

YIKUN BAI

CONTACT INFORMATION

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RESEARCH INTERST

Machine learning, computational optimal transport

EMPLOYMENT

Vanderbilt University, Department of Computer Science 2022 - Present
Postdoctoral Research Associate Mentor: Dr. Soheil Kolouri

- Role: Research Associate, leading research on the theory and applications of Computational Optimal Transport in Machine Learning.
- Achievements:
 - First author publication at CVPR 2023
 - First author publication at ICML 2023
 - Contributed to 3 papers as a co-author on computational optimal transport (two are co-first authors).

EDUCATION

Ph.D. Electrical and Computer Engineering 2019 - 2022
The University of Delaware (U.S.) GPA: 4.0/4.0
Thesis: Optimal transport meets information theory: from measure concentration to information theory, to machine learning

M.S. Applied Mathematics (Ph.D. Transferred) 2016 - 2018
University of Delaware (U.S.) GPA: 4.0/4.0
Qualifying exams passed:
- Functional analysis, Stochastic process, Hypothesis test

M.A. Mathematics 2014 - 2016
Marshall University (U.S.) GPA: 4.0/4.0

B.S. Medical Imaging 2007 - 2012
Mudanjiang Medical University (China) Grade: 83/100

SKILLS AND COURSEWORK

Mathematical: optimal transport, numerical analysis, partial differential equations, convex optimization, empirical process
Machine learning: research experience in GAN, shape registration, transfer learning
Programming: Python, Matlab, R, Mathematica
Machine Learning Tool: Pytorch, Scikit-Learn
Operation Systems: Ubuntu, MacOS, Windows

Miscellaneous: L^AT_EX, Canvas, Sakai, Microsoft office (Excel, Powerpoint, etc).

PUBLICATIONS

Preprint

- Xinran Liu, **Yikun Bai**, Yuzhe Lu, Andrea Soltoggio, and Soheil Kolouri. Wasserstein task embedding for measuring task similarities. *arXiv preprint arXiv:2208.11726*, 2022

Conference

- Rocio P Diaz Martin*, Ivan Vladimir Medri*, **Yikun Bai***, Xinran Liu, Kangbai Yan, Gustavo Rohde, and Soheil Kolouri. Lcot: Linear circular optimal transport. *International Conference on Learning Representations (ICLR)*, 2024 (*Equally contribution)
- Xinran Liu*, **Yikun Bai***, Zhanqi Zhu, Mathew Thorpe, and Soheil Kolouri. Ptlp: Partial transport lp distances. *Optimal Transport and Machine Learning Workshop at Neural Information Processing Systems (NeurIPS)*, 2023 (*Equally contribution)
- **Yikun Bai**, Ivan Vladimir Medri, Rocio Diaz Martin, Rana Shahroz, and Soheil Kolouri. Linear optimal partial transport embedding. In *International Conference on Machine Learning*, pages 1492–1520. PMLR, 2023
- **Yikun Bai***, Bernhard Schmitzer*, Mathew Thorpe, and Soheil Kolouri. Sliced optimal partial transport. *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 2023 (*Equally contribution)
- Daria Reshetova, **Yikun Bai**, Xiugang Wu, and Ayfer Özgür. Understanding entropic regularization in gans. In *2021 IEEE International Symposium on Information Theory (ISIT)*, pages 825–830. IEEE, 2021
- **Yikun Bai**, Xiugang Wu, and Ayfer Özgür. Information constrained optimal transport: From talagrand, to marton, to cover. In *2020 IEEE International Symposium on Information Theory (ISIT)*, pages 2210–2215. IEEE, 2020

Journal

- **Yikun Bai**, Huy Tran, Steven B Damelin, and Soheil Kolouri. Partial transport for point-cloud registration [under review]. *IEEE Transactions on Image Processing*, 2023
- Daria Reshetova, **Yikun Bai**, Xiugang Wu, and Ayfer Ozgur. Understanding entropic regularization in gans. In *Journal of Machine Learning Research*, 2023
- **Yikun Bai**, Xiugang Wu, and Ayfer Özgür. Information constrained optimal transport: From talagrand, to marton, to cover. *IEEE Transactions on Information Theory*, 69(4):2059–2073, 2023
- Scott A Sarra and **Yikun Bai**. A rational radial basis function method for accurately resolving discontinuities and steep gradients. *Applied Numerical Mathematics*, 130:131–142, 2018

POSTERS AND PRESENTATIONS

- Title: Sliced optimal partial transport
 - Conference on Computer Vision and Pattern Recognition
 - Vancouver Convention Centrer
- 2023

