# Sangjoon "Joon" Lee, Ph.D.

CTR Postdoctoral Fellow at Stanford University

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## EDUCATION

**University of California, Berkeley** – Berkeley, CA, United States 2019/08 - 2024/08
Ph.D. / M.S. in *Mechanical Engineering*

- Designated emphasis: *Computational and Data Science and Engineering*

**Seoul National University** – Seoul, South Korea 2012/03 - 2018/08
*(involving 21-month military leave)*
B.S. in *Mechanical and Aerospace Engineering* &
B.B.A. (Bachelor of *Business Administration*)

- Honors: *Summa Cum Laude*

## RESEARCH EXPERIENCE

**Postdoctoral Fellow**, Stanford University 2024/10 -
Center for Turbulence Research (CTR) *(Faculty Sponsor: Dr. B. J. McKeon)*

- Advanced analysis for physical insights into turbulence and related phenomena

**Graduate Student Researcher**, University of California, Berkeley 2020/01 - 2024/08
Computational Fluid Dynamics (CFD) Lab *(Advisor: Dr. P. S. Marcus)*

- Numerical examination of destabilizing aircraft wake vortices using both linear and non-linear analyses in association with spectral collocation methods
- Data-driven topology optimization of hydro-/aerodynamic designs based on the Design-by-Morphing (DbM) technique

**Researcher**, Seoul National University 2017/07 - 2018/08
Energy & Environmental Flow Lab *(Director: Dr. W. Hwang)*

- Development of conjugate heat transfer codes analyzing heat convection and conduction simultaneously with an efficient interpolation scheme for thermal properties
- Turbulent channel flow visualization via magnetic resonance velocimetry supplemented with large eddy simulations

**Research Intern**, Seoul National University 2016/09 - 2017/12
Turbulence, Flow Control & CFD Lab *(Director: Dr. H. Choi)*

- Large eddy simulations of flow around a small rotating vertical axis wind turbine

## RESEARCH INTERESTS

**Fluid Mechanics** – *High-Fidelity CFD with ML for Cost-Efficient, Physics-Based Fluid System Optimization*

- Modeling and analyzing fundamental fluid instabilities and turbulent phenomena
- Pioneering new designs in nonlinear aero-/hydrodynamic systems through high-performance computing and physically reliable data-driven techniques
- Advancing flow solutions with respect to sustainability and clean environment, across scales (from droplet condensation to wind/gas turbines to aircraft contrails)

## GRANTS

**NSF ACCESS Allocation: PHY250071** 2025/03 - 2026/02
ACCESS by the U.S. National Science Foundation (NSF)
*PI · 1,500,000 HPC core-hours*
- Surface topology optimization for thermally-efficient dropwise condensation

## FELLOWSHIPS

**CTR Postdoctoral Fellowship** 2024 - 2025
Center for Turbulence Research (CTR) at Stanford University
- Funding granted by the Office of Naval Research (ONR)

**Departmental Graduate Fellowship** 2023
College of Engineering at the University of California, Berkeley
- Selective departmental recognition offering stipends with tuition and fee waivers

**Ilju Overseas Ph.D. Scholarship**, Study Abroad Doctoral Program 2019 - 2023
Ilju Academy & Culture Foundation
- Merit-based financial aids, selected as one of 6 recipients in 2019

**National Scholarship for Science and Engineering** 2012 - 2017
Korea Student Aid Foundation (KOSAF)
- Full-tuition scholarship for undergraduates with strong academic performance

## HONORS & AWARDS

**Outstanding Graduate Student Instructor (OGSI) Award** 2021
GSI Teaching & Resource Center at the University of California, Berkeley

**Representative of the Engineering Class of 2018**, 72nd Summer Commencement 2018
Seoul National University

**Student Paper Award: Bronze**, 9th National Fluid Engineering Contest for Undergraduates 2017
Fluid Engineering Division of the Korean Society of Mechanical Engineers

## TEACHING & TUTORING

**Teaching Assistant**, University of California, Berkeley 2024 Sp
Introduction to Computer Programming for Scientists and Engineers (ENGIN 7)

