

# Yi Liu (Steven)

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## EDUCATION

### University of Notre Dame

Notre Dame, IN

- Ph.D. Candidate in Aerospace & Mechanical Engineering  
• GPA: 4.0/4.0  
• Focus: computational fluid dynamics, turbulence, high-performance computing, aeroacoustics

2016 – Present

### Syracuse University

Syracuse, NY

- M.S. in Mechanical & Aerospace Engineering  
• GPA: 4.0/4.0  
• Focus: turbulence, dynamical system, geophysical fluid dynamics, high-throughput computing, GPU computing

2013 – 2015

### Tongji University

Shanghai, China

- B.S. in Automotive Engineering  
• GPA: 86.21/100  
• Focus: transportation design, automotive aerodynamics, artificial neural network
- Visiting student in Industrial Design at College of Architecture and Urban Planning

2007 – 2012

2007 – 2009

## EXPERIENCE

### Research Assistant, Institute for Flow Physics and Control, University of Notre Dame

2016 – Present

- Advisor: Prof. Meng Wang

### Research Assistant, Green Fluid Dynamics Lab, Syracuse University

2014 – 2016

- Advisor: Prof. Melissa Green

### Computer Programmer, Core Infrastructure Services, Syracuse University

2015 – 2016

- Assisted researchers in Department of Biology by performing bioinformatics programming on OrangeGrid (a high-throughput computing environment on campus) for evolutionary biology researches.

## SELECTED RESEARCH PROJECTS

### High-Reynolds-number turbulent boundary layer flow over a forward step

2021 – Present

- Perform wall-modeled large-eddy simulations (WMLES) to investigate the turbulent boundary-layer flow over a small forward-facing step, with a focus on the effect of the step on wall-pressure fluctuations.

### Wall-pressure fluctuations in compressible turbulent wall-bounded flows

2017 – Present

- Perform direct numerical simulations (DNS) to investigate spatiotemporal characteristics of unsteady wall pressure in compressible turbulent channel flows and boundary-layer flows.
- Participate in the development of in-house compressible DNS solver with high-order non-dissipative finite difference scheme

### Lagrangian coherent structures (LCS) in the Gulf Stream

2014 – 2018

- Developed programs to calculate the finite-time Lyapunov exponent (FTLE) and Lagrangian-averaged vorticity deviation (LAVD) to find LCS in the Gulf Stream region using altimeter data.
- Investigated the transport and mixing properties of the meandering jet and vortices, and the topological changes associated with the structures.
- Code available at <https://github.com/stevenliuyi/ocean-ftle>.

### Three dimensional LCS in a turbulent channel flow

2014 – 2016

- Computed 3D FTLE fields of the direct numerical simulation (DNS) results of a turbulent channel flow to investigate the 3D coherent structures.
- Adopted high-throughput computing (HTC) technique to speed up 3D calculations.
- Code available at <https://github.com/stevenliuyi/3d-ftle>.

### GPU programming in CFD simulations

2015

- Compared GPU parallel (OpenCL framework) and CPU sequential computing in CFD simulations.
- Developed CFD codes to capture shock-waves and tested for two cases (a shock-tube flow simulation and a transonic nozzle flow simulation).
- Code available at <https://github.com/stevenliuyi/gpu-cfd>.

### Aerodynamics of electric vehicles based on CFD and neural network

2012

- Combined artificial neural network, genetic algorithm and CFD simulation to develop a novel method to improve aerodynamics performance in the automobile design process.

## SELECTED GRADUATE COURSES

**Fluid Physics** – Fluid Dynamics, Computational Fluid Dynamics, Turbomachinery, Continuum Mechanics, Advanced Aerodynamics, Turbulence, Viscous Flow, Aeroacoustics, Hydrodynamic stability, Advanced Continuum Mechanics.

**Applied Math/Computer Science** – Statistical Methods in Data Mining, Design & Analysis of Algorithms, Methods of Analysis, Numerical Methods, Mathematical Methods, Advanced Scientific Computing, Uncertainty Quantification, Applied Partial Differential Equations, Advanced Topics in Machine Learning, Deep Learning with Graphs.

