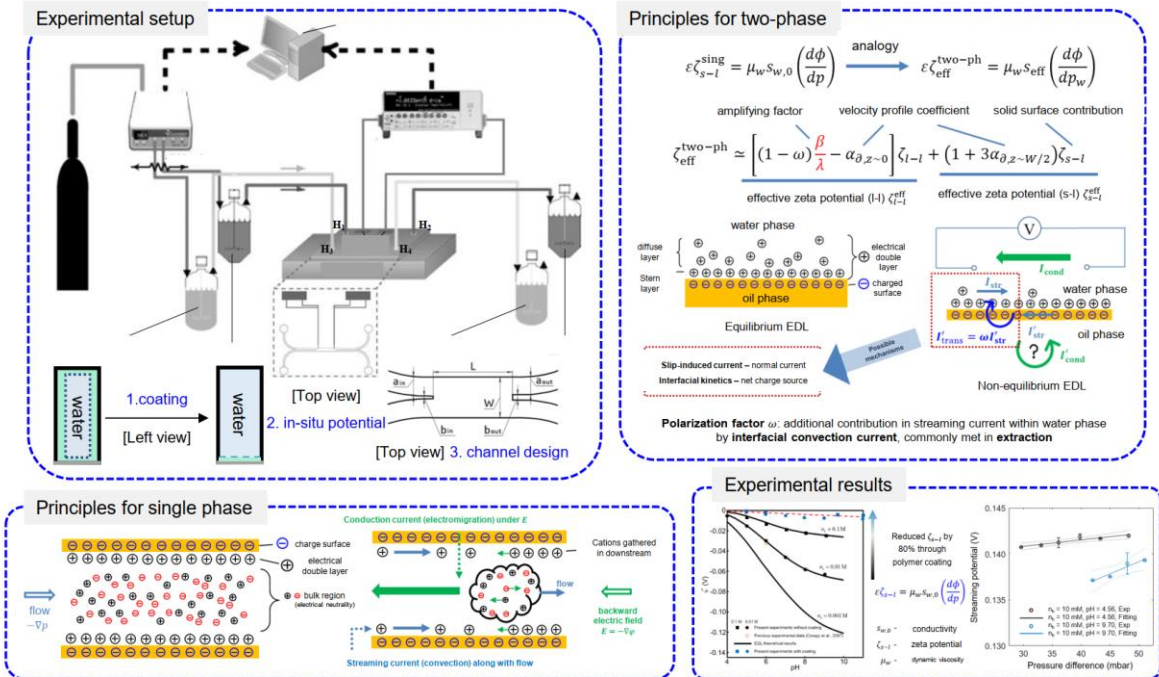


Y.F. Huang and M. Wang\*. *PRFluids*, 2024 (Editors' Suggestion); *PRFluids* (to be submitted); Software copyrights \* 1 ( $\mu^3$ -Flows)

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

## Electrokinetics: interfacial charging measurement

**Motivation:** to overcome limitations of traditional droplet electrophoresis method

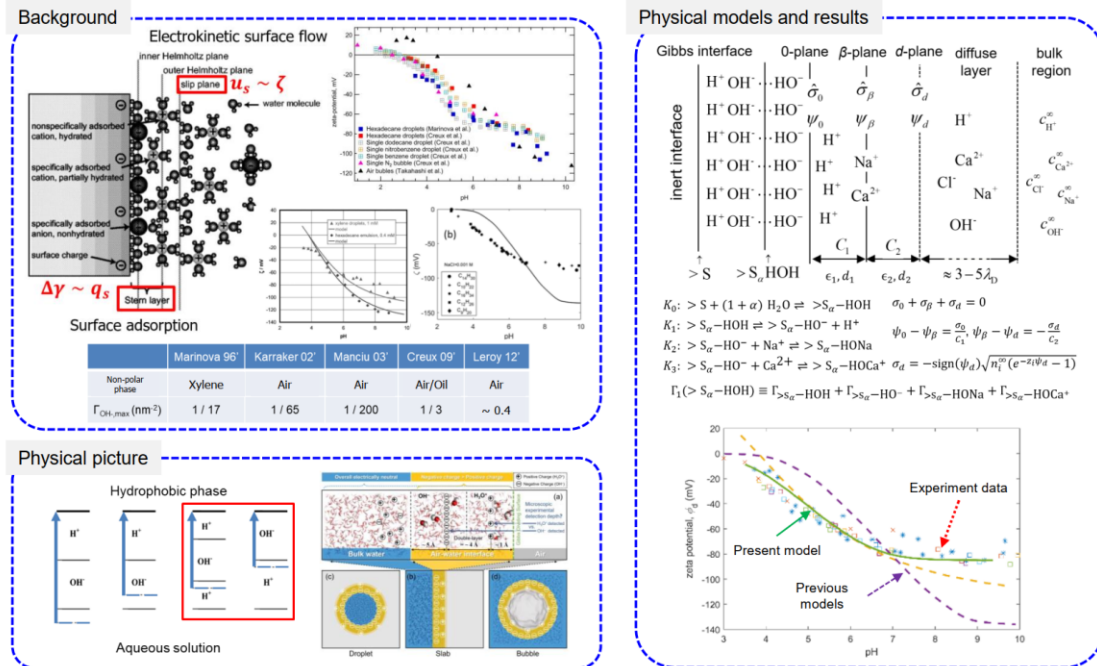


A. Alizadeh#, Y.F. Huang#, ... and M. Wang\*. *International Journal of Mechanical Sciences*, 2023; Patents \* 2 (measurement)



