# Tie Wei

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## Education

**University of Utah**, Salt Lake City, Utah                                            2004
Ph. D., Mechanical Engineering
Dissertation: One-Dimensional Turbulence Modeling of Turbulent Wall Bounded Flows.
Advisor: Professor Patrick McMurtry

**East China University of Science and Technology**, Shanghai, China          1996
M.S., Mechanical Engineering

**Shanghai Jiaotong University,** Shanghai, China                              1993
B.S., Mechanical Engineering

## Experience

**Assistant Professor**                                                      2014-current
**Visiting Assistant Professor**                                            2012-2014
New Mexico Institute of Mining and Technology
➢ Developed and taught courses on introduction to computational fluid dynamics, fluid mechanics, and advanced heat transfer. Mentored students in aerospace propulsion course.
➢ Investigating the mixing of fluids with different viscosities.
➢ Investigating flow mechanisms within low permeability media such as shale gas/oil reservoirs.
➢ Investigating flow patterns in aerosol deposition method.
➢ Investigating the effects of interface shape on explosive welding.
➢ Investigating the end-wall effects in Taylor-Couette flow.
➢ Investigating Flettner-rotor for wind-assisted propulsion.
➢ Investigating the potential wind power on US road systems.
➢ Investigating turbulent boundary layer flows with pressure gradient.

**Postdoctoral Research Associate**
Los Alamos National Laboratory, NM                                          2009-2012
➢ Performed high resolution direct numerical simulation of Rayleigh-Taylor instability (RTI) on supercomputers, including some of the largest clusters in the world, and compared results with experimental measurements. The study has led to the discovery of important and unexpected physics.
➢ Investigated the effects of tilting initial interface on Rayleigh-Taylor instability. The tilting interface RTI involves complex turbulence production mechanisms, and constitutes a novel and important test case for turbulence modeling.

**Postdoctoral Research Associate**
Department of Mechanical Engineering, The Pennsylvania State University, PA          2005-2009

- ➢ Developed a direct numerical simulation code, using spectral method, to investigate decaying homogeneous isotropic turbulence.
- ➢ Conducted numerical and theoretical analysis of aliasing error from nonlinear terms in different forms: advection form, divergence form, rotational form and skew-symmetric form.
- ➢ Applied and enhanced a synthetic field-type surface model in large-eddy simulation (LES) of high Reynolds number wall-bounded flows.
- ➢ Conducted numerical and theoretical analysis of the near-surface region in LES of high Reynolds number, shear-dominated turbulent flows, discovered the underlying mechanism that causes the poor performance of eddy-viscosity models in the near-surface region.
- ➢ Devised a methodology to improve accuracy in LES of wall-bounded flows.
- ➢ Investigated an anisotropic subfilter-scale model for LES.
- ➢ Conducted numerical and theoretical studies of flows with multiple physical processes.
- ➢ Conducted numerical experiments to study the effects of polymer drag reduction on turbulent structures.

**Research Assistant**
Department of Mechanical Engineering, University of Utah, Utah                    1998-2004
- ➢ Investigated scalar mixing in a turbulent pipe flow using a stochastic mixing model called Linear Eddy Model.
- ➢ Implemented and improved a one-dimensional phenomenological turbulence model to study turbulent channel flow and spatially developing turbulent boundary layer flow.
- ➢ Developed a new theory for the structures of turbulent wall-bounded flows in collaboration with Drs. Fife, Klewicki and McMurtry.
- ➢ Discovered the intrinsic hierarchy of 'scaling layers' in the stress gradient balance region, providing a mathematical interpretation for the law of the wall in turbulent wall-bounded flows.
- ➢ Identified a new scaling for heat transfer in turbulent wall-bounded flows which collapsed experimental data much better than previous theory.