## TEACHING EXPERIENCE

**Teaching Assistant**, University of Notre Dame 2016 – 2020

- AME34334 Heat Transfer (Spring 2020)
- AME20222 Mechanics II (Spring 2019)
- AME20214 Introduction to Engineering Computing (Fall 2018, Fall 2019)
- AME30363 Design of Machine Elements (Spring 2018)
- AME30331 Fluid Mechanics (Fall 2016, Fall 2017)
- AME20231 Thermodynamics (Spring 2017)

**Teaching Assistant**, Syracuse University 2014

- MAE585 Principle of Turbomachines (Fall 2014)

## PUBLICATIONS

Yi Liu, Kan Wang, Meng Wang (2022). “Effect of a Small Hump on Wall-Pressure Fluctuations in a Compressible Turbulent Channel Flow,” *AIAA* 2022-2991.

Hai Lan, Dexuan Sha, Anusha Srirenganathan Malarvizhi, Yi Liu, Yun Li, Nadine Meister, ... Chaowei Phil Yang (2021). “COVID-Scraper: An Open-Source Toolset for Automatically Scraping and Processing Global Multi-Scale Spatiotemporal COVID-19 Records,” *IEEE Access*, 9, 84783-84798.

Dexuan Sha, Yi Liu, Qian Liu, Yun Li, Yifei Tian, Fayez Beaini, ... Chaowei Yang (2021). “A Spatiotemporal Data Collection of Viral Cases for COVID-19 Rapid Response,” *Big Earth Data*, 5(1), 90-111.

Yi Liu, Kan Wang, Meng Wang (2022). “Direct Computation of Wall-Pressure Fluctuations in a Compressible Turbulent Channel Flow,” *AIAA* 2021-2142.

Yi Liu (2021). “A Commentary on Molecular Genealogy of Tusi Lu’s Family Reveals Their Paternal Relationship with Jochi, Genghis Khan’s Eldest Son,” *Journal of Human Genetics*, 66(5), 549-550.

Yi Liu, Melissa Green, Chris Wilson, Chris Hughes (2018). “Gulf Stream Transport and Mixing Processes via Coherent Structure Dynamics,” *Journal of Geophysical Research: Oceans*, 123(4), 3014-3037.

## PRESENTATIONS & ABSTRACTS

Di Zhou, Yi Liu, Meng Wang. “Wall-Pressure Fluctuations in a High Reynolds Number Turbulent Boundary Layer Flow over a Forward Step,” 75th Annual Meeting of the American Physical Society’s Division of Fluid Dynamics, Indianapolis, IN, USA. 20-22 Nov 2022.

Yi Liu, Kan Wang, Meng Wang. “Wavenumber-frequency Spectra of Wall-Pressure Fluctuations in Compressible Turbulent Channel Flow,” 72nd Annual Meeting of the American Physical Society’s Division of Fluid Dynamics, Seattle, WA, USA. 23-26 Nov 2019.

Yi Liu, Kan Wang, Meng Wang. “Computation of Wall Pressure Fluctuations in Compressible Turbulent Channel Flows,” 71st Annual Meeting of the American Physical Society’s Division of Fluid Dynamics, Atlanta, GA, USA. 18-20 Nov 2018.

Yi Liu, Chris Wilson, Melissa Green, Chris Hughes. “Gulf Stream Transport and Mixing Processes via Lagrangian Coherent Structure Dynamics,” 2018 Ocean Sciences Meeting, Portland, OR, USA. 11-16 Feb 2018.

Chris Wilson, Yi Liu, Melissa Green, Chris Hughes. “Gulf Stream Transport and Mixing Processes via Coherent Structure Dynamics,” European Geosciences Union General Assembly 2017, Vienna, Austria. 23-28 April 2017.

Chris Wilson, Yi Liu, Melissa Green, Chris Hughes. “An Update to the “Barrier or Blender” Model of the Gulf Stream, Based on Lagrangian Analysis of Aviso Altimetry,” 2016 Ocean Sciences Meeting, New Orleans, LA, USA. 21-26 Feb 2016.

Yi Liu, Chris Wilson, Melissa Green, Chris Hughes. “Lagrangian Coherent Structures in the Gulf Stream,” 68th Annual Meeting of the American Physical Society’s Division of Fluid Dynamics, Boston, MA, USA. 22-24 Nov 2015.

## HONORS & AWARDS

- WikiCite eScholarship, Alfred P. Sloan Foundation 2020
- Graduate Student Professional Development Award, University of Notre Dame 2019
- Outstanding Graduate Student of Mechanical & Aerospace Engineering, Syracuse University 2015  
For ranking first in the program
- Graduate Student Scholarship, Syracuse University 2013 – 2015

- Outstanding Student Scholarship, Tongji University

2008, 2009

*Computer Physics Communications*

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