## Electrokinetics: interfacial charging modeling

**Motivation:** to describe dependency of interface charging to solution property

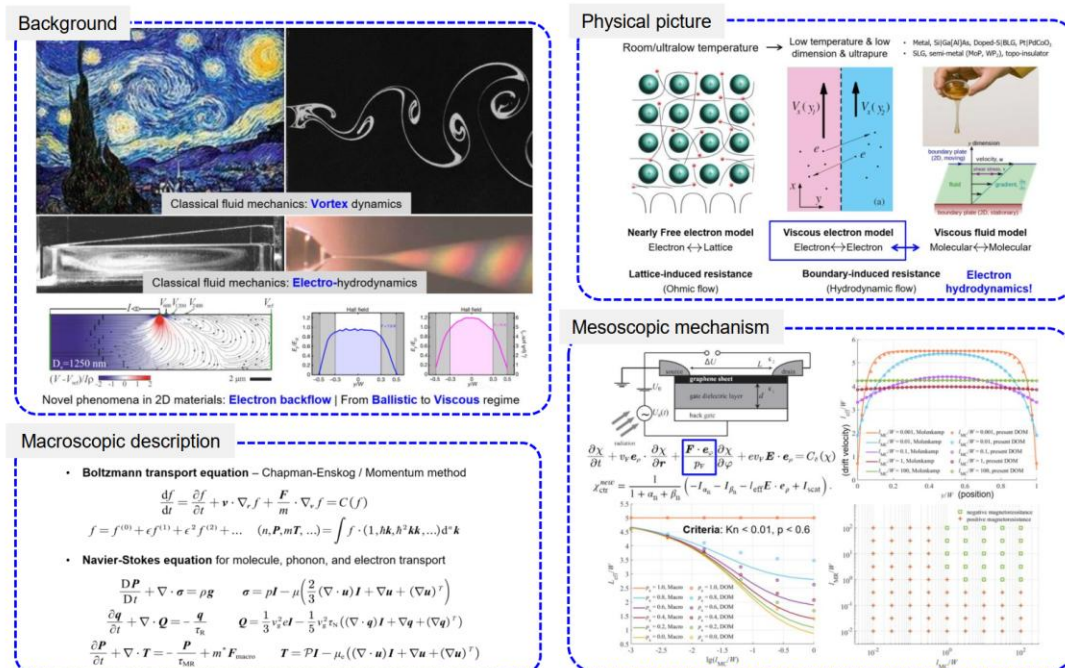


Y.F. Huang and M. Wang\*. *Langmuir* (in preparation)

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

## Quantum kinetics: electron hydrodynamics

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

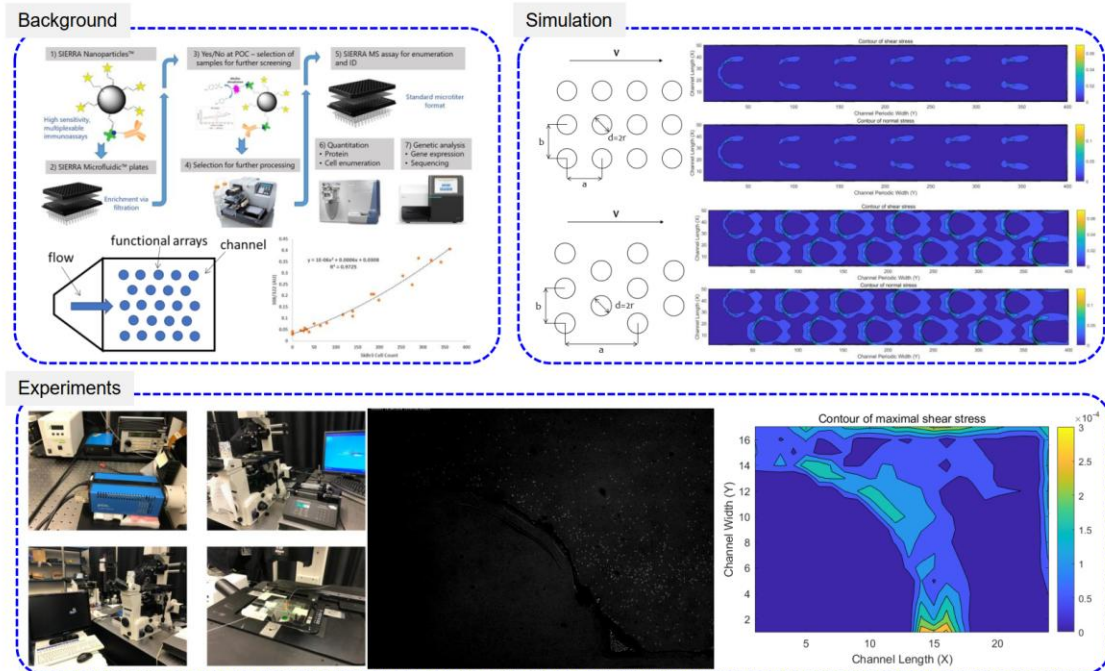


Y.F. Huang and M. Wang\*. *Physical Review B*, 2021; Bachelor thesis with honor

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