**Teaching Assistant**
Department of Mechanical Engineering, University of Utah, Utah                    1998-1999
- ➢ Served as TA for under-graduate fluid mechanics course. Duties included preparing laboratory handouts, giving one-hour lecture about experiments for 30 students, setting up and supervising laboratory sessions, grading laboratory reports.

**Engineer**
Asia Simulation Co., Zhuhai, China                    1996-1998
- ➢ Conducted simulation of heat/mass transfer processes in a coal-burning power plant.
- ➢ Provided pre-sales support of the company products, trained more than 30 customers in the use of simulation software; answered customers' technical questions.
- ➢ Drafted proposals for numerical simulation of a power plant combustion system.
- ➢ Assisted in the installation of our company's local area networks with more than 100 computers.

# Awards and Honors

- ➢ "Physics of Fluid": Award and Invited Paper (2010).
- ➢ "Los Alamos Postdoctoral Research Day": Outstanding Poster Award (2011).

# Professional Affiliations

- ➤ Member, American Society of Mechanical Engineering.
- ➤ Member, American Physical Society.

## Computer Skills
- ➤ Application Software: ANSYS, FLUENT, OpenFOAM, Salome
- ➤ Programming languages: Fortran, C, C++, MPI, Python, MATLAB, Bash
- ➤ Operating systems: UNIX/Linux, Windows
- ➤ DOE HPC platforms: ORNL-Jaguar (~300,000 cores), LANL-Mapache, Conejos… (~4000 cores).

## Professional and Community Services
- ➤ Science Communication Fellow (2016)
- ➤ Journal reviewers: Physics of Fluids, Experiments in Fluids, Journal of Fluid Engineering
- ➤ Host of Teaching Coffee Hour at New Mexico Tech, 2014-2015
- ➤ Co-founder, M-lab
- ➤ Co-founder, Society of Collegiate Inventors
- ➤ Advisor to Junior/Senior Design Projects, NMT
- ➤ Summer workshops on teaching, NMT, Aug, 2014
- ➤ Judge: Rube Goldberg Competition, NMT, Feb 15, 2014.
- ➤ Judge: Rube Goldberg Competition, NMT, Feb 16, 2013.
- ➤ Committee member: New Mexico Tech Computing on Campus, 2012-2014.
- ➤ Undergraduate advisor: New Mexico Tech, 2013.
- ➤ Advisor to Senior Design Project: New Mexico Tech, 2013.
- ➤ Faculty development workshop on Active Learning Techniques, August 2013
- ➤ Committee member: Los Alamos National Laboratory Postdoctoral Association.
- ➤ Judge: Los Alamos National Laboratory Student Symposium, Apr 23, 2012.

## Teaching Responsibilities
- ➤ 2016: Engineering fluid mechanics, Fluid Thermal System, Heat and Mass  Transfer
- ➤ 2015: Engineering fluid mechanics, Heat and Mass Transfer, Advanced Heat Transfer
- ➤ 2014: Engineering fluid dynamics, Computational fluid dynamics, Advance heat transfer
- ➤ 2013: Engineering fluid dynamics, Computational fluid mechanics and reaction, Advanced heat transfer.
- ➤ Fall 2012: Introduction to computational fluid dynamics; Aerospace propulsion.

## Advising
- ➤ Nick Alvarez, Master degree in mechanical engineering (2018-)
- ➤ Tyler Marquis, Master degree in mechanical engineering (2018-)
- ➤ David Pollard, Master degree in mechanical engineering (2016-)
- ➤ Steve Bayley, Master degree in mechanical engineering (2013-2015)
- ➤ Mitchell Powell, Master degree in mechanical engineering (2012-2014)
- ➤ Daniel Archuleta, Student work (2014-2015)

- ➢ Darien Williams, Student research (summer 2014)
- ➢ Jason Lee, undergraduate student research (2013-2015)

