Sangjoon "Joon" Lee, Ph.D.

CTR Postdoctoral Fellow at Stanford University

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EDUCATION

University of California, Berkeley – Berkeley, CA, USA 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 2-year military leave of absence*
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) *(Funder: ONR; Faculty Sponsor: Dr. B. J. McKeon)*

- Physical understanding of turbulence and related non-linear multi-scale phenomena

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

- Numerical examination of destabilizing aircraft wake vortices using both linear and non-linear analyses in association with spectral collocation methods
- Machine Learning (ML)-based 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 INTEREST

Fluid Mechanics (Emphasis in CFD), Computational Science & Flows in Human Environment

- Modeling and analyzing fundamental solutions and instabilities in fluid mechanics
- Computing and optimizing geometrically complex or dynamically turbulent flow motions in association with physically robust ML techniques
- Investigating flow problems with respect to sustainable energy (e.g., gas/wind turbines) and clean environment on various scales (from indoor air conditioning to condensation trails)

JOURNAL PUBLICATION

1. Lee, S., Baek, S. & Hwang, W. (2024). **Impact of Additively Manufactured Surface Roughness on Flow Motion in Internal Cooling Passages without or with Ribs**. [In Preparation].
2. Duarte, C., Raftery, P., Lee, S., & Solmaz, A. S. (2024). **Effect of Elevated Air Movement on Radiant Cooling Systems**. [In Preparation].
3. Lee, S., & Marcus, P. S. (2024). **Transient Growth of a Wake Vortex and its Initiation via Inertial Particles**. *arXiv Preprint*. arXiv:2402.07469 [Preprint].
4. Wang, J., Lee, S., & Marcus, P. S. (2024). **Triadic Resonance in Columnar Vortices**. *arXiv Preprint*. arXiv:2402.05287 [Preprint].
5. 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.
6. 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.
7. Sheikh, H. M., Lee, S. (co-first), 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.
8. 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.
9. 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.

CONFERENCE PAPER & PRESENTATION

1. Lee, S., Wang, J. & Marcus, P. S. (2024, Nov 24-26). **Modernized and Parallelized Mapped Legendre Spectral Method Code for Unbounded Vortical Flow Simulations.** In *Abstr. 77th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Salt Lake City, UT, USA* (no. L16.7). American Physical Society.
2. 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.** In *Abstr. 77th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Salt Lake City, UT, USA* (no. J38.5). American Physical Society.
3. Lee, S., & Marcus, P. S. (2024, Aug 25-30). **Particle-Initiated Transient Growth of a Wake Vortex in Consideration of Condensation Trails.** In *Ext. Abstr. 26th International Congress of Theoretical and Applied Mechanics (ICTAM), Daegu, South Korea* (pp. 2009-2010). International Union of Theoretical and Applied Mechanics.
4. Lee, S., & Marcus, P. S. (2023, Nov 19-21). **Investigation of Triggering Vortex Instabilities with Inertial Particles.** In *Abstr. 76th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Washington, DC, USA* (no. ZC38.5). American Physical Society.
5. Wang, J., Lee, S., & Marcus, P. S. (2023, Nov 19-21). **Three-Wave Resonance in Neutrally Stable Wake Vortices.** In *Abstr. 76th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Washington, DC, USA* (no. ZC38.2). American Physical Society.

6. Lee, S., & Marcus, P. S. (2022, Nov 20-22). **Viscous Perturbation to Inviscid Wake Vortices - Perturbation Theory in Vortex Stability.** In *Abstr. 75th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Indianapolis, IN, USA* (no. Q11.7). American Physical Society.
7. Marcus, P. S., Wang, J. & Lee, S. (2022, Nov 20-22). **A General Framework for Destabilizing Neutrally-Stable Flows Applied to Aircraft Wake Vortices.** In *Abstr. 75th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Indianapolis, IN, USA* (no. L18.1). American Physical Society.
8. Lee, S., & Marcus, P. S. (2021, Nov 21-23). **Linear Instability Analysis of Wake Vortices by a Spectral Method using Mapped Legendre Functions.** In *Abstr. 74th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Pheonix, AZ, USA* (no. E24.1). American Physical Society.
9. Wang, J., Lee, S., & Marcus, P. S. (2021, Nov 21-23). **Destabilizing Neutrally Stable Wake Vortices Using Degenerate Eigenmodes.** In *Abstr. 74th Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), Pheonix, AZ, USA* (no. E24.3). American Physical Society.
10. Lee, S., & Hwang, W. (2018, Jul 4-6). **Validation of a Conjugate Heat Transfer Code with Subgrid-scale Models for Turbulent Flow.** In *Proc. KSFM 2018 Summer Conference, Jeju, South Korea* (pp. 197-198). Korean Society for Fluid Machinery.
11. 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.** In *Proc. 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.*
12. Lee, S. (2017, Nov 1-3). **2D Simulation of an Unsteady Flow around a Small Vertical Axis Wind Turbine Using an Immersed Boundary Method.** In *Proc. KSME 2017 Annual Conference, Jeju, South Korea* (pp. 741-745). Korean Society of Mechanical Engineers. *Student Paper Award: Bronze*.
13. 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).** In *Proc. KSME 2017 Annual Conference, Jeju, South Korea* (pp. 581-583). Korean Society of Mechanical Engineers.

INVITED TALK & SEMINAR

1. 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.
2. Lee, S. (2023, Aug 8). **Design-by-Morphing (DbM): A Novel Design Methodology for Aerodynamic Optimization.** *2023 Hyundai Vision Conference, Seoul, South Korea*. Hyundai Motors.
3. 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.
4. 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.

TEACHING & TUTORING

Teaching Assistant, University of California, Berkeley — 2024 Sp
Introduction to Computer Programming for Scientists and Engineers (ENGIN 7)
- Essential programming strategies and numerical methods for scientific computing

Course Designer / Graduate Student Instructor, University of California, Berkeley — 2022 Fa - 2023 Sp
Introduction to Aerospace Engineering Design (AERO ENG 10)
- Computer-aided two-dimensional airfoil design practices with wind tunnel experiments

Graduate Student Instructor, University of California, Berkeley — 2019 Fa - 2022 Sp
Experimentation and Measurements (MEC ENG 103)
- Measurements and experimental techniques for mechanical engineers

Undergraduate Tutor, Seoul National University — 2013 Sp - 2013 Fa
Basic Calculus 1, 2 & Basic Physics 1 (007.098A, 102 & 099A)
- Review of basics of university-level calculus and physics

GRANT & FELLOWSHIP

CTR Postdoctoral Fellowship — 2024 - 2025
Center for Turbulence Research (CTR) at Stanford University
- Supports and grants for research on turbulence or relevant non-linear phenomena

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

Overseas Ph.D. Scholarship, Study Abroad Doctoral Program — 2019 - 2023
Ilju Academy & Culture Foundation
- Merit-based financial aids for promising Ph.D. students studying out of Korea
- 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

HONOR & AWARD

Outstanding Graduate Student Instructor (OGSI) Award — 2021
GSI Teaching & Resource Center at 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 Korean Society of Mechanical Engineers

PROFESSIONAL SERVICE

Peer Reviewer
- *Physics of Fluids*, AIP Publishing (invited since 2024)

COMMUNITY OUTREACH

SNU Tomorrow's Engineers Membership, Seoul National University — 2016 - 2018
Member & Head Manager
- Annual *Vision Mentoring* for high school students interested in engineering and science
- Student-driven regular intercollegiate academic knowledge exchange sessions