

## RESEARCH INTERESTS

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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

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- **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

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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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://ieeexplore.ieee.org/document/9444444), 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](https://arxiv.org/abs/1902.07654), 2019*.

## EXPERIENCE

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- **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 2019-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 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

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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** November 2018-February 2020  
GMI-GO Team Member
  - 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** August 2020-August 2021  
GMI-GO Team Member
  - Extension of SC-ACOPF with additional complicated constraints:
    - \* topology optimization, unit commitment, discretized tap ratio/phase shift.

## SCHOLARSHIPS AND AWARDS

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- 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

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- 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

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- 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

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