- Southeastern Analysis Meeting 39 2023
Clemson University
- KIAS AI Seminar 2023
Korea Institute For Advanced Study, South Korea
- Title: linear optimal partial transport embedding
- International Conference on Machine Learning 2023
Hawaii Convention Center

RESEARCH AND PROJECT EXPERIENCE

Vanderbilt University
Department of Computer Science

03/2022 – present
Mentor: Dr. Soheil Kolouri

- **Partial OT in Shape Registration**
 - Developed algorithms incorporating Optimal Partial Transport (OPT) and its sliced version, and RBF/TPS regression techniques for non-rigid registration problems in 2D and 3D point clouds.
 - Provided a novel interpretation of the classical TPS-RPM method from the Sinkhorn Optimal Transport (OT) perspective, leading to an improved algorithm for non-registration tasks.
- **Linear Circle Optimal Transport (Co-First Author)**
 - Collaborated with Rocío Martín and Ivan Medri to formulate Linear Circle OT embedding (LCOT) and related concepts (LCOT distance, LCOT geodesics, etc). Proved corresponding properties of LCOT (metric properties and its relationship with Circle OT).
 - Developed algorithms for the general version of LCOT embedding and a continuous version. Conducted experiments on their performance comparison.
- **Partial Transport L_p Distances (Co-First Author)**
 - Established a connection between PTL_p space and positive Radon measure space. Formulated the PTL_p distance and its sliced version, proving various properties, including metric properties and convergence behaviour.
 - Developed algorithms for the sliced versions of PTL_p and TLL_p distances.
- **Linear Optimal Partial Transport**
 - Proposed a novel linear embedding technique in the Optimal Partial Transport (OPT) setting in Euclidean space, with theoretical proofs of key properties. Introduced related concepts in linear OPT embedding (e.g. LOPT distance, OPT barycentric projection, LOPT interpolation), and implemented associated algorithms.
 - Conducted practical experiments involving point cloud interpolation and PCA analysis.
- **Sliced Optimal Partial Transport**
 - Collaborated with Dr. Bernhard Schmitzer to create a faster computational method for the 1-D optimal partial transport problem.

- Developed and proposed the sliced version of the optimal partial transport distance (SOPT) with theoretical proofs of key properties.
- Designed and executed shape registration and color adaptation experiments using the SOPT approach.

University of Delaware

06/2019 - 08/2021

Department of Electrical and Computer Engineering

• Information Constraint Optimal Transport Inequality and Measure Concentration

- Proposed and proved an information constraint (equivalent to entropic) version of optimal transportation inequality.
- Established connections between the new transportation inequality, measure concentration inequality, and classical Talagrand inequality.
- Applied the new entropic OT inequality to solve a significant open problem in network information theory: the Capacity of Relay Channel.

• Entropic OT GANs (Second Author)

- Provided a novel interpretation of entropic Optimal Transport Generative Adversarial Network (GAN) within the realm of rate-distortion theory.
- Collaborated with Daria Reshetova (first author) to provide theoretical evidence for the sample complexity of entropic regularized GAN.

Marshall University

Department of Mathematics

09/2015 – 12/2016

• Rational RBF Method (Second Author)

- Collaborated with Dr. Sarra Scott to propose a new rational RBF method that eliminates oscillations induced by classical RBF methods.

TEACHING EXPERIENCE

Visiting Instructor

Foundations of Machine Learning (CS5262)

Teaching Assistant

Advanced Machine Learning (ELEG 867, ELEG 602)

Convex Optimization (ELEG 667)

Random Signals and Probability (ELEG 310)

Statistics (MATH 210)

Calculus and Analytic Geometry (MATH 241, MATH 221)

Vanderbilt University

Fall 2023

University of Delaware

Spring 2019, Fall 2020

Fall 2019

Spring 2020, Spring 2021

Spring 2018, Fall 2018

Fall 2016, Spring 2017

SERVICES

Conference Reviewer

- The International Conference on Learning Representations (ICLR) 2023
- Conference on Neural Information Processing Systems 2023
- IEEE / CVF Transactions on Machine Learning Researcher 2023
- IEEE International Symposium on Information Theory 2023
- IEEE International Symposium on Information Theory 2022

- IEEE / CVF Computer Vision and Pattern Recognition Conference 2022

Journal Reviewer

- Mathematics of Computation 2023
- IEEE Transactions on Circuits and Systems for Video Technology 2023
- IEEE transaction on information science 2021

AWARDS AND HONORS

- Travel grant of Southeastern Analysis Meeting 39 Clemson Univeristy, 2023
- ECE Research Day 2021 poster sessions University of Delaware, 2021
- GEMS project fund University of Delaware, 2017

PROFESSIONAL MEMBERSHIP

- IEEE member 2022
- CVF Sponsored Conferences 2023