YIKUN BAI

CONTACT INFORMATION

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RESEARCH INTERST

Computational optimal transport, Shape Registration, Linear Embedding, Machine Learning

EMPLOYMENT

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

EDUCATION

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

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

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

Mudanjiang Medical University (China) — 2007 - 2012
B.S. Medical Imaging — 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: LaTeX, Canvas, Sakai, Microsoft office (Excel, Powerpoint, etc).

PUBLICATIONS

Preprint

- Xinran Liu*, Yikun Bai*, Zhanqi Zhu, Mathew Thorpe, and Soheil Kolouri. Ptlp: Partial transport lp distances. *Conference on Neural Information Processing Systems*, 2023 [submitted] (**Equally contribution*)

Conference

- Yikun Bai, Ivan Medri, Rocio Diaz Martin, Rana Muhammad Shahroz Khan, and Soheil Kolouri. Linear optimal partial transport embedding. *Proceedings of International Conference on Machine Learning*, 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*)
- Xinran Liu, Yikun Bai, Yuzhe Lu, Andrea Soltoggio, and Soheil Kolouri. Wasserstein task embedding for measuring task similarities. *arXiv preprint arXiv:2208.11726*, 2022
- Daria Reshetova, Yikun Bai, Xiugang Wu, and Ayfer Özgür. Understanding entropic regularization in gans. In *2021 IEEE International Symposium on Information Theory (ISIT)*. 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

- Daria Reshetova, Yikun Bai, Xiugang Wu, and Ayfer Özgür. Understanding entropic regularization in gans. In *Journal of Machine Learning Research*, 2021
- Yikun Bai, Xiugang Wu, and Ayfer Özgür. Information constrained optimal transport: From talagrand, to marton, to cover. In *IEEE Transactions on Information Theory*, pages 2210–2215. IEEE, 2021
- 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 2023
    Vancouver Convention Centrer
  - Southeastern Analysis Meeting 39 2023
    Clemson University
- Title: linear optimal partial transport embedding
  - International Conference on Machine Learning 2023
    Hawaii Convention Center

Conferences and Workshop

Conference on Neural Information Processing Systems, New Orleans, LA 2022
PIMS-IFDS-NSF Summer School on Optimal Transport, University of Washington 2022
IEEE International Symposium on Information Theory, Los Angeles, CA 2020

RESEARCH AND PROJECT EXPERIENCE

University of Delaware
Department of Computer Science 03/2022 – present
Mentor: Dr. Soheil Kolouri

- Partial transport lp distances (co-first author)
  - Prove the connection between PTLp space and positive Radon measure space. Collaborated with Xinran Liu (first author) to formulate the PTlp distance and its sliced version. Proved related concepts of the new Lp distance (e.g. property of metric, limit cases, the relation between the old and new Lp distances).
  - Develop the algorithms for sliced version of PTLp distance and TLp distance.
- Linear optimal partial transport
  - Developed and proposed a novel linear embedding technique in the optimal partial transport (OPT) framework in Euclidean space. Theoretically proved various properties, such as the existence of Monge mapping, the relationship between old and new embedding techniques. Collaborated with Ivan Medri and Rocio Martin to prove the connection between the new embedding technique and the Benamou Brenier formulation.
  - Introduced and defined additional concepts in linear OPT embedding, including OPT Barycentric projection, Linear OPT discrepancy, OPT and Linear OPT interpolation, and established their associated properties.
  - Designed and implemented algorithms for linear OPT embedding, including the OPT barycenter algorithm.
  - Conducted experiments involving point cloud interpolation and PCA analysis to showcase practical applications of Linear OPT embedding.
- Sliced optimal partial transport
  - Collaborated with Dr. Barnhard Schmitzer to create an innovative computational method for the 1-D optimal partial transport problem, achieving faster results compared to traditional methods such as the Sinkhorn algorithm and network simplexity.
  - Developed and proposed the sliced version of the optimal partial transport distance (SOPT), backed by theoretical proofs of its key properties including the existence of Monge mapping and metric properties.
  - Designed and executed shape registration and color adaptation experiments utilizing the SOPT approach, demonstrating its practical applications. Additionally, developed the SOPT-version of the ICP algorithm.

Department of Electrical and Computer Engineering 06/2019 - 08/2021

- Information constraint optimal transport inequality and measure concentration
  - Proposed and proved a new information constraint (equivalent to entropic) version of optimal transportation inequality.
  - Established the connection between the new transportation inequality, measure concentration inequality, and classical Talagrand inequality.

- Applied the new entropic OT inequality to solve a long-standing significant open problem in network information theory called Capacity of Relay channel.

- Entropic OT GANs (second author)
  - Proposed 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)
  - Collabrated with Dr. Sarra Scott to proposed a new rational RBF method. Numerically shows that the new method removes the oscillations induced by the classical RBF methods.

TEACHING EXPERIENCE

Teaching Assistant **University of Delaware**

Advanced Machine Learning (ELEG 867, ELEG 602)	Spring 2019, Fall 2020
Convex Optimization (ELEG 667)	Fall 2019
Random Signals and Probability (ELEG 310)	Spring 2020, Spring 2021
Statistics (MATH 210)	Spring 2018, Fall 2018
Calculus and Analytic Geometry (MATH 241, MATH 221)	Fall 2016, Spring 2017

SERVICES

Conference Reviewer

- 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

- 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