

# LIN FU

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## BACKGROUND

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## ACADEMIC CAREER

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**Center for Turbulence Research, Stanford University** *Jan. 2018 -*  
**CTR Postdoctoral fellow**  
Supervisor: Parviz Moin

**Center for Turbulence Research, Stanford University** *Jun. 24 - Jul. 20, 2018*  
**CTR Summer Program 2018**

**Department of Mechanical Engineering, Technical University of Munich** *Sep. 2017 - Dec. 2017*  
**Postdoctoral fellow**  
Supervisor: Prof. Nikolaus A. Adams

## EDUCATION

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**Technical University of Munich, Germany** *2013-2017*  
**Ph.D.**, Fluid Mechanics  
Grade: **summa cum laude (passed with highest distinction)**  
Supervisor: Prof. Nikolaus A. Adams and PD Dr.-Ing. habil. Xiangyu Hu

**Northwestern Polytechnical University, P.R. China** *2010-2013*  
**Master of Science**, Fluid Mechanics  
Grade: 90.15%  
Supervisor: Prof. Zhenghong Gao

**Northwestern Polytechnical University, P.R. China** *2006-2010*  
**Bachelor of Science**, Aerospace Engineering  
Grade: 90.2% (Top 2/300)

## RESEARCH PROJECTS

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**Transitional shock-wave/boundary-layer interactions in hypersonic flow** *Jan. 2018-  
Co-PI* *Center for Turbulence Research, Stanford University*

- Funded by U.S. Air Force Office of Scientific Research (AFOSR), Grant NO. 1194592-1-TAAHO.
- Supervisor: Prof. Parviz Moin.

## RESEARCH TOPICS

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### **Turbulence and modeling**

- Incompressible and compressible wall-bounded turbulence.
- Isotropic turbulence and shock-turbulence interaction.
- Subgrid-scale (SGS) model.
- Wall-modeled large-eddy simulation.
- Shock-boundary-layer interaction.
- Shock-induced transition.
- Flow stability.

### **High-order numerical scheme for conservation laws**

- Novel high-order TENO schemes (targeted ENO) for hyperbolic conservation laws.
- Low-dissipation low-dispersion optimal finite-difference schemes.
- Novel implicit large eddy simulation (ILES) model.
- New TENO reconstruction framework.

### **Interface tracking method for multi-phase flow**

- Multi-scale and multi-resolution simulations.
- Low-dissipation numerical approach for level-set based interface advection.
- Explicit reinitialization and extending algorithm for level-set function.
- Compressible multi-phase flow simulations based on sharp interface method.

### **Smoothed-particle hydrodynamics (SPH) method**

- Numerical discretization algorithms for SPH method.
- Large-scale simulation framework for SPH method.

### **Partitioning and domain decomposition methods**

- Novel physics-driven SPH based partitioning method for Adaptive Mesh Refinement (AMR) mesh.
- Novel Centroidal Voronoi Particle (CVP) based domain decomposition method.
- Large-scale parallelization algorithms for the partitioning method.

### **Unstructured mesh generation**

- Novel SPH based isotropic and anisotropic unstructured mesh generation.
- Novel CVP based mesh generation.
- Multi-material/regional unstructured mesh generation.
- Partitioning and parallel algorithms for adaptive unstructured mesh.

### **RANS methodology for aerodynamics**

- CPU and GPU based parallel multi-block flow solvers for complex geometries, e.g. aircraft.
- High-resolution numerical methods, e.g. Riemann solver and reconstruction schemes.
- State-of-the-art turbulence models for engineering problems.

## PUBLICATIONS

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### Ph.D. thesis

- **Lin Fu**, Ph.D thesis, Numerical methods for computational fluid dynamics - a new ENO paradigm and a new domain decomposition method, Technical University of Munich, Germany, Oct. 2nd, 2017, **summa cum laude (passed with highest distinction)**.

### Patent

- 1 Method and system for generating a mesh, Xiangyu Hu, **Lin Fu (the first author as a Ph.D. student and the major contributor)**, Luhui Han, Nikolaus Adams, EP3255611, Dec. 13, 2017.

