Bokun **Wang**

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Education

Texas A&M University   *College Station, TX, USA*

PH.D. STUDENT IN COMPUTER SCIENCE, ADVISED BY PROF. TIANBAO YANG   *August 2021 -*

> My research focuses on stochastic optimization for machine learning and AI, with a particular emphasis on learning from imbalanced data, self-supervised representation learning, and distributionally robust optimization (DRO).

University of California, Davis   *Davis, CA, USA*

M.S. IN COMPUTER SCIENCE   *Sept. 2018 - June 2020*

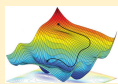**University of Electronic Science and Technology of China**   *Chengdu, Sichuan, China*

B.S. IN COMPUTER SCIENCE AND ENGINEERING (YINGCAI HONORS COLLEGE)   *Sept. 2014 - June 2018*

Research Overview

Theory for Modern Machine Learning and AI with Non-Decomposable Losses

Optimization Theory

Simple, Efficient, Minibatch Algorithms with Convergence Guarantees

Optimal Convergence Rates and Lower Complexity Bounds

Towards Fewer Assumptions on Lipschitz Continuity and Smoothness

⬇ **Exploiting Data Parallelism and Collaboration**

Providing a Statistical Framework ⬆

Distributed and Federated Learning

Adaptive Quantization for Faster Computation and Communication
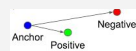
Personalization for clients

Discriminative Probabilistic Modeling

Unified Framework for Supervised and Self-Supervised Learning

Generalization Analysis

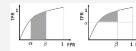[ICML 22, ICLR 22, NeurIPS 22, JMLR 23, ArXiv 23, ArXiv 24]
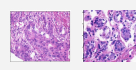
Applications

Contrastive Learning

Deep Learning on Graph

Learning with Imbalanced Data

Learning with Multi-Instance Medical Data

Group Robustness/Fairness

End-to-End 8-bit Minifloat Federated Learning

Differentiable Attack on Graph

[ICML 22, ICML 23, KDD-W 24, WWW 24]

Honors & Awards

2024	**Oral Presentation,** Conference on the Mathematical Theory of Deep Neural Networks (DeepMath)
2022	**Scholar Award,** 36th Conference on Neural Information Processing Systems (NeurIPS)
2022	**Travel Award,** 39th International Conference on Machine Learning (ICML)
2022	**Spotlight Presentation,** 10th International Conference on Learning Representations (ICLR)
2018	**Outstanding Graduate,** University of Electronic Science and Technology of China (UESTC)
2016	**National Scholarship,** Ministry of Education of the People's Republic of China
2016	**People's Scholarship (Special Class),** University of Electronic Science and Technology of China (UESTC)

Publications

▷ **On Discriminative Probabilistic Modeling for Self-Supervised Representation Learning**   *International Conference on Learning Representations (ICLR)*

BOKUN WANG, YUNWEN LEI, YIMING YING, TIANBAO YANG   *2025*

- **tl;dr:** We study the discriminative probabilistic modeling problem over a continuous domain for (multimodal) self-supervised representation learning, yielding a new contrastive objective for self-supervised representation learning.

▷ **Everything Perturbed All at Once: Enabling Differentiable Graph Attacks**

International World Wide Web Conference (TheWebConf)

HAORAN LIU, **BOKUN WANG**, JIANLING WANG, XIANGJUE DONG, TIANBAO YANG, JAMES CAVERLEE

2023

- **tl;dr:** By leveraging continuous relaxation and parameterization of the graph structure, we propose a novel attack method to efficiently generate effective attacks and meanwhile eliminate the need for costly retraining.

▷ **Memory-Based Optimization Methods for Model-Agnostic Meta-Learning and Personalized Federated Learning**

Journal of Machine Learning Research (JMLR), 24(145):1–46

BOKUN WANG, ZHUONING YUAN, YIMING YING, TIANBAO YANG

2023

- **tl;dr:** We propose memory-based stochastic algorithms for MAML that converge with vanishing error. The proposed algorithms require sampling a constant number of tasks and data samples per iteration, making them suitable for the continual learning scenario. Moreover, we also extend the proposed algorithms to personalized federated learning settings.

▷ **Provable Multi-instance Deep AUC Maximization with Stochastic Pooling**

40th International Conference on Machine Learning (ICML)

DIXIAN ZHU, **BOKUN WANG**, ZHI CHEN, YAXING WANG, MILAN SONKA, XIAODONG WU, TIANBAO YANG

2023

- **tl;dr:** We consider a novel application of deep AUC maximization (DAM) for multi-instance learning (MIL), in which a single class label is assigned to a bag of instances (eg, multiple 2D slices of a CT scan for a patient). We propose an algorithm called MIDAM to address a neglected yet non-negligible computational challenge of MIL in the context of DAM: bag size is too large to be loaded into GPU memory for backpropagation.

▷ **Theoretically Better and Numerically Faster Distributed Optimization with Smoothness-Aware Quantization Techniques**

36th Conference on Neural Information Processing Systems (NeurIPS)

BOKUN WANG, MHER SAFARYAN, PETER RICHTÁRIK

2022

- **tl;dr:** In this work, we extend the smoothness-aware compression strategy in Safaryan et al (2021) to arbitrary unbiased compression operators and then instantiate the theory by quantization operators.

