Wonjun Lee

ASSISTANT PROFESSOR AT OSU

Columbus, OH

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Research Interests

My research focuses on developing partial differential equations (PDE)-based algorithms to solve high-dimensional machine learning problems and analyze the theoretical properties of the algorithms.

Machine learning, deep learning, generative modeling, contrastive learning, optimal transport, gradient flows, mean field games.

Academic Positions

The Ohio State University — *Columbus, OH*
Assistant Professor — *Aug 2025 - Present*

- Assistant professor at the department of mathematics.

University of Minnesota, Twin Cities — *Minneaplis, MN*
IMA-NIST Postdoctoral Fellow — *Aug 2022 - Aug 2025*

- A joint IMA-NIST Postdoctoral Fellowship in Analysis of Machine Learning at the Institute for Mathematics and its Applications (IMA) in the College of Science and Engineering at the University of Minnesota (UMN).
- Working on machine learning research with Prof. Jeff Calder, Prof. Li Wang, and Prof. Gilad Lerman.

University of California, Los Angeles — *Los Angeles, CA*
Assistant Adjunct Professor — *Jun 2022 - Aug 2022*

- Taught introductory programming course in C++ (PIC 10A) as a main instructor.

Education

University of California, Los Angeles — *Los Angeles, CA*
Ph.D. in Mathematics — *Sep 2017 - Jun 2022*

- **Advisor:** Professor Stanley Osher.
- **Thesis:** Algorithms For Optimal Transport And Their Applications To PDEs.

George Mason University — *Fairfax, Virginia*
B.S. in Mathematics — *May 2015*

- Concentration in Applied Mathematics and Mathematical Statistics.
- GPA: 3.84/4.0 *magna cum laude*, Phi Beta Kappa.

Honors and Awards

2022   Rising Star in Data Science from the University of Chicago. Profile Link.

2021   UCLA Dissertation Year Fellowship ($20,000$)

2014   2014 Outstanding Presentation Award at the Joint Mathematical Meetings, Baltimore, MD.

Publications

- J. Calder, **W. Lee**, A.M. Neuman, *Spectral convergence rate of the graph p-Laplacian on a manifold with boundary*, **In preparation**

- **W. Lee**, L. Wang, W. Li, *Generalized Deep JKO: an IMEX particle method for kinetic Fokker-Planck equations*, **In preparation**

- M. Jacobs, **W. Lee**, *An efficient numerical scheme for tumor growth models*, **In preparation**

- **W. Lee**, R. O'Neill, D. Zou, J. Calder, G. Lerman, *Geometry-Preserving Encoder/Decoder In Latent Generative Models*, **Submitted**

- J. Calder, **W. Lee**, *Understanding Contrastive Learning through Variational Analysis and Neural Network Optimization Perspectives*, **Submitted**

- **W. Lee**, Y. Yang, D. Zou, G. Lerman, *Monotone Generative Modeling via a Gromov-Monge Embedding*, SIAM Journal on Mathematics of Data Science, 2025

- J. Calder, **W. Lee**, *Monotone Discretizations of Levelset Convex Geometric PDEs*, Numerische Mathematik, 2024

- Y. Yang, **W. Lee**, D. Zou, G. Lerman, *Improving Hyperbolic Representations via Gromov-Wasserstein Regularization*, ECCV, 2024

- **W. Lee**, L. Wang, W. Li, *Deep JKO: Time-Implicit Particle Methods For General Nonlinear Gradient Flows*, Journal of Computational Physics, 2024

- **W. Lee**, S. Liu, W. Li, S. Osher, *Mean Field Control Problems For Vaccine Distribution*, Research in the Mathematical Sciences, 2022

- W. Li, **W. Lee**, S. Osher, *Computation Mean-Field Information Dynamics Associated With Reaction Diffusion Equations*, Journal of Computational Physics, 2022

- S. Agrawal, **W. Lee**, S. W. Fung, L. Nurbekyan, *Random Features for High-Dimensional Nonlocal Mean-Field Games*, Journal of Computational Physics, 2022