**Course Designer / Graduate Student Instructor**, University of California, Berkeley 2022 Fa - 2023 Sp
Introduction to Aerospace Engineering Design (AERO ENG 10)

**Graduate Student Instructor**, University of California, Berkeley 2019 Fa - 2022 Sp
Experimentation and Measurements (MEC ENG 103)

## PROFESSIONAL SERVICE

**Peer Reviewer**
- *Physics of Fluids* (AIP Publishing) 2024 -
- *Journal of Fluid Mechanics* (Cambridge University Press) 2025 -

## COMMUNITY OUTREACH

**Stanford seeME & CTR$^2$**, Stanford University 2025
Volunteer (Teaching, Photographing & On-day Assistance)
- On-campus hands-on classes for young students to learn various aspects of engineering

**SNU Tomorrow's Engineers Membership**, Seoul National University 2016 - 2018
Member & Head Manager
- Annual *Vision Mentoring* events for high school students interested in engineering and science

## JOURNAL PUBLICATIONS

* corresponding
† co-first

1. Hong, J., Lee, S.†, Lee, D., Bae, J. & Hwang, W. (2025). **Experimental and Numerical Investigation of 3D Flow Structures in a Turbulent Channel Flow with Riblets**, In Preparation.
2. Lee, S. & Vijay, S. (2025). **Structured Porous Media Design and its Application to Passive Wall-Bounded Turbulence Control**. In Preparation.
3. Jung, J., Lee, S. & Gu, G. X. (2025). **Data-Driven Optimization of Novel Morphing Airfoil Designs for Enhanced Flutter Control**, In Preparation.
4. Duarte, C., Raftery, P., Lee, S., & Solmaz, A. S. (2025). **Effect of Elevated Air Movement on Radiant Cooling Systems**. *Journal of Building Performance Simulation*, Submitted.
5. Lee, S. & Sheikh, H. M. (2025). **Airfoil Optimization using Design-by-Morphing with Minimized Design-Space Dimensionality**. *Journal of Computational Design and Engineering*, Submitted.
6. Lee, S., & Marcus, P. S. (2025). **Transient Growth of a Wake Vortex and its Initiation via Inertial Particles**. *Journal of Fluid Mechanics*, 1014, A16, doi:10.1017/jfm.2025.253.
7. Lee, S., Baek, S., Ryu, J., Song, M. & Hwang, W. (2025). **Flow in Ribbed Cooling Channels with Additive Manufacturing-Induced Surface Roughness**. *Physics of Fluids*, 37(6), 065118. doi:10.1063/5.0268180.
8. Wang, J., Lee, S., & Marcus, P. S. (2024). **Triadic Resonance in Columnar Vortices**. *arXiv Preprint*. doi:10.48550/arXiv.2402.05287.
9. Lee, S.*, Sheikh, H. M., Lim, D. D., Gu, G. X., & Marcus, P. S. (2024). **Bayesian-Optimized Riblet Surface Design for Turbulent Drag Reduction via Design-by-Morphing with Large Eddy Simulation**. *Journal of Mechanical Design*, 146(8), 081701. doi:10.1115/1.4064413.
10. Lee, S., & Marcus, P. S. (2023). **Linear Stability Analysis of Wake Vortices by a Spectral Method Using Mapped Legendre Functions**. *Journal of Fluid Mechanics*, 967, A2. doi:10.1017/jfm.2023.455.
11. Sheikh, H. M., Lee, S.†, Wang, J. & Marcus, P. S. (2023). **Airfoil Optimization using Design-by-Morphing**. *Journal of Computational Design and Engineering*, 10 (4), 1443-1459. doi:10.1093/jcde/qwad059.
12. Lee, S., & Hwang, W. (2019). **Development of an Efficient Immersed-Boundary Method with Subgrid-Scale Models for Conjugate Heat Transfer Analysis using Large Eddy Simulation**. *International Journal of Heat and Mass Transfer, 134*, 198-208. doi:10.1016/j.ijheatmasstransfer.2019.01.019.
13. Baek, S., Lee, S., Hwang, W., & Park, J. S. (2019). **Experimental and Numerical Investigation of the Flow in a Trailing Edge Ribbed Internal Cooling Passage**. *Journal of Turbomachinery, 141* (1), 011012. doi:10.1115/1.4041868.

