

Lei Fang Ph.D.

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EDUCATION

2017 - 2020 **Stanford University, Stanford, California**

Ph.D., Civil and Environmental Engineering

Ph.D. minor, Computational and Mathematical Engineering

2015 - 2017 **Stanford University, Stanford, California**

M.S., Civil and Environmental Engineering

2012 - 2015 **Colorado State University, Fort Collins, Colorado**

B.S., First Place in the Department, Environmental Engineering

ACADEMIC POSITIONS

2020 - present **Assistant Professor (tenure track)**

Department of Civil and Environmental Engineering, Department of Mechanical & Materials Science (secondary appointment), University of Pittsburgh

2016 - 2020 **Graduate Research Assistant**

Department of Civil and Environmental Engineering, Stanford University

Advisor: Prof. Nicholas T. Ouellette

supported by the U.S. NSF under Grant No. CMMI-1563489

2014 Summer **Research Assistant**

Colorado State University, Engineering Research Center

RESEARCH FUNDING

2024 - 2027 **National Science Foundation:** CBET-2429374

Collaborative Research: How small is too small? On the Minimum Swimmer Size Required to Generate Sustained Biogenic Turbulence (Total **\$600,000** with Prof. Eckart Meiburg)

Role: Lead PI

2022 - 2025 **National Science Foundation:** CMMI-2143807

Toward the Two-way Coupling between Active Matter and Transport Barriers (**\$361,476**)

Role: PI

2022 - 2025 **National Science Foundation:** IIS-2313074

Collaborative Research: HCC: Medium: Aerodynamic Virtual Human Simulation on Face, Body, and Crowd (**\$52,141**)

Role: Co-PI

- 2022 - 2026 **Department of Defense: W911NF2220001**
 Improving cooperation and coordination in heterogeneous crowds of soldiers and robots (**\$1,175,000**, equally shared with Prof. Amin Rahimian)
 Role: PI
- 2021 - 2022 **University of Pittsburgh Momentum Fund**
 Toward the two-way coupling of swimmer and surface gravity waves (**\$25,000**)
 Role: PI
- 2022 - 2023 **University of Pittsburgh Momentum Fund**
 Data Mining Approaches to Understand Tensor Properties in Turbulent Cascade (**\$16,000**)
 Role: PI
- 2021 - 2022 **University of Pittsburgh Momentum Fund**
 Toward the Two-way Coupling between Active Matter and Transport Barriers (**\$16,000**)
 Role: PI

PEER-REVIEWED JOURNAL PUBLICATIONS (students are underlined; including in preparation and submitted ones)

- 2024 Xinyu Si and **Lei Fang**. “Biologically generated turbulent energy cascade in shear flow depends on tensor geometry,” PNAS Nexus, pgae056.
- 2024 Xinyu Si and **Lei Fang**. “Interaction between swarming active matter and flow: the impact on Lagrangian coherent structures,” Physical Review Fluids, **Chosen as Editors’ Suggestion**.
- 2024 Zexu Li and **Lei Fang**. “On the ideal gas law for crowds with high pressure,” Physica A: Statistical Mechanics and its Applications (2024): 129657.
- 2024 Xinyu Si, Filippo De Lillo, Guido Boffetta, and **Lei Fang**. “Manipulating the direction of turbulent energy flux via tensor geometry in a two-dimensional flow” Under review.
- 2024 Yu Zhao and **Lei Fang**. “Understanding phonetic variations in expiratory turbulent puffs through three-dimensional particle tracking velocimetry,” Under review.
- 2024 Xinyu Si and **Lei Fang**. “Significant transport enhancement through the manipulation of Lagrangian coherent structures via small-scale physical perturbations,” In prep.
- 2024 Zexu Li and **Lei Fang**. “Thin layer formation of ellipsoidal gyrotactic swimmer in unsteady hydrodynamic shear,” In prep.
- 2022 Xinyu Si and **Lei Fang**. “Preferential transport of swimmers in heterogeneous two-dimensional turbulent flow,” Physical Review Fluids 7 (2022), 094501.
- 2021 Xinyu Si and **Lei Fang**. “Preferential alignment and heterogeneous distribu-

