Peng-Yu Duan

Institute of Fluid Mechanics, Beihang University
Shahe Univ. Park 102206, Beijing, China
Email: pyduan@buaa.edu.cn Personal page: https://pengyu-duan.github.io

EDUCATION

Ph.D. in Fluid Mechanics Sep. 2021 – Present (expected June 2026)
Institute of Fluid Mechanics, Beihang University, Beijing, China
Advisor: Prof. Xi Chen
- *Topics: wall-bounded turbulence, small-scale turbulence, direct numerical simulation, and turbulence control*

B.S. in Mechanics Sep. 2015 - June 2021
School of Aeronautic Science and Engineering, Beihang University, Beijing, China
- *Dissertation title: Large eddy simulation of turbulent channel flows with riblets*

RESEARCH EXPERIENCE

Graduate Research Assistant Sep. 2021 - Present
Beihang University, Beijing, China
- ***Two-Dimensional Turbulence***
  - Developed a direct numerical simulation (DNS) code of incompressible two-dimensional channel flows based on Fortran/MPI+OpenMP. Conducted 19 cases with a maximum mesh size of 10^7, Reynolds number up to 10^6, and more than 10^6 CPU hours on supercomputers are used.
  - Discovered an unbounded Reynolds number scaling of turbulent fluctuations in two-dimensional near-wall turbulence, which was previously not considered, and developed a theoretical explanation for this newly found scaling.
  - Revealed the different scaling of 2D and 3D wall flows is arising from the distinct energy cascade process.
- ***Small-Scale Turbulence***
  - Analyzed the multiscale characteristics and intermittency of circulation in the inertial range of wall-bounded turbulence, and revealed the near-wall non-fractal and outer bifractal of circulation in wall-parallel planes.
  - Analyzed the intermittency of dissipation rate in the wall-parallel planes of wall-bounded turbulence, and revealed a bounded defect power-law scaling of wall dissipation moments and a power-law scaling of outer dissipation moments.
- ***Passive Scalar Turbulence***
  - Developed a new theoretical model for the mean scalar profiles in wall-bounded turbulence for different Prandtl numbers (both $\mathrm{Pr} \ll 1$ and $\mathrm{Pr} \gtrsim 1$).
  - Analyzed the scaling of near-wall scalar fluctuations in wall-bounded turbulence.
- ***Drag Reduction***
  - Developed a DNS code of incompressible three-dimensional channel flows based on Fortran/OpenMP, with immersed boundary methods applied to resolve the complex wall modifications. Friction Reynolds number up to 550.
  - Developed a new composite drag reduction method combining the large-scale control and surface riblets.
  - Derived the expression of friction coefficient by turbulent dissipation rate for complex surfaces and active controls.

Scientific Summer School July 2023
University of Cambridge, Cambridge, UK
- ***Complex Motion in Fluids***
  - Attended a series of lectures on turbulence, low Reynolds-number flows, and non-linear dynamics.
  - Discussed about the Reynolds numbers scaling of near-wall turbulence fluctuations with attendees.

Visiting Research Assistant Oct. 2020 – Oct. 2021
Sun Yet-sen University, Guangzhou, China
- ***Direct Numerical Simulations and Parallel Computing***
  - Participated in the project of developing a high-performance parallel DNS code for turbulent channel flows with friction Reynolds number up to 4000, grid resolution up to 8×10^9, and more than 9000 CPU cores are used.
  - Utilized the Tianhe-2 supercomputing platform at the National Supercomputer Center in Guangzhou.

PUBLICATIONS (* corresponding author)

[1] **Peng-Yu Duan**, Xi Chen*, and Katepalli R. Sreenivasan. "On how walls shape dissipation intermittency." *Under review in Physical Review Research*, 2025. arXiv:2506.22917

[2] **Peng-Yu Duan**, Xi Chen*, and Katepalli R. Sreenivasan. "Multiscale circulation in wall-parallel planes of turbulent channel flows." *Journal of Fluid Mechanics*, **1009**, R4, 2025. doi: 10.1017/jfm.2025.252

[3] **Peng-Yu Duan**, Xi Chen*, Yong Ji, Jie Yao, and Fazle Hussain. "Large-scale control in turbulent flows over surface riblets." *Physics of Fluids*, **36**, 095137, 2024. doi: 10.1063/5.0227151

[4] Xi Chen*, **Peng-Yu Duan**, and Jianchao He. "Unbounded two-dimensional wall turbulence induced by inverse cascade." *Physical Review Fluids*, **9**, 034609, 2024. doi: 10.1103/PhysRevFluids.9.034609