## Funding/Research Proposals

- ➢ Linear stability analysis of buoyancy and shear driven turbulence, PI, $50,000.00 (LANL, 2016-2017)
- ➢ Enhanced heat transfer by nano-fluid, PI, $10,000 (New Mexico Tech and LANL, 2016-2017)
- ➢ Osmotic Power Development, New Mexico EPScor, co-PI (2013-)
- ➢ ES491-Collaborative Senior Design Capstone Project-Magnetic Refrigeration, PI, $5,000 (2015)
- ➢ Plastic Part Slicer for Los Alamos National Laboratory, PI, $2,000 (2015)
- ➢ ES491-Collaborative Senior Design Capstone Project-Reflective insulator, PI, $5,000 (2014)
- ➢ Composite Overwrapped Pressure Vessel for Los Alamos National Laboratory, PI, $5,000 (2014)
- ➢ Federal College Work Study (Daniel Archuleta): $3,500 (2014)
- ➢ New Mexico Alliance for Minority Participation (New Mexico AMP) Undergraduate Research Assistance (Jason Lee): $1,250 (2014)
- ➢ New Mexico Alliance for Minority Participation (New Mexico AMP) Undergraduate Research Assistance (Jason Lee): $1,250 (2013)
- ➢ "Wind-assisted Propulsion: Optimal Design of Flettner-Rotor to Propel Road Vehicles," Proposal to American Public Power Association (PI).
- ➢ "Mixing characteristics among fluids with different viscosities," Los Alamos National Laboratory.
- ➢ "Kinetics and Turbulence in chem/bio defeat," Proposal to DTRA PerC (Co-PI).
- ➢ "Flow patterns and bonding mechanism in aerosol deposition method," Proposal to NSF Materials Processing and Manufacturing (in preparation, Co-PI).
- ➢ "Flow mechanism in shale oil/gas reservoirs," Proposal to DoE (PI).

## Peer Reviewed Journal Publications

- ➢ T. Wei, "Scaling of Reynolds stresses in a differentially heated vertical channel flow," Physical Review Fluids (to appear)
- ➢ T. Wei and J. Abraham, "Heat transfer regimes in fully developed circular pipe flows, a map of flow regimes," Int. Comm. in Heat and Mass Transfer, 104: 147-152 (2019)
- ➢ T. Wei, "Heat transfer regimes in fully developed channel flow," Int. J. of Heat and Mass Transfer, 131: 140-149 (2019)
- ➢ T. Wei, "Integral properties of temperature variance production in turbulent channel flow with scalar transport," Int. J. of Heat and Mass Transfer, 133: 393-404 (2019)
- ➢ T. Wei, "Multi-scaling analysis of the mean thermal energy balance equation in fully-developed turbulent channel flow," Physical Review Fluid, 3, 094608 (2018)
- ➢ T. Wei, "Integral properties of turbulent-kinetic-energy production and dissipation in turbulent-wall-bounded flows," Journal of Fluid Mechanics, 854: 449-473 (2018)

➢ Y. Maciel, T. Wei, A. Gungo, and M. Simens, "Outer scales and parameters of adverse pressure gradient turbulent boundary layers", Journal of Fluid Mechanics, 844:5-35 (2018)

➢ T. Wei and Y. Maciel, "Derivation of Zagarola-Smits scaling in zero-pressure-gradient turbulent boundary layers", Physical Review Fluids, 3, 012601(R), 2018

➢ T. Wei, Y. Maciel and J. Klewicki, "Integral Analysis of boundary layer flows with pressure gradient", Physical Review Fluids, 2, 092601(R), 2017

➢ T. Wei, "Self-similarity analysis of turbulent wake flows", Journal of Fluid Engineering, 139(5), 051203, 2017

➢ T. Wei and J. Klewicki, "Scaling the mean wall-normal flow in turbulent boundary layer flows", Physical Review Fluids, 1, 082401, 2016

➢ T. Wei and J. Ford, "Enhancing the Connection to Undergraduate Engineering Students: A Hands-on and Team-Based Approach to Fluid Mechanics", *Journal of STEM education*, *Vol 16, No. 2*, 2015.