- tion of active non-spherical swimmers near Lagrangian coherent structures,” *Physics of Fluids* 33, no. 7 (2021): 073303. **Chosen as Editor’s Picks.**
- 2021 Xinyu Si and **Lei Fang**. “A novel social distance model reveals the sidewall effect at bottlenecks,” *Scientific Reports* 11, 20982 (2021).
- 2021 **Lei Fang** and Nicholas T. Ouellette. “Spectral condensation in laboratory two-dimensional turbulence,” *Physical Review Fluids* 6, 104605 (2021).
- 2021 **Lei Fang** and Nicholas T. Ouellette. “Assessing the information content of complex flows,” *Physical Review E* 103, 023301 (2021).
- 2020 **Lei Fang**, Sanjeeva Balasuriya, and Nicholas T. Ouellette. “Disentangling resolution, precision, and inherent stochasticity in nonlinear systems,” *Physical Review Research* 2, 023343 (2020).
- 2020 Zeyou Zhou, **Lei Fang**, Nicholas T. Ouellette, and Haitao Xu. “Vorticity gradient stretching in the direct enstrophy transfer process of two-dimensional turbulence,” *Physical Review Fluids* 5, 054602 (2020).
- 2019 **Lei Fang**, Sanjeeva Balasuriya, and Nicholas T. Ouellette. “Local linearity, coherent structures, and scale-to-scale coupling in turbulent flow,” *Physical Review Fluids* 4, 014501 (2019).
- 2019 **Lei Fang** and Nicholas T. Ouellette. “Transport across a bathymetric interface in quasi-two-dimensional flow,” *Physical Review Fluids* 4, 064501 (2019).
- 2018 **Lei Fang** and Nicholas T. Ouellette. “Influence of lateral boundaries on transport in quasi-two-dimensional flow,” *Chaos* 28, 023113 (2018). **Chosen as a Featured paper in Chaos**, and summarized in an **AIP Scilight**.
- 2017 **Lei Fang** and Nicholas T. Ouellette. “Multiple stages of decay in two-dimensional turbulence,” *Physics of Fluids* 29, 111105 (2017).
- 2016 **Lei Fang** and Nicholas T. Ouellette. “Advection and the efficiency of spectral energy transfer in two-dimensional turbulence,” *Physical Review Letters* 117, 104501 (2016).

CONFERENCE PROCEEDING (students are underlined)

- 2024 Zexu Li and **Lei Fang**. “Gyrotactic trapping of spheroidal motile microswimmers,” APS March Meeting, March 3-8, Minneapolis, MN, USA
- 2024 Xinyu Si and **Lei Fang**. “Interaction between swarming active matter and flow: the impact on Lagrangian coherent structures,” APS March Meeting, March 3-8, Minneapolis, MN, USA
- 2024 **Lei Fang** and Xinyu Si. “Biologically generated mixing and the direction of energy cascade,” APS March Meeting, March 3-8, Minneapolis, MN, USA
- 2023 **Lei Fang** and Xinyu Si. “Biologically generated mixing and the direction of energy cascade,” APS DFD Meeting, Nov 19-21, Washington DC, USA

- 2023 Xinyu Si and **Lei Fang**. “Interaction between swarming active matter and flow: the impact on Lagrangian coherent structures,” APS DFD Meeting, Nov 19-21, Washington DC, USA
- 2023 Ayan Banerjee and **Lei Fang**. “Orientation, displacement and accumulation of anisotropic microswimmers under surface gravity waves,” APS DFD Meeting, Nov 19-21, Washington DC, USA
- 2023 Yu Zhao and **Lei Fang**. “Understanding phonetic variations in expiratory turbulent puffs through 3D particle tracking velocimetry,” APS DFD Meeting, Nov 19-21, Washington DC, USA
- 2023 **Lei Fang** and Xinyu Si. “Biologically generated mixing and the direction of energy cascade,” APS DFD Pre-Meeting, Nov 15-16, Philadelphia, Pennsylvania, USA
- 2023 **Lei Fang**. “Toward ideal gas law for crowds with large pressures,” APS March Meeting, March 5-10, Las Vegas, Nevada, USA
- 2022 Xinyu Si and **Lei Fang**. “Preferential transport of swimmers in heterogeneous two-dimensional turbulent flow,” The 75th Annual Meeting of the APS Division of Fluid Dynamics, November 20-22, Indianapolis, Indiana, USA
- 2021 Xinyu Si and **Lei Fang**. “Preferential alignment and heterogeneous distribution of active non-spherical swimmers near Lagrangian coherent structures,” American Geophysical Union Fall Meeting, December 13-17, New Orleans, Louisiana, USA
- 2021 **Lei Fang** and Xinyu Si. “Preferential alignment and heterogeneous distribution of active non-spherical swimmers near Lagrangian coherent structures,” The 74th Annual Meeting of the APS Division of Fluid Dynamics, November 21-23, Phoenix, Arizona, USA
- 2019 **Lei Fang** and Nicholas T. Ouellette. “Enhanced Spectral Transfer in Weakly Mixing Regions of a Turbulent Flow,” The 72nd Annual Meeting of the APS Division of Fluid Dynamics, November 23-26, Seattle, Washington, USA
- 2019 Nicholas T. Ouellette, **Lei Fang** and Sanjeeva Balasuriya. “Disentangling Resolution, Precision, and Inherent Stochasticity in Fluid Mixing,” The 72nd Annual Meeting of the APS Division of Fluid Dynamics, November 23-26, Seattle, Washington, USA
- 2018 **Lei Fang**, Nicholas T. Ouellette and Sanjeeva Balasuriya. “Local linearity, coherent structures, and scale-to-scale coupling in turbulent flow,” The 71st Annual Meeting of the APS Division of Fluid Dynamics, November 18-20, Atlanta, Georgia, USA
- 2017 **Lei Fang** and Nicholas T. Ouellette. “Multiple stages of decay in two-dimensional turbulence,” The 70th Annual Meeting of the APS Division of Fluid Dynamics, November 19-21, Denver, Colorado, USA

