

# 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, Department of Bioengineering (secondary appointments), 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

2026 - 2029 **National Science Foundation:** CBET-2552483

CDS&E: Uncovering Self-Competition and Weak Asymmetry in Turbulence through Data-Enabled Diagnostics and Learning (**\$372,882**)

Role: PI

2025 - 2028 **National Science Foundation:** CBET-2444494

Aggregation Scale Eddy Generation During Collective Active Particle Migration: Spectral Energy Flux, Mechanisms, and Impact on Mixing Efficiency (**\$325,089**)

Role: PI

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
- 2023 - 2024     **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)**

- 2025            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,” Science Advances 11.30 (2025): eadv0956.
- 2025            Zexu Li and **Lei Fang**. “Thin layer formation of ellipsoidal gyrotactic swimmer in unsteady hydrodynamic shear,” Journal of Fluid Mechanics 1016 (2025): A8.
- 2025            Ziyue Yu, Xinyu Si and **Lei Fang**. “Turbulence at low Reynolds number,” Under Referee Review of Science Advances.
- 2025            Xinyu Si, Filippo De Lillo, Guido Boffetta, and **Lei Fang**. “Small Perturbations Weaken Multi-kilometre Ocean Transport Barriers,” Under Referee Review of Nature Geoscience.

- 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; Selected as Physical Review Fluids’ Top Paper of 2024**.
- 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.
- 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 distribution 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)

- 2025 Zexu Li and **Lei Fang**. “How small is too small - the minimum size of a swimmer to generate biogenic turbulence is not fixed,” APS DFD Meeting, Nov 23 - 25, Houston, TX, USA
- 2025 **Lei Fang**, Xinyu Si, Filippo De Lillo and Guido Boffetta . “Manipulating the direction of turbulent energy flux via tensor geometry in a two-dimensional flow,” APS DFD Meeting, Nov 23 - 25, Houston, TX, USA
- 2025 Ziyue Yu and **Lei Fang**. “Low Reynolds number turbulence: tensor geometry drives turbulence in the diminishing of inertia,” APS DFD Meeting, Nov 23 - 25, Houston, TX, USA
- 2024 Xinyu Si and **Lei Fang**. “Interaction between swarming active matter and flow: the impact on Lagrangian coherent structures,” APS DFD Meeting, Nov 24 - 26, Salt Lake City, UT, USA
- 2024 **Lei Fang** and Xinyu Si. “Biologically generated mixing and the direction of energy cascade,” APS DFD Meeting, Nov 24 - 26, Salt Lake City, UT, USA
- 2024 Zexu Li and **Lei Fang**. “Gyrotactic trapping of spheroidal motile microswimmers,” APS DFD Meeting, Nov 24 - 26, Salt Lake City, UT, USA
- 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

- 2026 **Lei Fang**. “Manipulating Spectral Energy Flux in Turbulent Flows: Applications and Implications Across Scales,” GALCIT Colloquium at Caltech, Feb 20, 2026 (scheduled)
- 2025 **Lei Fang**. “Manipulating Spectral Energy Flux in Turbulent Flows: Applications and Implications Across Scales,” Department of Physics, Brown University, Oct 15, 2025, Providence, RI.

- 2025 **Lei Fang.** “Manipulating Spectral Energy Flux in Turbulent Flows: Applications and Implications Across Scales,” Department of Mechanical Engineering at Michigan State University, Sep 30, 2025, , East Lansing, Michigan.
- 2025 **Lei Fang.** “Manipulating Spectral Energy Flux in Turbulent Flows: Applications and Implications Across Scales,” Fluid + Seminar, Department of Mechanical Engineering, University of Illinois Urbana-Champaign,
- 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

Two-way coupling between active particles and flow

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

2025 **Section chair:** APS DFD Meeting, November 23 - 25, Houston, TX, USA

2025 **NASA Panel Reviewer:**  
NASA TechLeap Price

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:**  
CBET

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, 1<sup>st</sup> 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