Zhouhao Yang

Email: zyang145@jh.edu   Mobile: +1 443-378-6940

PROFILE

- Current Ph.D. Student in Department of Applied Mathematics and Statistics, Johns Hopkins University.
- Research Interest: AI for Science, LLMs, diffusion models, Reinforcement Learning, stochastic control.
- Diverse research experiences: Ph.D. Candidate of Applied Mathematics and Statistics at JHU, One-Year Ph.D. Student at NUS Computing, Caltech Visiting Undergraduate Research Program.

EDUCATION

Johns Hopkins University   Aug 2024 – Present
  Ph.D. Candidate, Department of Applied Mathematics and Statistics
    Advisor: Haoyang Cao
    Research Direction: Memory-Efficient LLMs, Reinforcement Learning, Impulse Control Problems.

National University of Singapore   Aug 2023 – Jun 2024
  Ph.D. Candidate, Department of Computer Science
    Advisor: Kenji Kawaguchi and Johnathon Scarlett
    Research Direction: AI for Science, Physics-Informed Neural Networks, Memory-Efficient LLMs.

Shanghai Jiao Tong University   Sep 2019 – Jun 2023
  Bachelor of Mathematics and Applied Mathematics (Zhiyuan Honors Program)
    Selected Coursework: Probability, Statistics, Stochastic Process, Foundations of data science, Numerical Analysis and Scientific Computing, Partial Differential Equations, Fourier Analysis and Real Analysis, etc.

PUBLICATIONS

- Zhouhao Yang, Xingyu Xu and Yuantao Gu, "A General Framework for Accurate and Private Mean Estimation," in IEEE Signal Processing Letters, vol. 29, pp. 2293-2297, 2022, doi: 10.1109/LSP.2022.3219356.

- Zhouhao Yang*, Yihong Guo*, Pan Xu, Anqi Liu, and Anima Anandkumar, "Distributionally robust policy gradient for offline contextual bandits," in International Conference on Artificial Intelligence and Statistics, pages 6443–6462. PMLR, 2023.

- Zheyuan Hu*, Zhouhao Yang*, Yezhen Wang*, George Em Karniadakis, Kenji Kawaguchi, "Bias-variance trade-off in physics-informed neural networks with randomized smoothing for high-dimensional PDEs." *SIAM Journal on Scientific Computing* 47.4 (2025): C846-C872.

- Qianli Shen, Yezhen Wang, Zhouhao Yang, Kenji Kawaguchi et al., "Memory-Efficient Gradient Unrolling for Large-Scale Bi-level Optimization," The Thirty-eighth Annual Conference on Neural Information Processing Systems. 2024.

- Yan Hao Ling, Zhouhao Yang, Jonathan Scarlett, "Statistical Mean Estimation with Coded Relayed Observations," Under review in IEEE Transactions on Information Theory.

- Yezhen Wang*, Zhouhao Yang*, Kenji Kawaguchi et al, "Memory-Efficient LLM Training by Various-Grained Low-Rank Projection of Gradients." Under review in Neurips 2025.

RESEARCH EXPERIENCE

JHU: Continuous-Time Reinforcement Learning for Randomized Impulse Control Problems
Dec 2024-Present

- Professor of guidance: Haoyang Cao.
- Designed two randomization methods for impulse control problem (Poisson compound measure/ Relation to optimal stopping) which produces the same HJB equation.
- Proved convergence theorem for randomization approach.
- Designed an actor-critic RL algorithm and proved the policy improvement theorem.

NUS: Statistical Mean Estimation with Coded Relayed Observations

May 2024-Aug 2024

- Professor of guidance: Jonathan Scarlett.
- Studied the problem of statistical mean estimation, in which the samples are not observed directly, but are instead observed by a relay ("teacher") that transmits information through a memoryless channel to the decoder ("student"), who then produces the final estimate.
- Focused on Bernoulli sources and binary symmetric channels, and then sub-Gaussian and heavy-tailed settings along with arbitrary discrete memoryless channels.
- Designed a block-structured strategy, proved its superiority on error rate compared with baselines.

