

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

EXPERIENCE

- **Alibaba US-Damo Academy** Bellevue, WA, USA
Research Intern at Decision Intelligence Lab June 2020–August 2020
 - Mentors: Dr. Wotao Yin, Dr. Jian Tan, and Mou Sun.
 - 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
Graduate Research Assistant January 2017–Present
 - 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
- 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.

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 constrained optimization”, *submitted to Computational Optimization and Applications. [arXiv preprint arXiv:1902.07654](#), 2019*.

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

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.