Wei Su

Research Associate
University of Strathclyde

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- My research mainly focuses on the computational rarefied gas dynamics, with emphasis in developing accurate and efficient numerical methods for kinetic equations and multiscale simulation.
- I am interested in studying the rarefied gas flow phenomena with a variety of engineering applications, e.g. high-altitude flight, micro-electro-mechanical system, unconventional gas production and vacuum science. Exploiting the unique features of rarefied gas to improve and innovate technologies is my long-term research goal.
- I am also interested in the sophisticated modeling of nonequilibrium relaxation in shock-heated flow, occurring in the context of space exploration.

EDUCATION

PhD. Eng. 2015
Beihang University *Beijing, China*

· in **Aerospace Propulsion Theory and Engineering**
· Thesis: *'Solving Boltzmann model equations with high-order Runge-Kutta discontinuous Galerkin method: the research and application'*
· Grade: A level

BSc. Eng. 2008
Beihang University *Beijing, China*

· in **Aerospace Power Engineering**
· GPS: 3.6/4.0

EXPERIENCES

Research Associate October 2018 - Present
James Weir Fluids Laboratory, University of Strathclyde *Glasgow, UK*

Visiting Researcher October 2017 - September 2018
James Weir Fluids Laboratory, University of Strathclyde *Glasgow, UK*

Postdoctoral Researcher November 2015 - December 2016
Institute of Nanotechnology, Consiglio Nazionale delle Ricerche *Bari, Italy*

Visiting PhD Student September 2011 - September 2012
School of Aeronautics and Astronautics, Purdue University *West Lafayette, USA*

Visiting Undergraduate Student January 2008 - June 2008
ESTACA Ecole D'Ingenieurs *Paris, France*

AWARDS

Innovative Award 2019, Northwestern Polytechnical University, China
Young Researcher Innovative Award, Symposium on 'Modelling and Numerical Methods for Non-Equilibrium Transport Problem'

ROW 2017, Technical University of Munich, Germany
Travel fellowship for 'Research Opportunities Week' *50 (in 273 applicants) PhD students worldwide*

National Scholarship 2012, Chinese Government
National Scholarship for Postgraduate Students *top 0.2% postgraduate students nationwide*

International Scholarship 2011, Chinese Scholarship Council
Support the visiting study in Purdue University

Oversea Scholarship 2008, Beihang University, China
Support the visiting study in ESTACA

Excellent Student 2007, China Aerospace Science and Technology Corporation
Industrial Scholarship *Third-class*

Excellent Academic Performance 2005/2006/2007, Beihang University, China
Scholarship for Excellent Academic Performance *First-class*

Excellent Student 2005, Shanghai Baosteel Group Corporation, China
Industrial Scholarship *Third-class*

GRANTS

National Science Foundation for Young Researcher January 2014 – December 2016
Co-PI, £30,000 *Chinese Government*

· Topic: *'The direct numerical simulation of Boltzmann model equations based on high-order Runge-Kutta discontinuous Galerkin method'*

Innovation Foundation for Postgraduate Student September 2010 – August 2011
PI, £1,500 *Beihang University*

· Topic: *'Extension of the low diffusion particle method in simulating near continuum two-phase flow'*

MENTORING

Undergraduate Teaching January 2019 – May 2020
ME301 Mass and Flow *University of Strathclyde*

· Lead tutorials and mark examinations

Undergraduate Teaching October 2018 – February 2020
ME107/EF016 Experimental and Laboratory Skills: Wind Tunnel *University of Strathclyde*

· Demonstrate and mark experimental reports

Undergraduate Project January 2018 – May 2019
Co-supervision *University of Strathclyde*

· Topic #1: *'The rarefied gas properties of porous media constructed by Sierpinski carpet and channel with rectangular obsacles'*
· Topic #2: *'Investigation of gas flow through fractal structures'*
· Topic #3: *'Investigation of rarefied gas flows through 2D Bifurcating channels using the BGK model of the Boltzmann equation'*, Best Project Award of Institute of Mechanical Engineers

Bachelor Thesis January 2015 – June 2015
Supervision *Beihang Univeristy*

· Topic : *'RKDG based adaptive mesh for 1D Boltzmann kinetic model equation'*

PUBLICATIONS

Journal Submissions

[1] **W Su**, Y Zhang, L Wu (2020). Multiscale simulation of molecular gas flows by the general synthetic iterative scheme. Submitted to *Computer Methods in Applied Mechanics and Engineering*