[5] **Peng-Yu Duan**, Xi Chen*. "Composite drag control and energy flux analysis for wall turbulence." (In Chinese) *Journal of Experiments in Fluid Mechanics*, **4**, 38, 2024. doi: 10.11729/syltlx20230126

[6] Jianchao He, **Peng-Yu Duan**, Xi Chen*. "Double-reflection symmetry of thermal convection for Rayleigh numbers up to 10^{10}." *Physics of Fluids*, **36**, 105113, 2024. doi: 10.1063/5.0229110

TEACHING & MENTORING EXPERIENCE

Teaching Assistant Fall 2021, Spring 2022

Beihang University, Beijing, China

- Theoretical Mechanics I & II (undergraduate level)

Undergraduate Research Mentor Oct. 2021 - June 2022

Beihang University, Beijing, China

- Guided 1 undergraduate student for research for bachelor's degree on "Direct numerical simulations of two-dimensional rough channel flow".
- Guided 1 undergraduate student for research for bachelor's degree on "Drag control by spanwise wall forcing in turbulent channels".
- Guided 3 undergraduate students for research on direct numerical simulations and turbulence drag reduction.

Graduate Research Mentor Oct. 2023 - present

Beihang University, Beijing, China

- Guided 3 graduate students for research on two-dimensional turbulence, circulation, and direct numerical simulations.

HONORS AND AWARDS

- National Scholarship 2025
- First Class Academic Scholarship 2025
- Merit Student of Beihang University 2024
- Outstanding Graduate Students 2024
- President Scholarship for Graduate Students 2024
- First Class Academic Scholarship 2024
- Second Class Academic Scholarship 2023
- Scholarships for Outstanding New Graduate Students 2022
- National Inspiration Scholarship 2020

SCIENTIFIC CONFERENCE TALKS

[1] *78th Annual Meeting of the APS Division of Fluid Dynamics*, Houston, USA, 2025.
Multiscale circulation in wall-parallel planes of turbulent channel flows.

[2] *10th Chinese Congress of Theoretical and Applied Mechanics (CCTAM 2025)*, Changsha, China, 2025.
Unbounded wall turbulence induced by inverse cascade.

[3] *iTi Conference on Turbulence XI*, Bertinoro, Italy, 2025.
Multiscale circulation in wall-parallel planes of turbulent channel flows.

[4] *13th National Conference on Fluid Mechanics*, Harbin, China, 2024.
Unbounded wall turbulence induced by inverse cascade.

[5] *26th International Conference of the Theoretical and Applied Mechanics (ICTAM 2024)*, Daegu, Korea, 2024.
Large-scale control in turbulent channels over surface riblets.

[6] *Euromech colloquia 631-Control of skin friction and convective heat transfer in wall-bounded flows,* Online, 2024.
Large-scale control in turbulent channels over riblets.

[7] *16th International Conference on Fluid Control, Measurements, and Visualization*, Beijing, China, 2023.
Unbounded wall turbulence induced by inverse cascade.

[8] *76th Annual Meeting of the APS Division of Fluid Dynamics*, Washington, DC, USA, 2023.
Unbounded two-dimensional wall turbulence induced by inverse cascade.

[9] *2nd Chinese Conference of Areodynamics*, Tianjin, China, 2023.
Composite drag reduction of riblets and large-scale control.

[10] *12th National Conference on Fluid Mechanics*, Online, 2022.
Large-scale control in turbulent channels over surface riblets.

[11] *75th Annual Meeting of the APS Division of Fluid Dynamics*, Online, 2022.
Large-scale control in turbulent channels over surface riblets.

[12] 9th Chinese Congress of Theoretical and Applied Mechanics (CCTAM 2022), Chengdu, China, 2022.
Direct numerical simulation and mean theory of two-dimensional channel turbulence.

SOCIAL SERVICE ACTIVITIES

Olympic Volunteer Feb. 2022 – Mar. 2022

Beijing, China

- Event Service Volunteer in Ban-Quan General Service Center of Beijing 2022 Winter Olympics and Paralympics.
- Appointed as a supervisor of Event Service Volunteers.

Community Service Volunteer June 2016 – Present

Beijing, China

- Provide services for community during pandemic.
- Provide guidance and enquiry service for the Challenge Cup Science and Technology Competition.
- Collecting donated winter clothing for impoverished families in southwestern China.

TECHNICAL SKILLS

Programming Languages	Fortran, MATLAB, Python, Latex, Bash (Unix Shell)
Numerical Packages	MPI, OpenMP, HDF5, FFTW
Software Capability	ParaView, Tecplot, Origin Pro, OpenFOAM, ANSYS Fluent