## PEER-REVIEWED ARTICLES

1. Lee, S., Song, H., & Lele, S. K. (2025). **Global Instability of Shock Trains in Supersonic Isolator Ducts**. *CTR Annual Research Briefs*, 2025. In Preparation.
2. Lee, S., Vijay, S. (2025). **Topology-Aware Drag–Permeability Modeling in Architected Porous Structures**. *CTR Annual Research Briefs*, 2025. In Preparation.

## DISSERTATION

1. Lee, S. (2024). **Linear Stability of a Wake Vortex and its Transient Growth: Numerical Analysis in Light of Critical-Layer Eigenmodes and Spectra** (Publication No. 31483920) [Doctoral Dissertation, University of California, Berkeley]. *ProQuest Dissertations & Theses*.

## CONFERENCE PAPERS & PRESENTATIONS

1. Lee, S., & Vijay, S. (2025, Nov 23-25). **Topological Design of Porous Structures for Flow Control: A Design-by-Morphing Approach**. 78th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Houston, TX, United States (no. J32.3). American Physical Society.
2. Hong, J., Lee, S., Lee, D., Bae, J. & Hwang, W. (2025, Sep 15-19). **Experimental and Numerical Investigation of 3D Flow Structures in a Turbulent Channel Flow with Riblets.** 16th International Symposium on Experimental and Computational Aerothermodynamics of Internal Flows (ISAIF), Prague, Czech Republic (no. C7.1). Institute of Thermomechanics, Czech Academy of Sciences.
3. Lee, S., Wang, J. & Marcus, P. S. (2024, Nov 24-26). **Modernized and Parallelized Mapped Legendre Spectral Method Code for Unbounded Vortical Flow Simulations**. 77th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Salt Lake City, UT, United States (no. L16.7). American Physical Society.
4. Wang, J., Lee, S. & Marcus, P. S. (2024, Nov 24-26). **Stability Analysis of the Q-Vortex: Critical Swirling Parameter Determination via Perturbation Theories and Resonant Triadic Perturbations in the Sub-Critical Region**. 77th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Salt Lake City, UT, United States (no. J38.5). American Physical Society.
5. Lee, S., & Marcus, P. S. (2024, Aug 25-30). **Particle-Initiated Transient Growth of a Wake Vortex in Consideration of Condensation Trails**. 26th International Congress of Theoretical and Applied Mechanics (ICTAM), Daegu, South Korea (pp. 2009-2010). International Union of Theoretical and Applied Mechanics.
6. Lee, S., & Marcus, P. S. (2023, Nov 19-21). **Investigation of Triggering Vortex Instabilities with Inertial Particles**. 76th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Washington, DC, United States (no. ZC38.5). American Physical Society.
7. Wang, J., Lee, S., & Marcus, P. S. (2023, Nov 19-21). **Three-Wave Resonance in Neutrally Stable Wake Vortices**. 76th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Washington, DC, United States (no. ZC38.2). American Physical Society.
8. Lee, S., & Marcus, P. S. (2022, Nov 20-22). **Viscous Perturbation to Inviscid Wake Vortices - Perturbation Theory in Vortex Stability**. 75th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Indianapolis, IN, United States (no. Q11.7). American Physical Society.
9. Marcus, P. S., Wang, J. & Lee, S. (2022, Nov 20-22). **A General Framework for Destabilizing Neutrally-Stable Flows Applied to Aircraft Wake Vortices**. 75th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Indianapolis, IN, United States (no. L18.1). American Physical Society.
10. Lee, S., & Marcus, P. S. (2021, Nov 21-23). **Linear Instability Analysis of Wake Vortices by a Spectral Method using Mapped Legendre Functions**. 74th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Pheonix, AZ, United States (no. E24.1). American Physical Society.
11. Wang, J., Lee, S., & Marcus, P. S. (2021, Nov 21-23). **Destabilizing Neutrally Stable Wake Vortices Using Degenerate Eigenmodes**. 74th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Pheonix, AZ, United States (no. E24.3). American Physical Society.