➢ J. Ford and T. Wei, "Quad charts in the classroom to reinforce technical communication fundamentals", *Journal of technical writing and communication, Vol 45, No 3*, 2015.

➢ M. Andrews, D. Youngs, D. Livescu and T. Wei "Computational studies of two-dimensional Rayleigh-Taylor driven mixing for a tilted-rig" *Journal of Fluid Engineering, Vol 136, 091212, (2014)*.

➢ S. Saha, J. Klewicki, A. Ooi, H. Blackburn, and T. Wei "Scaling properties of the equation for passive scalar transport in wall-bounded turbulent flows" *International Journal of Heat and Mass Transfer, Vol 70, (2014)*.

➢ T. Wei and D. Livescu "Late-time quadratic growth in single-mode Rayleigh-Taylor instabilities." *Physical Review E* 86, 046405 (2012).

➢ D. Livescu, T. Wei and M. Petersen "Direct Numerical Simulation of Rayleigh-Taylor Instability." *Journal of Physics: Conference series* 318, 082007 (2011).

➢ J. Brasseur and T. Wei "Designing large-eddy simulation of the turbulent boundary layer to capture law-of-the-wall scaling." *Physics of Fluids* 22, 021303 (2010).

➢ J. Klewicki, P. Fife and T. Wei "On the logarithmic mean profile." *J. Fluid Mech*. 638:73-93 (2009).

➢ P. Fife, J. Klewicki and T. Wei "Time averaging in turbulence settings may reveal an infinite hierarchy of length scales." *Discrete and Continuous Dynamical Systems* 24 (2009).

➢ T. Wei, P. Fife and P. McMurtry "On scaling the mean momentum balance and its solutions in turbulent Couette-Poiseuille flow." J. *Fluid Mech*. 573: 371-398 (2007).

➢ J. Klewicki, P. McMurtry, P. Fife and T. Wei "A physical model of the turbulent boundary layer consonant with the structure of the mean momentum balance." *Phil. Trans. R. Soc. A* 365: 823-839 (2007).

➢ J. Klewicki, P. Fife, T. Wei and P. McMurtry "Overview of a Methodology for Scaling the Indeterminate Equations of Wall Turbulence." *AIAA J*. 44: 2475-2481 (2006).

➢ P. Fife, T. Wei, J. Klewicki and P. McMurtry "Stress-gradient-balance layers and scale hierarchies in wall-bounded turbulent flows." *J. Fluid Mech*. 532: 165-189 (2005).

➢ T. Wei, P. Fife, J. Klewicki and P. McMurtry "Properties of the mean momentum balances in turbulent boundary layers, pipe and channel flows." *J. Fluid Mech*. 522: 303-327 (2005).

- P. Fife, J. Klewicki, P. McMurtry and T. Wei "Multiscaling in the presence of indeterminacy: wall-induced turbulence." *Multiscale Model. Simul.* 4: 936-959 (2005).

- T. Wei, Schmidt R. and P. McMurtry "Comment on the 'Clauser-chart' method to compute friction velocity." *Experiments in Fluids* 38: 695-699 (2005).

- T. Wei, P. McMurtry, J. Klewicki and P. Fife "Meso-scaling of Reynolds shear stress in turbulent channel and pipe flow." *AIAA J.* 43: 2350-2353 (2005).

- T. Wei, P. Fife, J. Klewicki and P. McMurtry "Scaling heat transfer in fully developed turbulent channel flow." *International Journal of Heat and Mass Transfer* 48: 5284-5296 (2005).

## Manuscripts in preparation

- Y.X. Wang and T. Wei, "Enhancement of heat and mass transfer by herringbone microstructures in microfluidics".

- Y.X. Wang and T. Wei, "Effects of boundary conditions on scalar transport in microfluidics".

- Y.X. Wang and T. Wei, "Mechanisms of scalar transport enhancement by microstructures".

