

Wonjun Lee

JOINT NIST-IMA POSTDOCTORAL ASSOCIATE, UMN

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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, generative modeling, optimal transport, gradient flows, mean field games.

Academic Positions

University of Minnesota, Twin Cities

Minneapolis, MN

IMA-NIST Postdoctoral Fellow

Aug 2022 - Present

- A joint NIST-IMA 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 projects with Prof. Jeff Calder, Prof. Gilad Lerman, and Prof. Li Wang.

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

- **W. Lee**, L. Wang, W. Li *Deep JKO: Time-Implicit Particle Methods For General Nonlinear Gradient Flows*, Preprint, 2023
- **W. Lee**, Y. Yang, D. Zou, G. Lerman *Monotone Generative Modeling via a Gromov-Monge Embedding*, Preprint, 2023
- J. Calder, **W. Lee**, *Monotone Discretizations of Levelset Convex Geometric PDEs*, Preprint, 2023
- **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.

Presentations, Talks

- 2023 **Kernel Club, Colorado School of Mines**
Monotone Generative Modeling via a Gromov-Monge Embedding.
- 2023 **ACMD Seminar, National Institute of Standards and Technology (NIST)**
Monotone Generative Modeling via a Gromov-Monge Embedding.
- 2023 **Workshop on kinetic and optimal transport**
Deep JKO for general gradient flows.

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

Teaching Experience

University of Minnesota

Minneapolis, MN

Instructor

Aug 2022 – Present

Spring 2023 **Math 2243:** Linear Algebra and Differential Equations

Spring 2024 **Math 2243:** Linear Algebra and Differential Equations

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.

Work Experience

University of California, Los Angeles

Los Angeles, CA

Research Assistant

Aug 2017 – Aug 2022

- Developing a new algorithm to compute the Wasserstein distance between large point clouds. Applications in machine learning models such as generative adversarial networks (GAN). (PyTorch, C++)
- Developed a fast and accurate algorithm that computes the solution of the Wasserstein gradient flows on 2D or 3D grids. (C++)
- Developed a new mean-field control model in controlling the propagation of epidemics in response to COVID pandemic. (C++)
- Studied Regularity theory for minimizers of polyconvex functionals related to incompressible / compressible Navier-Stokes equations under Prof. Wilfrid Gangbo.

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.

Skills

Programming C/C++, Python, Matlab

Language English, Korean