[2] L Zhu, X Pi, **W Su**, Y Zhang, L Wu (2020). General synthetic iteration scheme for gas-kinetic simulation of multi-scale rarefied gas flows. *Submitted to Journal of Computational Physics*

Journal Publications

[3] **W Su**, L Zhu, L Wu (2020). Fast convergence and asymptotic preserving of the general synthetic iterative scheme. *SIAM Journal on Scientific Computing*. Accepted

[4] P Wang, **W Su**, L Wu (2020). Thermal transpiration in molecular gas. *Physics of Fluids*, 32: 082005.

[5] **W Su**, M T Ho, Y Zhang, L Wu (2020). GSIS: an efficient and accurate numerical method to obtain the apparent gas permeability of porous media. *Computers & Fluids*, 206: 104576.

[6] M T Ho, J Li, **W Su**, L Wu, M Borg, Y Zhang (2020). Rarefied flow separation in microchannel with bends. *Journal of Fluid Mechanics*, 901: A26.

[7] **W Su**, P Wang, Y Zhang, L Wu (2020). Implicit discontinuous Galerkin method for the Boltzmann equation with full collision operator. *Journal of Scientific Computing*, 82: 39.

[8] **W Su**, L Zhu, P Wang, Y Zhang, L Wu (2020). Can we find steady-state solutions to multiscale rarefied gas flows within dozens of iterations? *Journal of Computational Physics*, 407: 109245.

[9] **W Su**, P Wang, Y Zhang (2019). High-order hybridizable discontinuous Galerkin method for the gas kinetic equation. *International Journal of Computational Fluid Dynamics*, 33: 335-342. (Invited paper on the special issue of 'Discontinuous Galerkin methods: new trends and applications')

[10] **W Su**, P Wang, H Liu, L Wu (2019). Accurate and efficient computation of the Boltzmann equation for Couette flow: influence of intermolecular potentials on Knudsen layer function and viscous slip coefficient. *Journal of Computational Physics*, 378: 573-590.

[11] P Wang, **W Su**, L Zhu, Y Zhang (2019). Heat and mass transfer of oscillatory lid-driven flow in the continuum, transition and free molecular flow regimes. *International Journal of Heat and Mass Transfer*, 131: 291-300.

[12] **W Su**, P Wang, Y Zhang, L Wu (2019). A high-order hybridizable discontinuous Galerkin method with fast convergence to steady-state solutions of the gas kinetic equation. *Journal of Computational Physics*, 376: 973-991.

[13] P Wang, **W Su**, Y Zhang (2018). Oscillatory rarefied gas flow inside a three dimensional rectangular cavity. *Physics of Fluids*, 30: 102002.

[14] W Liu, G Tang, **W Su**, L Wu, Y Zhang (2018). Rarefaction throttling effect: Influence of the bend in micro-channel gaseous flow.' *Physics of Fluids*, 30: 082002.

[15] P Wang, L Zhu, **W Su**, L Wu, Y Zhang (2018). Nonlinear oscillatory rarefied gas flow inside a rectangular cavity. *Physical Review E*, 97: 043103.

[16] **W Su**, H Liu, Y Zhang, L Wu (2017). Rarefaction cloaking: Influence of the fractal rough surface in gas slider bearings. *Physics of Fluids*, 29: 102003.

[17] **W Su**, D Bruno, Y Babou (2017). State-specific modeling of vibrational relaxation and nitric oxide formation in shock-heated air. em Journal of Thermophysics and Heat Transfer, 32: 337-352.

[18] **W Su**, S Lindsay, H Liu, L Wu (2017). Comparative study of the discrete velocity and lattice Boltzmann methods for rarefied gas flows through irregular channels. *Physical Review E*, 96: 023309.

[19] **W Su**, Z Tang, B He, G Cai (2017). A stable Runge-Kutta discontinuous Galerkin solver for hypersonic rarefied gaseous flows based on 2D Boltzmann kinetic equations. *Applied Mathematics and Mechanics*, 38: 343-362.