- "Properties of turbulent kinetic energy production in turbulent boundary layers under adverse pressure gradient".


## Selected Proceedings

- Y. Maciel, T. Wei, A. Gungor and M. Simens, 2018 "Governing parameters of adverse pressure gradient turbulent boundary layers," 5th Joint US-European Fluids Eng Summer Conf, July 15-20, 2018, Montreal, Quebec, Canada

- T. Wei and D. Livescu, 2014 "New findings on the growth of Single-mode Rayleigh-Taylor Instability," 17th U.S. National Congress on Theoretical and Experimental Mechanics.

- T. Wei and D. Livescu, 2012 "Direct Numerical Simulation of Rayleigh-Taylor instability." *Theory, Simulation, and Computation Directorate Science Highlight.* Los Alamos National Lab.

- T. Wei and D. Livescu, 2011 "The effects of initial conditions on single- and two-mode Rayleigh-Taylor instability." *Theory, Simulation, and Computation Directorate Science Highlight.* Los Alamos National Lab.

- T. Wei and D. Livescu, 2011 "The effects of initial conditions on single- and two-mode Rayleigh-Taylor instability." In *Proceedings of the 3rd International Conference on Turbulent Mixing and Beyond*.

- D. Livescu, T. Wei and M. Petersen, 2011 "Direct Numerical Simulation of Rayleigh-Taylor Instability." *Journal of Physics: Conference series* 318, 082007.

- D. Livescu, M. R. Petersen, T. Wei and M. Petersen, 2010 "Turbulence and mixing characteristics in the variable density Rayleigh-Taylor mixing layer." *Proceedings of the NECDC 2010*.

- J. Brasseur, S. Ramachandran and T. Wei, 2010 "Advances in the Design of LES to Capture Law-of-the-Wall: Role of the SFS Stress Model." (abstract) *Bull. Amer. Phys. Soc.* 55 (16): 119.

- J. Brasseur, T. Wei and S. Ramachandran, 2009 "Predicting law-of-the-wall with LES: role of SFS and surface stress models." (abstract) *Bull. Amer. Phys. Soc.* 54 (19): 228.

- J. Brasseur and T. Wei, 2008 "Designing Large-Eddy Simulation of High Reynolds Number Wall-bounded Flows." (abstract) *Bull. Amer. Phys. Soc.* 53:294.

- P. Fife, T. Wei, J. Klewicki, P. McMurtry and M. Metzger, 2006 "Scaling Approaches to Wall-Induced Turbulence." *15th U.S. National Congress on Theoretical and Applied Mechanics*, Boulder, CO.

- J. Klewicki, P. Fife, T. Wei and P. McMurtry, 2005 "Overview of a Methodology for Scaling the Indeterminate Equations of Wall Turbulence." *4th AIAA Theoretical Fluid Mechanics Conference* (invited), Toronto.

- J. Klewicki, P. McMurtry, P. Fife and T. Wei, 2004 "A Physical Model of the Turbulent Boundary Layer Consonant with the Structure of the Mean Momentum Balance." Proceedings of the *15th Australasian Fluid Mechanics Conference*, University of Sydney.

- J. Klewicki, P. Fife, T. Wei and P. McMurtry, 2004 "On the Hierarchical Scaling Behaviors of Turbulent Wall-Flows." *Perryfest*, Kingston, Ontarios.

## Selected Presentations

- T. Wei "Integral properties of turbulent-kinetic-energy production and dissipation in turbulent wall-bounded flows," 71th Annual Meeting of APS DFD, Atlanta, GA, Nov, 2018

- T. Wei, Y. Maciek, and J. Klewicki "Integral analysis of boundary layers with pressure gradient," 70th Annual Meeting of the APS Division of Fluid Dynamics, Denver, CO, Nov. 2017.