- A. Vepa, A. Choi, N. Nakhaei, **W. Lee**, N. Stier, A. Vu, G. Jenkins, X. Yang, M. Shergill, M. Desphy, K. Delao, M. Levy, C. Garduno, L. Nelson, W. Liu, F. Hung, F. Scalzo, *Weakly-Supervised Convolutional Neural Networks for Vessel Segmentation in Cerebral Angiography*, Proceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision (WACV), 2022

- **W. Lee**, W. Li, B. Lin, A. Monod, *Tropical Optimal Transport and Wasserstein Distances in Phylogenetic Tree Space*, Information Geometry, 2021

- M. Jacobs, **W. Lee**, F. Léger, *The back-and-forth method for Wasserstein gradient flows*, ESAIM: COCV, 27:28, 2021.

- **W. Lee**, S. Liu, H. Tembine, W.C. Li, S. Osher., *Controlling propagation of epidemics via mean-field games*, SIAM Journal on Applied Math, 2020

- **W. Lee**, R.J. Lai, W. Li, S. Osher., *Generalized unnormalized optimal transport and its fast algorithms*, Journal of Computational Physics, 2020

- H. Gao, **W. Lee**, W. Li, Z. Han, S. Osher, and H. V. Poor, *Energy-efficient Velocity Control for Massive Rotary-Wing UAVs: A Mean Field Game Approach*, IEEE Globecom, 2020.

- Y. Kang, S. Liu, **W. Lee**, W. Li, H. Zhang, and Z. Han, *Joint Task Assignment and Trajectory Optimization for a Mobile Robot Swarm by Mean-Field Game*, IEEE Globecom, 2020.

Teaching Experience

University of Minnesota *Minneapolis, MN*
Instructor *Aug 2022 – Present*

Fall 2024	**Math 2243**: Linear Algebra and Differential Equations
Summer 2024	**Summer School**: Machine Learning Summer Camp for high school students
Spring 2024	**Math 2243**: Linear Algebra and Differential Equations
Summer 2023	**Summer School**: Machine Learning Summer Camp for high school students
Summer 2023	**Summer School**: Random Structures in Optimizations and Related Applications
Spring 2023	**Math 2243**: Linear Algebra and Differential Equations

University of Minnesota *Minneapolis, MN*
Mentor from Directed Reading Program (DRP) *Aug 2023 - May 2024*

- Mentoring undergraduate students for the quarter-long independent study project in math.
- Topics: survey of optimization methods and their applications in neural newtorks.

University of California, Los Angeles *Los Angeles, CA*
Teaching Assistant *Aug 2017 – Jun 2021*

- PIC 10ABC: Intro, intermediate, advanced C++ programming.
- PIC 16: Python with Applications - Python modules such as PyQt, SciPy, Pandas, and NLTK.
- Math 164: Fundamentals of optimization. Linear / nonlinear programming.
- Math 151B: Applied numerical methods with analysis of algorithms and computer implementations.

University of California, Los Angeles *Los Angeles, CA*
Mentor from Directed Reading Program (DRP) *Jan 2021 - Mar 2022*

- Mentoring undergraduate students for the quarter-long independent study project in math.
- Topics: unsupervised learning of image segmentation, generative adversarial networks, applications of mean field games in finance.

Service and Outreach

2024	Ambassador for the University of Minnesota's Data Science Initiative (DSI), **UMN DSI**
2024	Co-organizer of the minisymposium 'Theory and Applications of Optimal Transport in Machine Learning' with Jeff Calder, **SIAM Annual Meeting 2024**

Work Experience

University of California, Los Angeles   *Los Angeles, CA*

Research Assistant   *Aug 2017 – Aug 2022*

- Developed efficient algorithms using PDEs and optimal transport to solve challenging problems, including Wasserstein gradient flows, Navier-Stokes equations, and epidemic models. (PyTorch, C++)

George Mason University   *Fairfax, VA*

Research Assistant   *May 2017 – May 2018*

- Developed deep learning methods using SVD and diffusion map for classification tasks. (Tensorflow)

Cheiron, Inc   *Washington D.C.*

Actuary   *Feb 2015 - Sep 2016*

- Evaluated the likelihood of undesirable events using actuarial pricing and projection models.
- Worked on actuarial valuation reports for public, single-employer, and multi-employer plans.