**Journal papers** (*J. Comput. Phys.* 5, *Comput. Methods. Appl. Mech. Eng.* 2, *Comput. Phys. Commun.* 4, *Commun. Comput. Phys.* 3, *J. Sci. Comput* 1, *Comput. Fluids* 1, *AIAA J.* 1)

- 21 **Fu, Lin**; Tang, Qi; High-order low-dissipation targeted ENO schemes for ideal magnetohydrodynamics, *Journal of Scientific Computing*, Accepted, in press, 2019.
- 20 **Fu, Lin**; et al. ; An isotropic unstructured mesh generation method based on a fluid relaxation analogy, *Computer Methods in Applied Mechanics and Engineering*, Accepted, in press, 2019.
- 19 Ji, Zhe; **Fu, Lin**; et al. ; A Lagrangian Inertial Centroidal Voronoi Particle method for dynamic load balancing in particle-based simulations, *Computer Physics Communications*, Accepted, in press, 2019.
- 18 **Fu, Lin**; A hybrid method with TENO based discontinuity indicator for hyperbolic conservation laws, *Communications in Computational Physics*, Accepted, in press, 2018.
- 17 **Fu, Lin**; et al. ; Parallel fast-neighbor-searching and communication strategy for particle-based methods, *Engineering Computations*, Accepted, in press, 2018.
- 16 **Fu, Lin**; et al. ; Improved Five- and Six-Point Targeted Essentially Nonoscillatory Schemes with Adaptive Dissipation, *AIAA Journal*, Vol. 57, No. 3 (2019), pp. 1143-1158.
- 15 **Fu, Lin**; A low-dissipation finite-volume method based on a new TENO shock-capturing scheme, *Computer Physics Communications*, Volume 235, February 2019, Pages 25-39.
- 14 Ji, Zhe; **Fu, Lin**; et al. ; A new multi-resolution parallel framework for SPH, *Computer Methods in Applied Mechanics and Engineering*, 346 (2019) 1156-1178.
- 13 **Fu, Lin**; Ji, Zhe ; An optimal particle setup method with Centroidal Voronoi Particle dynamics, *Computer Physics Communications*, Volume 234, January 2019, Pages 72-92.
- 12 **Fu, Lin**; et al. ; A new class of adaptive high-order targeted ENO schemes for hyperbolic conservation laws, *Journal of Computational Physics*, Volume 374, 1 December 2018, Pages 724-751.
- 11 **Fu, Lin**; et al. ; A targeted ENO scheme as implicit model for turbulent and genuine subgrid scales, *Communications in Computational Physics*, Accepted, in press, 2018.
- 10 Dong, Haibo; **Fu, Lin**; Zhang, Fan; et al. ; Detonation simulations with a fifth-order TENO scheme, *Communications in Computational Physics*, 25 (2019), pp. 1357-1393.
- 9 **Fu, Lin**; et al. ; Single-step reinitialization and extending algorithms for level-set based multi-phase flow simulations, *Computer Physics Communications*, Volume 221, December 2017, Pages 63-80.
- 8 **Fu, Lin**; et al. ; Targeted ENO schemes with tailored resolution property for hyperbolic conservation laws, *Journal of Computational Physics*, Volume 349, 15 November 2017, Pages 97-121.
- 7 **Fu, Lin**; et al. ; A physics-motivated Centroidal Voronoi Particle domain decomposition method, *Journal of Computational Physics*, Volume 335, 15 April 2017, Pages 718-735.
- 6 **Fu, Lin**; et al. ; A novel partitioning method for block-structured adaptive meshes, *Journal of Computational Physics*, Volume 341, 15 July 2017, Pages 447-473.
- 5 **Fu, Lin**; et al. ; A family of high-order targeted ENO schemes for compressible-fluid simulations, *Journal of Computational Physics* 305 (2016): 333-359.
- 4 **Fu, Lin**; et al. ; A multi-block viscous flow solver based on GPU parallel methodology, *Computers and Fluids* 95 (2014): 19-39.