▷ **When AUC meets DRO: Optimizing Partial AUC for Deep Learning with Non-Convex Convergence Guarantee**

39th International Conference on Machine Learning (ICML)

DIXIAN ZHU, GANG LI, **BOKUN WANG**, XIAODONG WU, TIANBAO YANG

2022

- **tl;dr:** We propose new formulations of partial area under the ROC Curve (pAUC) by using the distributionally robust optimization (CVaR or KL divergence based) to define the loss for each individual positive data. For one-way/two-way pAUC maximization, we propose two provably convergent algorithms and numerically verify the effectiveness on various image and medical datasets.

▷ **Finite-Sum Coupled Compositional Stochastic Optimization: Theory and Applications**

39th International Conference on Machine Learning (ICML)

BOKUN WANG AND TIANBAO YANG

2022

- **tl;dr:** This paper studies stochastic optimization for a sum of compositional functions, where the inner-level function of each summand is coupled with the corresponding summation index. We provide convergence analysis and numerical verification of a simple algorithm.
- The proposed algorithm is **a workhorse of the LibAUC library**.

▷ **GraphFM: Improving Large-Scale GNN Training via Feature Momentum**

39th International Conference on Machine Learning (ICML)

HAIYANG YU*, LIMEI WANG*, **BOKUN WANG***, MENG LIU, TIANBAO YANG, SHUIWANG JI (*EQUAL)

2022

- **tl;dr:** We propose a new way of incorporating historical embeddings when updating feature representations in sampling-based and memory-based graph neural networks (GNNs).

▷ **IntSGD: Adaptive Floatless Compression of Stochastic Gradients**

10th International Conference on Learning Representations (ICLR)

KONSTANTIN MISHCHENKO, **BOKUN WANG**, DMITRY KOVALEV, PETER RICHTÁRIK

2022

- **tl;dr:** We propose a family of adaptive integer compression operators for distributed Stochastic Gradient Descent (SGD) that do not communicate a single float, which is provably convergent and computationally cheap. IntSGD has the same iteration complexity as that of FP32 SGD while only communicating 25% bits. We numerically compare our algorithm to baselines on image classification and language modelling tasks.

▷ **Riemannian Stochastic Proximal Gradient Methods for Nonsmooth Optimization over the Stiefel Manifold**

Journal of Machine Learning Research (JMLR), 23(106), 1-33

Bokun Wang, Shiqian Ma, Lingzhou Xue

2022

- **tl;dr:** We present two Riemannian stochastic proximal gradient methods for nonsmooth optimization over the Stiefel manifold. Analysis on the incremental first-order oracle (IFO) complexity of the proposed algorithms is provided.

Manuscripts

▷ **ALEXR: An Optimal Single-Loop Algorithm for Convex Finite-Sum Coupled Compositional Stochastic Optimization**

Under Submission

Bokun Wang and Tianbao Yang

2023

- **tl;dr:** We revisit a class of convex Finite-Sum Coupled Compositional Stochastic Optimization (cFCCO) problems and introduce an efficient single-loop primal-dual block-coordinate proximal algorithm with optimal oracle complexity.

▷ **Towards Federated Learning with On-device Training and Communication in 8-bit Floating Point**

FedKDD Workshop at 2024 ACM SIGKDD Conference

Bokun Wang, Axel Berg, Durmus Alp Emre Acar, Chuteng Zhou

2024

- **tl;dr:** In this work, we investigate the use of FP8 training in a federated learning context.

▷ **Towards Fair Deep Clustering With Multi-State Protected Variables**

ICML Workshop on the Security and Privacy of Machine Learning

Bokun Wang and Ian Davidson

2019

- **tl;dr:** In this work, we consider a general and setting where there can be many protected groups and propose a deep fair clustering algorithms, which learns a discriminative but fair cluster assignment function.

Experience

Central Technology / Machine Learning Group, ARM

Waltham, Massachusetts

Research Intern advised by Dr. Chuteng Zhou and Dr. Durmus Alp Emre Acar,

May 2023 - August 2023

- Topic: Propose and implement a new framework for efficient federated learning with neural network quantization and communication quantization, based on the new FP8 data type (see the whitepaper by NVIDIA, ARM and Intel).
- Results lead to a patent application and a KDD 2024 workshop paper.

OptML Lab, King Abdullah University of Science and Technology (KAUST)

Thuwal, KSA

Research Intern advised by Prof. Peter Richtárik,

Sept. 2020 - August 2021

- Topic: efficient optimization algorithms for distributed ML. I contributed to theoretical and numerical parts: building problem formulation, establishing convergence analysis, and writing Python (including Pytorch) code for numerical verifications. In particular, I have experience using King Abdullah University of Science and Technology's large-scale Shaheen supercomputer to conduct experiments on 16 GPU nodes.
- Results lead to an ICLR 2022 paper and a NeurIPS 2022 paper.

Services

2024	**Co-organizer of a session titled "New Min-max Optimization Algorithms and Their Applications in Machine Learning and AI",** 2024 INFORMS Annual Meeting, Seattle
2024	**Reviewer,** The Forty-first International Conference on Machine Learning (ICML)
2023	**Reviewer,** The Eleventh International Conference on Learning Representations (ICLR)
2023	**Reviewer,** The 26th International Conference on Artificial Intelligence and Statistics (AISTATS)
2023	**Reviewer,** The Thirty-seventh Conference on Neural Information Processing Systems (NeurIPS)
2023	**Reviewer,** The Forty International Conference on Machine Learning (ICML)
2021	**Reviewer,** The Thirty-fifth Conference on Neural Information Processing Systems (NeurIPS)
Since 2021	**Reviewer,** Neurocomputing
Since 2023	**Reviewer,** IISE Transactions
Since 2024	**Reviewer,** Mathematical Programming