NUS: Bias-Variance Trade-off in Physics-Informed Neural Networks with Randomized Smoothing for High-Dimensional PDEs

Aug 2023-Nov 2023

- Professor of guidance: George Em Karniadakis from Brown University, Kenji Kawaguchi from NUS.
- Conducted in-depth research for physics-informed neural network with randomized smoothing, a backpropagation-free method for high-dim PINN, which addresses the memory and time costs brought by curse of dimension.
- Analyzed the bias-variance trade-off in Randomized Smoothing-PINN training.
- Corrected the bias brought by randomized smoothing in non-linear MSE loss and PDE terms.
- Proposed a hybrid loss function of biased and unbiased version to accelerate convergence of training and improve final accuracy. Biased training loss provides faster convergence, while unbiased training loss ensures better accuracy.
- Conducted extensive experiments on various PDEs including Fokker-Planck, HJB, Allen-Cahn, Sine-Gorden, etc.

NUS: Gradient-Enhanced Physics-Informed Neural Networks with Variance Reduced Randomized Smoothing for High-Order and High-dimensional PDEs

Aug 2023-Jan 2024

- Professor of guidance: George Em Karniadakis from Brown University, Kenji Kawaguchi from NUS.
- Generalized RS-PINN to high-order derivatives and various differential operators.
- Proposed variance reduction methods for randomly smoothed derivative estimators, including antithetic variate method, importance sampling, and Gaussian quadrature.
- Proved that gradient-enhanced techniques are basically free lunch under randomized smoothing, which greatly improves the efficiency of training.
- Conducted thorough experiments on low-dim and high-dim PDEs with RS-GPINN.

Caltech VURP (Visiting Undergraduate Research Program): Distributionally Robust Policy Gradient for Offline Contextual Bandits

Mar 2022-Oct 2022

- Professor of guidance: Anima Anandkumar from Caltech, Pan Xu from Duke University.
- Proposed a distributionally robust policy optimization method (DROPO) for offline contextual bandits, addressing the distributional shift between the static logging policy and the learning policy in policy gradient.
- Modelled the distributionally robust policy optimization problem as a minimax optimization problem, which has an analytical framework of solution.
- Generalized the DROPO method to contextual bandits with limited online exploration.
- Provided a generalization bound and a convergence analysis for DROPO.
- Designed and implemented experiments on *UCI Optdigits* and *MNIST*.

A General Framework for Accurate and Private Mean Estimation

July 2021-Jun 2022

- Professor of guidance: Yuantao Gu from Tsinghua University.
- Proposed a differentially private mean estimation algorithm for general types of distributions with given cumulative distribution function.
- Proved an upper bound for the algorithm's sample complexity, which is tailored to the cumulative distribution function of underlying population.
- Illustrated that our complexity bound is better in order for heavy-tailed distribution and at least enjoys the same order for light-tailed distribution.
- Designed and implemented experiments on Gaussian distribution and Levy-stable distribution.
- Independently studied the book *"High-dimensional Probability"* written by Roman Vershynin.

Bachelor's Thesis: Machine Learning Methods-Based Inverse Lithography Technology

Aug 2021-May 2023

- Professor of guidance: Dan Hu from Shanghai Jiao Tong University.
- Conducted a thorough literature review for the development of Inverse Lithography Technology over past decades.
- Proposed a complete machine learning methods-based ILT framework is proposed, which consists of a sequential framework of machine learning-based ILT and simulated annealing method-based ILT.
- Designed a convolutional neural network (UNet) to learn the mapping from on-wafer patterns to masks.
- Introduced a simulated annealing method based-ILT framework to refine the quasi-optimized masks and achieve better mask quality.
- Implemented the ML-based ILT framework and conducted experiments on ICCAD 2013 dataset.

HONORS AND AWARDS

- Outstanding students Scholarship of Shanghai Jiao Tong University   2019-2023 (four times)
- Honors scholarship for students of Zhiyuan College   2019-2023 (four times)

TEACHING EXPERIENCE

- Teaching Assistant for Introduction to Computational Mathematics (EN.553.385)   Aug 2024-May 2025