- 3 **Fu, Lin**; et al. ; Application on MLP high order reconstruction scheme, *Journal of Aerospace Power*, vol. 29, no. 10, pp. 23212330, 2014.
- 2 **Fu, Lin**; et al. ; High order WENO scheme based on HLL-HLLC solver and its application, *Chinese Journal of Computational Mechanics*, vol. 31, no. 1, pp. 128-134, 2014.
- 1 **Fu, Lin**; et al. ; Construction and application research of HLL-HLLC scheme, *Acta Aerodynamica Sinica*, vol. 32, no. 1, pp.116-122, 2014.

### Archival publications

- 2 **Fu, Lin**; Karp, Michael; Bose, Sanjeeb; Moin, Parviz; Urzay, Javier; “Equilibrium wall-modeled LES of shock-induced aerodynamic heating in hypersonic boundary layers,” *Ann. Res. Briefs 2018*, Center for Turbulence Research, Stanford University.
- 1 Gao, Xiangyu; Buchmeier, Jonas; Bermejo-Moreno, Ivan; Larsson, Johan; **Fu, Lin**; Lele, Sanjiva; “Scalar mixing under shock/turbulence interaction: DNS, statistical and geometric analyses,” *Proceedings of the Summer Program 2018*, Center for Turbulence Research, Stanford University.

### Conference papers

- 19 **Fu, Lin**; “Reviewing of High-order TENO Schemes for Hyperbolic Conservation Laws,” SIAM Conference on Computational Science and Engineering, Feb. 24, 2019 - Mar. 01, 2019, Spokane, Washington USA.
- 18 **Fu, Lin**; et al.; “ WMLES of shock-induced aerodynamic heating in hypersonic boundary layers,” The Thermal & Fluid Sciences Affiliates Program (TFSA), February 5-6, 2019, Stanford University, USA.
- 17 Buchmeier, Jonas; Gao, Xiangyu; Bermejo-Moreno, Ivan; Larsson, Johan; Lele, Sanjiva; **Fu, Lin**; “ Time-evolution of passive scalar structures in shock-turbulence interaction,” The 71st Annual Meeting of the American Physical Societys Division of Fluid Dynamics (DFD), November 18-20, 2018, the Georgia World Congress Center in Atlanta, Georgia, USA.
- 16 Gao, Xiangyu; Bermejo-Moreno, Ivan; Larsson, Johan; **Fu, Lin**; Lele, Sanjiva; “ Flow Topology and Alignment Analysis of Passive Scalar Mixing in Shock Turbulence Interaction,” The 71st Annual Meeting of the American Physical Societys Division of Fluid Dynamics (DFD), November 18-20, 2018, the Georgia World Congress Center in Atlanta, Georgia, USA.
- 15 **Fu, Lin**; et al.; “ Equilibrium wall-modeled LES of shock-induced aerodynamic heating in hypersonic boundary layers,” The 71st Annual Meeting of the American Physical Societys Division of Fluid Dynamics (DFD), November 18-20, 2018, the Georgia World Congress Center in Atlanta, Georgia, USA.
- 14 **Fu, Lin**; Advances in PDEs: Theory, Computation and Application to CFD, August 20 - August 24, 2018, Institute for Computational and Experimental Research in Mathematics (ICERM), Brown University, USA.
- 13 **Fu, Lin**; et al.; “ High-order Targeted ENO Scheme for Turbulence Simulations,” The 13th World Congress in Computational Mechanics, July 22, 2018 - July 27, 2018, New York, USA.
- 12 Ji, Zhe; **Fu, Lin**; et al.; “ A Lagrangian inertial centroidal Voronoi particle method for dynamic load balancing in particle-based simulations,” 13th SPHERIC International Workshop, 26-28 June 2018, Galway, Ireland.
- 11 **Fu, Lin**; “Novel high order TENO schemes and new domain decomposition method,” The 2nd NPU Aoxiang Forum for Distinguished Young Scholars, November 15th to 20th, 2017, Xi’an, China.
- 10 **Fu, Lin**; et al.; “Implicit Large Eddy Simulations with a high-order TENO scheme,” Tenth International Symposium on Turbulence and Shear Flow Phenomena (TSFP10), July 6-9, 2017, Swissotel, Chicago-IL, USA.
- 9 **Fu, Lin**; et al.; “An unstructured-mesh generator based on SPH analogy,” The 17th Platform for Advanced Scientific Computing (PASC) Conference (PASC17), June 26 to 28, 2017, at Università della Svizzera italiana (USI), Lugano, Switzerland.