- T. Wei and J. Klewicki "Scaling of the mean wall-normal flow in turbulent boundary layer flows," 69th Annual Meeting of the APS Division of Fluid Dynamics, Portland, OR. Nov. 2016.

- T. Wei and D. Livescu "New findings on the growth of Single-mode Rayleigh-Taylor Instability," 17th U.S. National Congress on Theoretical and Experimental Mechanics, June 18, 2014

- Jason Lee, Darien Williamson, Brigitte Ek, and Tie Wei "Wind assisted propulsion using Flettner-rotor," The 3rd Student Research Symposium, New Mexico Tech, 09 Apr 2014.

- Mitchell Powell and Tie Wei "Effects of gap-size and spin rate on rotating cylinders," The 3rd Student Research Symposium, New Mexico Tech, 09 Apr 2014.

- Calvin Santistevan, Bryan Melchart, and Tie Wei "Fluid flow inside two rotating cylinders," The 3rd Student Research Symposium, New Mexico Tech, 09 Apr 2014.

- D. Livescu and T. Wei "Turbulence characteristics in the variable-density Rayleigh-Taylor mixing layer," The 13th International Workshop on the Physics of Compressible Turbulent Mixing, London, UK, 16–20 July 2012.

- T. Wei and D. Livescu "Direct Numerical Simulation of Tilted Rayleigh-Taylor Instability," The International Conference on Numerical Methods in Multiphase Flows, State College, PA. June, 2012.

- T. Wei and D. Livescu "Effects of initial conditions on single and two-mode Rayleigh-Taylor Instability," 3rd Turbulent Mixing and Beyond (TMB), Trieste, Italy. Aug. 2011.

- T. Wei, D. Livescu and M. Andrews "The effect of initial conditions on single and two-mode Rayleigh-Taylor Instability," 63rd Annual Meeting of the APS Division of Fluid Dynamics, Long Beach, CA. Nov. 2010.

- T. Wei, J. Brasseur and S. Ramachandran "Designing LES of the Atmospheric boundary layer to capture law-of-the-wall: surface stress model and the von Karman constant," 19th Symposium on Boundary Layers and Turbulence, Keystone, CO. August, 2009.

- T. Wei and J. Brasseur "Designing simulations to overcome the surface layer overshoot of mean shear in large eddy simulation of the neutral atmospheric boundary layer," NCAR TOY2008 Workshop 1. Turbulence Theory and Modeling, Boulder, Co, Feb. 2008.

- T. Wei and J. Brasseur "Role of subfilter-scale model anisotropy on large-eddy simulation of the neutral atmospheric boundary layer," 60th Annual Meeting of the Division of Fluid Dynamics, Salt Lake City, UT, Nov. 2007.

- T. Wei and J. Brasseur "Experiments on the over-prediction of mean shear in the large-eddy simulation of atmospheric boundary layer," 59th Annual Meeting of the Division of Fluid Dynamics, American Physical Society (APS), Tampa Bay, FL, Nov. 2006.

- T. Wei and J. Brasseur "The critical importance of aliasing in near-surface large-eddy simulation," 58th Annual Meeting of the Division of Fluid Dynamics, American Physical Society (APS), Chicago, IL, Nov. 2005.

- T. Wei  "Multiscale analysis of turbulent Couette-Poiseuille flow," 57th Annual Meeting of the Division of Fluid Dynamics, American Physical Society (APS), Seattle, WA, Nov. 2004.

- T. Wei, P. Fife, J. Klewicki and P. McMurtry "Scaling properties of the mean momentum balance in turbulent wall flows," 56th Annual Meeting of the Division of Fluid Dynamics, American Physical Society (APS), East Rutherford, NJ, Nov. 2003.

- T. Wei, P. McMurtry and R. Schmidt "One-Dimensional Turbulence Modeling of channel flow and zero-pressure-gradient boundary layers," 55th Annual Meeting of the Division of Fluid Dynamics, American Physical Society (APS), Dallas, Texas, Nov. 2002.