Xiaoyi Gu

Curriculum Vitae

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Work Experience

2022 – present **Quantitative Researcher**, Susquehanna International Group.
Use mathematics, probability theory, statistics, machine learning and game theory to:
- Build signals and models for equity trading to generate additional profit.

Summer 2021 **Data Science Intern**, Uber Freight, Uber.
Use statistics and machine learning to:
- Build models to predict user preference and improve customer satisfaction;
- Perform variable selection and improve model interpretability using SHAP value;
- Design A/B experiments with switchback to evaluate the effectiveness of the business strategy.

Summer 2019 **Research Intern**, Power Systems Branch, Argonne National Lab.
- Use machine learning to model the historical data of solved mixed integer problems;
- Apply the learned model to guide branching decisions during branch-and-bound of new problems;
- Significantly accelerate solving large-scale mixed integer problems with applications in power systems.

Education

2017 – 2022 **Ph.D.**, Georgia Institute of Technology.
Operations Research (Minor: Machine Learning)
Advisors: Santanu S. Dey and Shabbir Ahmed
Research Fields: discrete optimization, non-convex optimization, statistics and machine learning

2013 – 2017 **B.S.**, Peking University, China.
Applied Mathematics; Physics (double degree)

Publications

2023 **Xiaoyi Gu**, Santanu S. Dey, Jean-Philippe P. Richard, *Lifting Convex Inequalities for Bipartite Bilinear Programs*, Mathematical Programming.

2022 Shancong Mou, **Xiaoyi Gu**, Meng Cao, Haoping Bai, Ping Huang, Jiulong Shan, Jianjun Shi, *RGI: robust GAN-inversion for mask-free image inpainting and unsupervised pixel-wise anomaly detection*, ICLR.

2020 **Xiaoyi Gu**, Shabbir Ahmed, Santanu S. Dey, *Exact Augmented Lagrangian Duality for Mixed Integer Quadratic Programming*, SIAM Journal on Optimization.

2019 Honglin Yuan, **Xiaoyi Gu**, Rongjie Lai, Zaiwen Wen, *Global Optimization with Orthogonality Constraints via Stochastic Diffusion on Manifold*, Journal of Scientific Computing.

Research Experiences

2020 – 2023 **Lifting Convex Inequalities for Bipartite Bilinear Programs**.
Collaborators: Santanu S. Dey and Jean-Philippe P. Richard
- Prove the existence of lifting coefficient for bilinear programming;
- Propose high quality seeding inequalities for bipartite bilinear programming;
- Perform sequence-independent lifting to generate convex cuts from the seeding inequalities;
- Design an efficient algorithm with heuristics to efficiently reduce gap using the convex cuts.

2019 – present **Learning to Branch in Security-Constrained Unit Commitment**.
Collaborators: Álinson Santos Xavier, Qiu Feng and Santanu S. Dey
- Develop schemes of machine learning utilizing historical results of solved mixed integer problems;
- Generate high quality branching decisions efficiently using learned models;
- Apply the branching decisions to improve the exploration of the branch-and-bound tree;
- Accelerate solving large-scale mixed integer problems with applications in power systems.

2017-2019 **Exact Augmented Lagrangian Duality for Mixed Integer Quadratic Programming**.
Collaborators: Shabbir Ahmed and Santanu S. Dey
- Analyze the augmented Lagrangian for mixed integer quadratic programming:
- Prove asymptotic zero duality gap as the penalty coefficient goes to infinity;
- Prove zero duality gap with any norm penalty function and finite penalty coefficient;
- Polynomially bound the size of the penalty coefficient which attains zero duality gap.

2015-2017 **Global Optimization with Orthogonality Constraints via Stochastic Diffusion on Manifold**.
Collaborators: Honglin Yuan, Zaiwen Wen and Rongjie Lai
- Investigate and theoretically analyze stochastic differential equations on Euclidean space;
- Analyze optimization methods on Euclidean space using stochastic differential equations;
- Propose an efficient algorithm to calculate stochastic differential equations on Stiefel manifold;
- Propose an efficient stochastic algorithm for optimization with orthogonality constraints;
- Prove global convergence of the optimization algorithm.

Reviewed Journals

SIAM Journal on Optimization, (2021, 2022, 2023).

Mathematical Programming, (2020, 2021).

Optimization Letters, (2022, 2023).

Conferences

Oct. 2022 INFORMS Annual Meeting 2022, Session on ML for Discrete Optimization Solvers, Indianapolis IN.

Oct. 2021 INFORMS Annual Meeting 2021, Session on Advances in Discretion Optimization, Anaheim CA.

May. 2021 IPCO 2021, *Georgia Tech*, Atlanta GA.

Nov. 2020 INFORMS Annual Meeting 2020, Session on Frontier of Power System Optimization/Computing, Virtual.

Jul. 2019 MIP 2019, *MIT*, Boston MA.

Awards and Honors

2017 – 2019 **Kerry Clayton Fellowship**, Georgia Tech.

2015 **Silver medal, 6th Chinese Mathematics Competition**.

2013 **Silver medal, 28th Chinese Mathematical Olympiad**.

Selected Courses

Machine Learning and Statistics.
Statistical Learning, Computational Data Analysis, Computer Vision, Algorithms for Big Data Analysis, Multivariate Data Analysis, Advanced Statistical Modeling, Mathematics Statistics

Optimization.
Linear Optimization, Discrete Optimization, Nonlinear Optimization, Advanced Combinatorial Optimization, Modern Convex Optimization, Stochastic Optimization, Stochastic Programming

Mathematics and Probability.
Functional Analysis, Partial Differential Equations, Real Analysis, Mathematical Physics, Probability Theory, Measure Theory, Stochastic Process, Methods of Stochastic Simulations

Algorithm.
Computational Methods, Data Structure and Algorithms, Graduate Algorithms, Numerical Linear Algebra

Teaching Experience

2020 **Teaching Assistant**, Machine Learning, CSE/ISYE 6740, Georgia Tech.

2019 **Teaching Assistant**, Financial Optimization, ISYE 6673, Georgia Tech.

2017 – 2018 **Teaching Assistant**, Stochastic Manufacturing & Service Systems, ISYE 3232, Georgia Tech.

Skills and Languages

Proficient in: Python, Julia, C, Java, SQL, MATLAB, CPLEX, Gurobi, Scikit-learn, PyTorch, LaTeX.