- 8 Ji, Zhe; **Fu, Lin**; et al.; “A new parallel framework for SPH method with adaptive smoothing-length,” 12th International Smoothed Particle Hydrodynamics European Research Interest Community (SPHERIC) Workshop (SPHERIC 2017), 13-15 June 2017, at the Universidade de Vigo (Ourense Campus), Spain.
- 7 **Fu, Lin**; et al.; “A new class of adaptive high-order TENO schemes for Hyperbolic Conservation Laws,” ECCOMAS Thematic Conference: European Conference on High Order Nonlinear Numerical Methods for Evolutionary PDEs: Theory and Applications, HONOM 2017, March 27 - March 31, 2017, University of Stuttgart, Germany.
- 6 **Fu, Lin**; et al.; “A high-order TENO scheme for the large eddy simulation of incompressible and compressible turbulence,” Frontiers in Applied and Computational Mathematics in honor of the 60th Birthday of Professor Chi-Wang Shu, Division of Applied Mathematics at Brown University, USA from January 4 - 6, 2017.
- 5 **Fu, Lin**; et al.; “A physics-motivated Centroidal Voronoi Particle domain decomposition method,” 11th International SPHERIC (SPHERIC 2016) Workshop at Technische Universität München (TUM) in Garching Germany, from June, 13-16, 2016.
- 4 **Fu, Lin**; et al.; “A family of high order targeted ENO scheme for compressible fluid simulations,” Ninth International Symposium On Turbulence and Shear Flow Phenomena (TSFP-9), the university of Melbourne, Australia from 30 June to 3 July, 2015.
- 3 **Fu, Lin**; et al.; “Explicit reinitialization and extending algorithms for level-set based sharp-interface method,” Ninth International Symposium On Turbulence and Shear Flow Phenomena (TSFP-9), the university of Melbourne, Australia from 30 June to 3 July, 2015.
- 2 **Fu, Lin**; et al.; “Physics-driven approach to load balancing in massively parallel CFD,” 2nd Frontiers in Computational Physics Conference: Energy Sciences, 3-5 June 2015, ETH university, Zurich, Switzerland.
- 1 **Fu, Lin**; et al.; “Numerical simulation of shock bubble interaction with a conservative sharp interface model,” 2nd International Conference on Numerical Methods in Multiphase Flows (ICNMMF-II), the university of Darmstadt, Germany, from June 30 to July 2 in 2014.

### Invited talks

- 3 **Fu, Lin**; “Recent development of the high order TENO schemes,” 4:30pm, February 08th, 2018, Department of Aeronautics & Astronautics, Stanford University, USA.
- 2 **Fu, Lin**; “The high order TENO schemes: concepts, methods and performances,” TURBULENCE TEA at 4:30pm, Friday, January 26th, 2018, CTR Conference Room, Stanford University, USA.
- 1 **Fu, Lin**; “Novel high order TENO schemes and new domain decomposition method,” State Key Laboratory for Mechanical Structural Strength and Vibration (SVL), Xi’an Jiaotong University, November 15th, 2017, Xi’an, China.

## PROFESSIONAL ACTIVITIES

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### Reviewing

- *Journal of Computational Physics (JCP)*, *Computer Methods in Applied Mechanics and Engineering (CMAME)*, *Journal of Scientific Computing (JSC)*, *Physics of Fluids (POF)*, *Advances in Computational Mathematics*, *Communications in Computational Physics (CICP)*, *Aerospace Science and Technology*, *Engineering Computations*, *CTR Summer Program (2018)*, *Energies*.