2016 Nicholas T. Ouellette and **Lei Fang**. “Advection and the efficiency of spectral energy transfer in two- dimensional turbulence,” The 69th Annual Meeting of the APS Division of Fluid Dynamics, November 20-22, Portland, Oregon, USA

INVITED TALKS

2024 **Lei Fang**. “Biologically generated mixing and the direction of turbulent energy flux,” Mechanical Engineering Seminar, Johns Hopkins University, September 27, 2024, Baltimore, Maryland

2024 **Lei Fang**. “Interaction between swarming active matter and flow: The impact on Lagrangian coherent structures,” American Physical Society, Phys. Rev. Journal Club, March 26, on Zoom

2024 **Lei Fang**. “Biologically generated mixing and the direction of turbulent energy flux,” E201 Ocean Engineering Seminar Series, University of California, Berkeley, February 23, 2024, California, USA

2022 **Lei Fang**. “Preferential alignment and heterogeneous distribution of active non-spherical swimmers near Lagrangian coherent structures,” School of Civil Engineering and Transportation, South China University of Technology, January 6, Guangdong, China

2021 **Lei Fang**. “Preferential alignment and heterogeneous distribution of active non-spherical swimmers near Lagrangian coherent structures,” Department of Civil and Environmental Engineering, Carnegie Mellon University, October 10, Pennsylvania, USA

2021 **Lei Fang**. “Preferential alignment and heterogeneous distribution of active non-spherical swimmers near Lagrangian coherent structures,” Department of Mechanical Engineering, University of Massachusetts, Dartmouth, March 26, Massachusetts, USA

2020 **Lei Fang**. “Preferential alignment and heterogeneous distribution of active non-spherical swimmers near Lagrangian coherent structures,” Department of Mechanical Engineering, University of New Hampshire, December 11, Durham, New Hampshire, USA

2020 **Lei Fang**. “Coherent Dynamics in Model Geophysical Flows,” Rowland Institute at Harvard, January 30, Cambridge, Massachusetts, USA

2020 **Lei Fang**. “Coherent Dynamics in Model Geophysical Flows,” Department of Civil and Environmental Engineering, University of Pittsburgh, January 9, Pittsburgh, Pennsylvania, USA

2019 **Lei Fang**. “Coherent Dynamics in Model Geophysical Flows,” Department of Mechanical Engineering, University of California, Berkeley, October 25, Berkeley, California, USA

RESEARCH EXPERIENCES AND INTERESTS

Coherent transport in geophysical flows

Turbulence dynamics

Active matter in complex flows

Microplastics at air-sea interface

Developing physical tools for flow structure probing (Linear Neighborhood and Dynamical Linear Neighborhood)

COURSES TAUGHT

Introduction to Water Resources Engineering

Fluid Mechanics

PROFESSIONAL MEMBERSHIPS

2016 - present **Member**, American Physical Society

2021 - present **Member**, American Geophysical Union

PROFESSIONAL SERVICE

2024 **Section chair of Division of Fluid Dynamics III:** APS March Meeting, March 3-8, Minneapolis, Minnesota, USA

2023 **Section chair:** APS DFD Meeting, November 19-21, Washington DC, USA

2023 **Seminar organizer:** Civil and Environmental Engineering, University of Pittsburgh

2023 **Section chair of Fluid VI:** APS March Meeting, March 5-10, Las Vegas, Nevada, USA

2022 - present **NSF Panel Reviewer:**
Fluid Dynamics Program

2021 **Primary convener and chair** for American Geophysical Union Fall Meeting Session OS013-I-I. Non-spherical Swimmers in the Ocean

2019 - present **Peer Reviewer:**
Journal of Fluid Mechanics
Experiments in Fluids
Physics of Fluids
Physical Review Fluids *Journal of Geophysical Research - Oceans International Journal of Multiphase Flow*

Experimental Thermal and Fluid Science
Journal of Fluid Engineering
Journal of Hydraulic Research

2017 - 2018 **Seminar Coordinator**, The Bob and Norma Street Environmental Fluid Mechanics Laboratory, Stanford University

AWARDS AND HONORS

2015 **Environmental Engineering Achievement Award**, Colorado State University

2015 **Graduate with Distinction, 1st place in the department**, Colorado State University

2013 - 2015 **Dean's Lists (five times)**, Colorado State University

2012 - 2015 **Colorado State University International Excellence Scholarship (total amount: \$24,000)**, Colorado State University

2012 - 2014 **Coca-Cola Water Scholars Program, Coca-Cola full scholarship (total amount: \$50,000)**, Colorado State University

COMPUTER SKILLS

Advanced C++ (with CUDA, OpenMP, MPI project experiences), MATLAB, Python, R

Intermediate JAVA, ArcGIS, HEC-RAS, ANSYS Fluent, AutoCAD, Julia

SOCIAL SERVICES

2018 - 2019 **Co-President**, Stanford Christian Students Club, Stanford University

2017 - 2019 **Coordinator and Volunteer**, Stanford New International Student Airport Pick up Program, Stanford University and The Church in Mountain View

2012 - 2013 **Officer**, Association of Chinese Students and Scholars, Colorado State University