12. Lee, S., & Hwang, W. (2018, Jul 4-6). **Validation of a Conjugate Heat Transfer Code with Subgrid-scale Models for Turbulent Flow**. KSFM 2018 Summer Conference, Jeju, South Korea (pp. 197-198). Korean Society for Fluid Machinery.
13. Baek, S., Lee, S., Hwang, W. & Park, J. S. (2018, Jun 11-15). **Experimental and Numerical Investigation of the Flow in a Trailing Edge Ribbed Internal Cooling Passage**. ASME 2018 Turbo Expo: Turbomachinery Technical Conference and Exposition, Lillestrøm, Norway (no. GT2018-76741). American Society of Mechanical Engineers. doi:10.1115/GT2018-76741. *Journal-Quality Appraisal and Transferred to J. Turbomach.*
14. Lee, S. (2017, Nov 1-3). **2D Simulation of an Unsteady Flow around a Small Vertical Axis Wind Turbine Using an Immersed Boundary Method**. KSME 2017 Annual Conference, Jeju, South Korea (pp. 741-745). Korean Society of Mechanical Engineers. *Student Paper Award: Bronze*.
15. Baek, S., Lee, S. & Hwang, W. (2017, Nov 1-3). **Investigation of Fully Developed Turbulent Pipe Flow Using Magnetic Resonance Velocimetry (MRV) and Large Eddy Simulation (LES)**. KSME 2017 Annual Conference, Jeju, South Korea (pp. 581-583). Korean Society of Mechanical Engineers.

## INVITED TALKS & SEMINARS

1. Lee, S. (2025, Aug 19). **Topology Optimization of Complex Nonlinear Systems Using High-Performance Simulations and Data-Driven Approaches**. GTR Technical Research Society Seminar, Suwon, South Korea. Global Technology Research, Samsung Electronics.
2. Lee, S. (2025, Jan 10). **Unmasking Hidden Physics and Bridging Data Sparsity: Two Paths to Tackling Fluid Problems**. CTR Tea Seminar, Stanford, CA, United States. Center for Turbulence Research, Stanford University.
3. Lee, S. (2024, Sep 10). **Physics-Based Computation in the Modern Era of Data-Driven Fluid Mechanics**. SNU Mechanical Engineering Seminar, Seoul, South Korea. Department of Mechanical Engineering, Seoul National University.
4. Lee, S. (2023, Aug 8). **Design-by-Morphing (DbM): A Novel Design Methodology for Aerodynamic Optimization**. 2023 Hyundai Vision Conference, Seoul, South Korea. Hyundai Motor Company.
5. Lee, S. (2022, Nov 16). **Modern Applications of Computational Fluid Dynamics (CFD)**. 2022 Online Special Lecture Series: Research Reinforcement for Sustainable Buildings and Urban Systems in Future, Online. Department of Architectural and Urban Systems Engineering, Ewha Womans University.
6. Lee, S. (2018, Aug 8). **An Introduction to In-House LES - Applications to Turbine Internal Cooling and Recent Improvements for Conjugate Heat Transfer Analysis**. KARI Computational Fluid Dynamics Seminar, Daejeon, South Korea. Korea Aerospace Research Institute.

## SOFTWARE & CODES

1. Lee, S., Wang, J. (2025). **MLegS: Modernized and Parallelized Mapped Legendre Spectral Method Code** (v1.0.2). https://github.com/ucbCFD/MLegS. doi:10.5281/zenodo.14976470.
2. Lee, S. (2025). **roughSurfaceGen: Artificial Rough Surface Generator that Fits Prescribed Surface Roughness Parameters** (v1.0.1). https://github.com/jun9303/roughSurfaceGen.