### Membership

- *American Physical Society (APS)*.
- *Society for Industrial and Applied Mathematics (SIAM)*.

### Organizer

- Minisymposia organizer and chair of **State-of-the-art high-order Numerical Methods and Complex Fluid Simulations**, *SIAM Conference on Computational Science and Engineering (CSE19)*, February 25 - March 1, 2019, Spokane Convention Center — Spokane, Washington, USA.

#### **Collaborators**

- Prof. Nikolaus Adams (Technical University of Munich), Prof. Parviz Moin (Stanford University), Dr. Javier Urzay (Stanford University), Dr. Qi Tang (Los Alamos National Laboratory), Dr. Sanjeeb Bose (Stanford University, Cascade Technologies), Dr. Michael Karp (Stanford University), Zhe Ji (Technical University of Munich), Yue Li (Technical University of Munich)

### **TEACHING & CO-DIRECTED PROJECTS**

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#### **Computational Solid and Fluid Dynamics**

- **Teaching Assistant / Grader** in Technical University of Munich (09.2013-09.2017)

#### **Flow Control and Shock Wave Boundary Layer Interaction**

- Ph.D. project of M.Sc. Yue Li in Technical University of Munich (09.2017-)
- Co-supervised with **Prof. Dr.-Ing. Nikolaus Adams**

### **HONORS & AWARDS**

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#### **Outstanding reviewer**

- Journal of Computational Physics (2017, 2018)

#### **Mathematical workshop travelling award**

- ICERM of Brown University (2018)

#### **CTR Postdoctoral fellowship**

- Stanford University (2018-2020)

#### **Ph.D. thesis award of summa cum laude (passed with highest distinction)**

- Technical University of Munich (2017)

#### **China Scholarship Council (CSC) scholarship**

- China Scholarship Council (NO. 201206290022) (2013-2017)

#### **The third prize in the competition of Mechanics**

- The Chinese Society of Theoretical and Applied Mechanics (2008)

#### **National scholarship**

- Chinese Ministry of Education (2008-2009)

#### **First-class scholarship**

- AVIC The First Aircraft Institute, China (2008-2009)

#### **First-class scholarship**

- China Airborne Missile Academy (2006-2007)

#### **Outstanding scholarship**

- Northwestern Polytechnical University (*2006-2010, 4 times*)

## REFEREES

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### **Prof. Parviz Moin**

- Email: [moin@stanford.edu](mailto:moin@stanford.edu)  
Director of the Center for Turbulence Research (CTR) at Stanford and Ames, Stanford University  
<https://web.stanford.edu/group/fpc/cgi-bin/fpcwiki/People/ParvizMoin>  
*Member of the American Academy of Arts and Sciences*  
*Member of the National Academy of Engineering*  
*Member of the National Academy of Sciences*  
*Fellow of the American Physical Society and AIAA*

### **Prof. Dr.-Ing. Nikolaus A. Adams**

- Email: [nikolaus.adams@tum.de](mailto:nikolaus.adams@tum.de)  
Chair of Aerodynamics and Fluid Mechanics, Technical University of Munich, Germany  
<https://www.aer.mw.tum.de/en/members/cv/prof-adams/>  
*Executive Editor of the Journal of Computational Physics (JCP)*  
*Fellow of the American Physical Society (APS)*

### **Prof. Feng Xiao**

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Department of mechanical engineering, Tokyo Institute of Technology, Japan  
<https://www.journals.elsevier.com/journal-of-computational-physics/editorial-board>  
*Executive Editor of the Journal of Computational Physics (JCP)*  
*Managing editor of International Journal of Computational Methods (IJCM)*  
*Fellow of Japan Society of Mechanical Engineers (JSME)*

### **Prof. Julian Andrzej Domaradzki**

- Email: [jad@usc.edu](mailto:jad@usc.edu)  
Chair of Aerospace and Mechanical Engineering, University of Southern California, USA  
<https://gapp.usc.edu/about/faculty/julian-domaradzki>  
*Associate Fellow of American Institute of Aeronautics and Astronautics, 2011*  
*Elected Fellow of American Physical Society (APS), 2008*