Kaizhao Sun

Email: ksun46@gatech.edu GitHub: github.com/ksun46 Website: https://ksun46.github.io

Research Interests

My research focuses on the theory and application of optimization. I am currently working on:

- distributed and decomposition algorithms for large-scale continuous/discrete optimization,
- theory and algorithms based on nonconvex augmented Lagrangian duality,
- convexification and smoothing in optimization, and
- sampling algorithms.

I am also interested in efficient and practical solution methods for nonconvex nonsmooth problems arising from data science and engineering fields.

EDUCATION

• Georgia Institute of Technology

Atlanta, GA, USA

Ph.D. in Operations Research with a minor in Mathematics

August 2017–May 2022 (Expected)

- Advisor: Dr. Xu Andy Sun
- Thesis Advisory Committee: Drs. Santanu S. Dey, Renato D.C. Monteiro, Wotao Yin, and Enlu Zhou
- Relevant Courseworks: Linear/Convex/Nonlinear/Discrete Optimization, Machine Learning, Stochastic Process,
 Simulation, Numerical Analysis, Functional Analysis, Graph Theory

• Georgia Institute of Technology

Atlanta, GA, USA

B.S. in Industrial and Systems Engineering (ISyE)

August 2013–May 2017

- Capstone Project: Work Measurement Improvement for UPS Small Package Facility

B.S. in Discrete Mathematics

August 2013-May 2017

- Thesis: A MIP Formulation of the Unit Commitment Problem and Polytope Analysis

Publications

Alphabetical order is indicated by "*".

- 1. J. Liang*, K. Sun*, E. Zhou, and X.A. Sun, "Log-difference-of-convex (Log-DC) sampling by the unadjusted Langevin Algorithm", submitted to Neural Information Processing Systems 2021.
- 2. A. Gholami*, **K. Sun***, S. Zhang*, and X.A. Sun, "Solving Large-Scale Security Constrained AC OPF Problems", submitted to Operations Research, 2021.
- 3. **K. Sun** and X.A. Sun, "Algorithms for difference-of-convex (DC) programs based on difference-of-Moreau-envelopes smoothing", submitted to Mathematical Programming. arXiv preprint arXiv:2104.01470, 2021.
- 4. **K. Sun**, M. Sun, and W. Yin, "Decomposition methods for global solutions of mixed-integer linear programs", submitted to Mathematical Programming. arXiv preprint arXiv:2102.11980, 2021.
- 5. **K. Sun** and X.A. Sun, "A two-level ADMM algorithm for AC OPF with global convergence guarantees", *Accepted at IEEE Transactions on Power Systems*, 2021
- 6. **K. Sun** and X.A. Sun, "A two-level distributed algorithm for nonconvex constrianed optimization", submitted to Computational Optimization and Applications. arXiv preprint arXiv:1902.07654, 2019.

Experience

• Alibaba US-Damo Academy

Bellevue, WA, USA

Research Intern at Decision Intelligence Lab

June 2020-August 2020

- Studied generic two-block mixed-integer linear programs (MILP) with block angular structures.
- Proposed an ALM-based decomposition framework and ADMM variant with convergence guarantees.
- Demonstrated the exactness and efficiency of the proposed algorithms on various MILP problems.

• Georgia Institute of Technology

Atlanta, GA, USA January 2019-Present

Graduate Research Assistant

- Decomposition and distributed algorithms for large-scale nonconvex constrained programs.
- First-order algorithm for difference-of-convex (DC) programs.
- Research collaboration with ISO New England on decentralized OPF:
 - * applied ADMM on SOCP-OPF to achieve decentralized computation and recovered feasible AC solution;
 - * implemented the algorithm in Python and submitted a technical report.

Graduate Teaching Assistant

August 2017-December 2018

- ISyE 6669: Deterministic Optimization

Spring 2018 and Fall 2018

- ISyE 6644: Simulation and Modeling for Engineering and Science

Spring 2018

- ISyE 3103: Introduction to Supply Chain Modeling: Logistics

Fall 2017

GRID OPTIMIZATION COMPETITION

I have been participating in the the ARPA-E Grid Optimization Competition (GO Competition). Entrant teams from around the globe thrive to develop innovative algorithmic softwares for modern power grids in the form of coding competition. I am a member of the GMI-GO team led by faculty advisors Prof. X. Andy Sun (PI) and Prof. Santanu Dey.

• ARPA-E Grid Optimization Competition Challenge 1

GMI-GO Team Member

November 2018-February 2020

- Problem: Security-constrained AC Optimal Power Flow (SC-ACOPF) under time limit. (In optimization language, this is a large-scale + two-stage + mixed-integer nonlinear program.)
- Our Approach: We deployed various optimization techniques in C++, including:
 - * smoothing techniques for disjunctive constraints;
 - * outer approximation of second-order cones;
 - * a convergence-guaranteed distributed algorithm though MPI;
 - * an effective contingency screening method;
 - * extensive engineering tuning and experiments of Ipopt, Gurobi, and Mosek;
 - * various safe-guarding mechanisms for robust solution output.
- Result: Our team ranked the third place in the final event, winning \$400,000 USD grant funding.

• ARPA-E Grid Optimization Competition Challenge 2

GMI-GO Team Member

August 2020-August 2021

- Extension of SC-ACOPF with additional complicated constraints:
 - * topology optimization, unit commitment, discretized tap ratio/phase shift.

SCHOLARSHIPS AND AWARDS

• SIAM Conference on Optimization (OP21) Student Travel Award

Summer 2021

• McLean Fellowship Stipend

Fall 2018 and Spring 2019

ISyE Stipend

Fall 2017 and Spring 2018

INVITED AND CONTRIBUTED TALKS

- Algorithms for DC Programs Based on DME Smoothing
 - SIAM Conference on Optimization (OP21) 2021, Virtual
 - INFORMS Annual Meeting 2021, Anaheim, CA, USA
- Decomposition Methods for Global Solutions of Mixed-Integer Linear Programs
 - Integer Programming and Combinatorial Optimization (IPCO) Workshop 2021, Virtual (Poster)
 - Mixed Integer Programming (MIP) Workshop 2021, Virtual (Poster)
- A Two-level ADMM Algorithm for AC OPF with Global Convergence Guarantee
 - Power Systems Engineering Research Center (PSERC) Meeting
 - * December 2017, Phoenix, AZ, USA (Poster)
 - * May 2018, Wichita, KS, USA (Poster)
 - Georgia Tech Workshop on Electric Energy Systems and Optimization
 - * November 2018, Atlanta, GA, USA (Poster)
 - * November 2019, Atlanta, GA, USA (Poster)
 - INFORMS Annual Meeting 2020, Virtual
- Distributed Algorithms for Sparse Regression
 - INFORMS Annual Meeting 2019, Seattle, WA, USA
- A Two-level Distributed Algorithm for Nonconvex Constrained Optimization
 - INFORMS Annual Meeting 2018, Phoenix, AZ, USA
 - International Conference on Continuous Optimization (ICCOPT) 2019, Berlin, Germany

SERVICE

- Co-chair of the session Distributed and Decentralized Optimization in ICCOPT 2019, Berlin, Germany
- Reviewer for MPC, JOTA, IEEE (TAC, TCNS, TII, TPWRS, TSG), ACC, CDC, IET, Quantum

TECHNICAL SKILLS

- Programming Languages: working knowledge of C++, Julia, Python, and Matlab.
- Optimization Solvers: experience with IPOPT, Gurobi, Mosek, Baron, Bonmin, Couenne, and Xpress.
- Typesetting: LATEX and Markdown.