[20] **W Su**, A Alexeenko, G Cai (2015). A parallel Runge-Kutta discontinuous Galerkin solver for rarefied gas flows based on 2D Boltzmann kinetic equations. *Computers & Fluids*, 109: 123-136.

[21] **W Su**, X He, G Cai (2013). Extension of the low diffusion particle method for near-continuum two-phase flow simulations. *Chinese Journal of Aeronautics*, 26: 37-46.

[22] G Cai, **W Su**, F Hou (2012). Theoretical development for DSMC local time stepping technique. *Science China: Technological Sciences*, 55: 2750-2756.

Conference Proceedings

[23] **W Su**, D Bruno, Y Babou (2017). Investigations of vibrational kinetic relaxation within air shock wave plasma. *Journal of Physics: Conference Series*, 815: 012026.

[24] **W Su**, D Bruno, Y Babou (2016). Vibrational specific simulation of nonequilibrium radiation from shock-heated air. *AIP Conference Proceedings*, 1786: 150001.

[25] **W Su**, B He, G Cai (2014). A stable Runge-Kutta discontinuous Galerkin solver for hypersonic rarefied gaseous flows. *AIP Conference Proceedings*, 1628: 980-987.

[26] **W Su**, A Alexeenko, G Cai (2012). A Runge-Kutta Discontinuous Galerkin solver for 2D Boltzmann model equations: verification and analysis of computational performance. *AIP Conference Proceedings*, 1501: 381-388.

TALKS

1. *'Solving the gas kinetic equation using synthetic iteration method'*
   9th International Congress on Industrial and Applied Mathematics, July 2019, Valencia, Spain
2. *'Can we find steady-state solutions to multiscale rarefied gas flows within dozens of iterations?'*
   3th Symposium on Modelling and Numerical Methods for Non-Equilibrium Transport Problem, June 2019, Xi'an, China
3. *'A high-order hybridizable discontinuous Galerkin method for gas kinetic equation'*
   7th European Conference on Computational Fluid Dynamics, June 2018, Glasgow, UK
4. *'Investigations of vibrational kinetic relaxation within air shock wave plasma'*
   7th International Workshop on Radiation of High Temperature Gases in Atmospheric Entry, September 2016, Stuttgart, Germany
5. *'Vibrational specific simulation of nonequilibrium radiation from shock-heated air'*
   30th International Symposium on Rarefied Gas Dynamics, July 2016, Victoria BC, Canada
6. *'A stable Runge-Kutta discontinuous Galerkin solver for hypersonic rarefied gaseous flows'*
   29th International Symposium on Rarefied Gas Dynamics, July 2014, Xi'an, China
7. *'A Runge-Kutta discontinuous Galerkin solver for 2D Boltzmann model equations'*
   28th International Symposium on Rarefied Gas Dynamics, July 2012, Zaragoza, Spain

IN-HOUSE CODES

GSIS/GSIS-Poly FORTRAN & OpenMP
'Multi-scale simulation for monatomic/molecular gas flow by general synthetic iterative scheme'

DG-FSM FORTRAN & OpenMP
'1D/2D implicit DG solver combining FSM for solution of the Boltzmann equation'

HDG FORTRAN & OpenMP & MPI
'2D HDG solver for the kinetic model equations and linearized Navier-Stokes equations'

RKDG C/C++ & MPI
'2D planar/axial RKDG solvers for the Boltzmann kinetic model equations'

StS FORTRAM
'1D state-specific simulation solver for vibrational kinetics in shock-heated air'

DSMC-LD C & MPI
'Coupled DSMC and low-diffusion particle solvers for multi-scale two-phase rarefied gas flow'

INDUSTRIAL PROJECTS

Chinese Academy of Space Technology 2009 – 2013

Main Participants *Intensive group work with colleagues, professors and experts from industry*

- Topic #1: *'Numerical and experimental analysis on the plume effects of CHANG'E-III main thruster during its landing'*
- Topic #2: *'Numerical simulation on the plume effects of SHENZHOU-VIII spacecraft on TIANGONG-I space lab during docking and separating'*

SERVICES

Peer-Review for Journals

Journal of Computational Physics, Physics of Fluids, Computer & Fluids, Vacuum, Advanced in Applied Mathematics and Mechanics, International Journal of Computational Fluid Dynamics