Jiawei Zhang | Curriculum Vitae

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EDUCATION

The Chinese University of Hong Kong, Shenzhen — **Shenzhen, China**
Ph.D. in Computer and Information Engineering — *2021*

University of Science and Technology of China — **Hefei, China**
B.Sc. in Mathematics (Hua Loo-Keng talent program) — *2016*

PROFESSIONAL EXPERIENCE

Massachusetts Institute of Technology — **Cambridge, MA**
Laboratory for Information & Decision Systems (LIDS)
Postdoctoral Associate (working with Prof. Asuman Ozdaglar) — *2021 - present*

The Chinese University of Hong Kong, Shenzhen — **Shenzhen, China**
Graduate Research & Teaching Assistant (Advisor: Prof. Zhi-Quan (Tom) Luo) — *2016 - 2021*

RESEARCH INTEREST

My research interests include **optimization theory**, designing **efficient optimization algorithms** and their applications to **machine learning** and **data science**. Recently, I am very interested in understanding **machine learning** especially **deep learning** from an optimization perspective.

RECENT PROGRESS

- Propose a new **smoothed primal-dual** algorithm for constrained nonconvex problems and prove its efficiency (achieving the $\mathscr{O}(1/\varepsilon^2)$ iteration complexity) for problems with polyhedral constraints by developing some new **error bounds** and novel **potential functions**.
- Extend our algorithms to solve nonconvex min-max problems and distributed optimization problems.

SELECTED PUBLICATIONS

Preprints

1. **Jiawei Zhang**, Zhi-quan Luo, ***A Global Dual Error Bound and Its Application to the Analysis of Linearly Constrained Nonconvex Optimization***, *arXiv preprint arXiv: 2006.16440, submitted to SIAM journal on optimization.*
2. **Jiawei Zhang**, Songyang Ge, Tsunghui Chang and Zhi-quan Luo, ***Decentralized Non-Convex Learning with Linearly Coupled Constraints***, *arXiv preprint arXiv:2103.05378.*

Journal Papers

1. **Jiawei Zhang**, Zhi-quan Luo, ***A Proximal Alternating Direction Method of Multiplier for Linearly Constrained Nonconvex Minimization***, *SIAM journal on optimization 30(3), 2272-2302.*

Conference Papers

1. **Jiawei Zhang**, Peijun Xiao, Ruoyu Sun and Zhi-quan Luo, ***A Single-loop Smoothed Gradient Descent-ascent Algorithm for Nonconvex-concave Min-max Problems***, *NeurIPS 2020.*
2. **Jiawei Zhang**, Songyang Ge, Tsunghui Chang and Zhi-quan Luo, ***A Proximal Dual Consensus Method for Linearly Coupled Multi-Agent Non-Convex Optimization***, *IEEE ICASSP 2020. (The full paper will be submitted to IEEE TSP.)*
3. **Jiawei Zhang**, Yushun Zhang, Mingyi Hong, Ruoyu Sun, and Zhi-quan Luo, ***When Expressivity Meets Trainability: Fewer than n Neurons Can Work***, *Advances in Neural Information Processing Systems 2021.*

SELECTED RESEARCH PROJECTS

Efficient algorithm for nonconvex problems with polyhedral constraints *Feb. 2018 - Jul. 2020*

- **Purpose**: To design a simple algorithm to achieve $\mathcal{O}(1/\varepsilon^2)$ iteration complexity for constrained nonconvex optimization problems.
- **Difficulty**: The traditional augmented Lagrangian method and the proximal ALM may oscillate for constrained nonconvex problems.
- **Theoretical results**: Introduced a smoothing technique to stabilize the oscillation and used a global error bound analysis to give the $\mathcal{O}(1/\varepsilon^2)$ iteration complexity when solving problems with polyhedral constraints.
- **Numerical experiments**: Conducted experiments with nonconvex quadratic objective functions and polyhedral constraints to show the smoothing step significantly improves the numerical behavior.

Faster algorithm in min-max optimization *Sept. 2019 - Jul. 2020*

- **Motivation**: To explore single-loop algorithms for nonconvex-concave min-max problems with the best-known $\mathcal{O}\left(1/\varepsilon^2\right)$ iteration complexity.
- **Difficulty**: The standard gradient descent-ascent method can oscillate for simple bilinear problems. The multi-loop algorithms usually need at least $\mathcal{O}(1/\varepsilon^2)$ outer iterations and hence the iteration complexity is larger than $\mathcal{O}(1/\varepsilon^2)$.
- **Theoretical results**: Introduced a novel smoothing technique on gradient descent ascent algorithm which fixes divergence issue. Achieved an $\mathcal{O}(1/\varepsilon^4)$ iteration complexity for general nonconvex-concave problems and an $\mathcal{O}(1/\varepsilon^2)$ iteration complexity for minimizing the pointwise maximum of a family of finite nonconvex functions.
- **Numerical experiments**: Presented the outstanding performance of the algorithm on robust image classification tasks.

Nonconvex decentralized optimization with linear coupling constraints *Jul. 2019 - Oct. 2020*

- **Motivation**: Problems with nonconvex objective functions and general linear coupling constraints often appear in smart grid and machine learning societies. A remarkable application is learning with distributed features. We want to design a computation and communication efficient algorithms for solving it over a decentralized network.
- **Difficulty**: How to deal with the nonconvexity and coupling constraints?
- **Theoretical results**: Applied a dual consensus technique in our smoothing framework to give a decentralized algorithm. Using a novel potential function and error bounds, we proved our algorithm has an $\mathcal{O}(1/\varepsilon^2)$ complexity.
- **Numerical experiments**: Verified the good numerical behavior on logistic regression and neural network learning with distributed features.