Presentations, Talks

2024   UMTC-UMD Postdoc Seminar Program, *Understanding Contrastive Learning from Variational and Neural Network Optimization Perspectives*, **University of Minnesota, Duluth**

2024   (Poster) SIAM Conference on Mathematics of Data Science (MDS24), *Understanding Contrastive Learning from Variational and Neural Network Optimization Perspectives*, **Atlanta Georgia**

2024   SIAM Conference on Mathematics of Data Science (MDS24), *Understanding Contrastive Learning from Variational and Neural Network Optimization Perspectives*, **Atlanta Georgia**

2024   SIAM Annual Meeting (SIAM AN24), *Geometry-preserving encoder and decoder on latent diffusion models*, **Spokane, Washington**

2024   SE Machine Learning and Data Science Seminar, *Monotone Generative Modeling via a Gromov-Monge Embedding.*, **University of Vienna**

2024   Computational and Applied Math (CAM) Seminar, *Monotone Generative Modeling via a Gromov-Monge Embedding.*, **Georgia Tech**

2024   MDL Collective Seminar, *Deep JKO: time-implicit particle methods for general nonlinear gradient flows*, **Iowa State University**

2024   Applied Math Seminar, *Monotone Generative Modeling via a Gromov-Monge Embedding.*, **UC Santa Barbara**

2023   Workshop on Models and Algorithms for Path Planning (MAPP), *Monotone Generative Modeling via a Gromov-Monge Embedding.*, **UT Austin**

2023   Analysis and Probability Seminar, *Monotone discretizations of levelset convex geometric PDEs.*, **Iowa State University**

2023   A Monthly Seminar at The Mokaplan Research, Mokameeting, *Monotone Generative Modeling via a Gromov-Monge Embedding.*, **Inria Paris**

2023   Kernel Club, *Monotone Generative Modeling via a Gromov-Monge Embedding.*, **Colorado School of Mines**

2023	ACMD Seminar, *Monotone Generative Modeling via a Gromov-Monge Embedding.*, **National Institute of Standards and Technology (NIST)**
2023	Workshop on kinetic and optimal transport, *Deep JKO for general gradient flows.*, **University of Minnesota**
2023	2023 Algorithms for Threat Detection PI Workshop (Poster session), *Monotone generative modeling via Gromov-Monge Embedding.*, **Washington D.C.**
2023	The Level Set Collective II, *Monotone discretizations of levelset convex geometric PDEs.*, **UCLA**
2023	SIAM Conference on Computational Science and Engineering , *Monotone discretizations of levelset convex geometric PDEs.*, **CSE23**
2022	IMA Data Science Seminar, *The back-forth method for Wasserstein gradient flows.*, **University of Minnesota**
2021	Optimal transport and Mean field games Seminar, *Mean field control problems for vaccine distribution.*, **University of South Carolina**
2021	Current Literature in Applied Mathematics Seminar, *The back-forth method for Wasserstein gradient flows.*, **UCLA**
2020	Optimal transport and Mean field games Seminar, *The back-forth method for Wasserstein gradient flows.*, **University of South Carolina**
2020	The Level Set Collective, *Numerical Methods and Applications of Optimal Transport.*, **UCLA**
2019	Optimal transport and Mean field games Seminar, *Tropical Wasserstein Distances in Phylogenetic Tree Space.*, **UCLA**
2019	Optimal transport and Mean field games Seminar, *Energy-efficient Velocity Control for Massive Rotary-Wing UAVs: A Mean Field Game Approach*, **UCLA**

Skills and Hobbies

Programming	C/C++, Python, Matlab
Language	English, Korean
Hobbies	Movies and video games