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Haoming Shen

Research Interests

Methodologies **Stochastic Optimization and Integer Programming**

Applications **Robotics, Power Grids, and Transportation Systems**

Education

2018–Present **Ph.D. in Industrial and Operations Engineering**,
University of Michigan, Ann Arbor, MI, USA
Advisor: Dr. Ruiwei Jiang

2021–2023 **M.S. in Mathematics**,
University of Michigan, Ann Arbor, MI, USA

2022–Present **Rackham Professional Certificate in Diversity, Equity, and Inclusion**,
University of Michigan, Ann Arbor, MI, USA

2016–2018 **M.S. in Electrical and Computer Engineering**,
University of Michigan, Ann Arbor, MI, USA
Specialized in Signal Processing and Machine Learning

2012–2016 **B.E. in Electrical Engineering**,
Xi'an Jiaotong University, Xi'an, Shannxi, China

Experience

Summer 2021 **Research Assistant**,
Argonne National Laboratory, Lemont, IL, USA
Advisor: Dr. Kibaek Kim

Preprints

2022 **Shen, H.** and Jiang, R., 2022. Wasserstein Two-Sided Chance Constraints with An Application to Optimal Power Flow. arXiv:2204.00191.

2021 **Shen, H.** and Jiang, R., 2021. Convex Chance-Constrained Programs with Wasserstein Ambiguity. arXiv:2111.02486. Major Revision at **Operations Research**.

- **Honorable mention in the 2022 INFORMS Optimization Society's Student Paper Prize**.

Publications

2022 **Shen, H.** and Jiang, R., 2022. Chance-Constrained Set Covering with Wasserstein Ambiguity. **Mathematical Programming**, pp.1-54.

2020 Chen, X., Huang, X., Cai, Y., **Shen, H.** and Lu, J., 2020. Intra-day Forecast of Ground Horizontal Irradiance Using Long Short-term Memory Network (LSTM). Journal of the Meteorological Society of Japan. Ser. II.

2018 Heimann, M., **Shen, H.**, Safavi, T. and Koutra, D., 2018, October. REGAL: Representation learning-based graph alignment. In Proceedings of the 27th ACM international conference on information and knowledge management (pp. 117-126).

2017 Jin, D., Leventidis, A., **Shen, H.**, Zhang, R., Wu, J. and Koutra, D., 2017, September. PERSEUS-HUB: Interactive and collective exploration of large-scale graphs. In Informatics (Vol. 4, No. 3, p. 22).

Research Projects

2022-Present **Chance-Constrained Path Planning for Robots**

Studied the path planning and control of robots in an uncertain environment.

- Proposed the first big-M free mixed-integer linear reformulations of the separation constraints in the deterministic, chance-constrained, and distributionally robust chance-constrained setting.
- Derived convex hull descriptions for the new mixed-integer linear reformulations.

2022-Present **On the Value of Stochastic Modeling with Right-Hand Side Uncertainty**

Evaluated the value of stochastic modeling (VSM), i.e. the improvement achieved by calibrating the probability distribution of the uncertainty, through optimization under uncertainty.

- Showed the NP-hardness of evaluating VSM exactly.
- Obtained tractable and asymptotically tight approximation bounds for calculating VSM.

2020-2021 **A Data-Driven Approach towards Strategic Planning of Charging Stations**

Developed a data-driven distributionally robust chance-constrained model for the strategic planning of charging stations for battery electric buses (BEBs), where the uncertainty in energy consumption and dwell time of BEBs are explicitly considered.

- Derived mixed-integer second-order conic reformulation for the problem.
- Designed an efficient algorithm based on separation and low-rank approximation.
- Extensive experiments on a real-world bus system demonstrated the effectiveness of the proposed models and algorithms.

2018-2019 **Projection Cuts for Two-Stage Stochastic Mixed-Integer Programs**

Proposed a new type of valid inequality, called projection cuts, for Benders decomposition to significantly reduce the Benders feasibility cuts and accelerate computation.

- Motivated by Principal Component Analysis (PCA), projection cuts are constructed from the minor components of the positive cone generated by the recourse matrix.
- Designed a two-phase variant of Benders decomposition with projection cuts to strengthen the initial relaxation.
- Demonstrated its effectiveness on an extensive numerical study based on stochastic unit commitment, multi-commodity network design, and stochastic production routing problems.

Presentations and Posters

2022 **Convex Chance-Constrained Programs with Wasserstein Ambiguity**

2022 International Conference on Continuous Optimization (ICCOPT).
2022 INFORMS Optimization Society Conference (IOS).

2022 **A Data-Driven Approach towards Strategic Planning of Charging Stations**

2022 INFORMS Computing Society Conference (ICS).

2021-2022 **Chance-Constrained Set Covering with Wasserstein Ambiguity**

2022 INFORMS Computing Society Conference (ICS).
2021 Mixed Integer Programming Workshop (MIP).
2021 INFORMS Annual Meeting.

2019 **Benders Decomposition with Projection Cuts**

2019 INFORMS Annual Meeting.

Awards

2022 INFORMS Optimization Society's Student Paper Prize (Honorable mention)

2019-2022 Rackham Graduate Student Travel Grant, University of Michigan

2019-2022 Rackham Graduate Student Research Assistantship, University of Michigan

2019-2020 Rackham Graduate Student Instructor, University of Michigan

2018 Engineering Graduate Fellowship, University of Michigan

Teaching

Winter 2021 **IOE 691 Stochastic and Robust Optimization**
Gave a guest lecture on distributionally robust chance-constrained optimization.

Winter, Fall 2020 **IOE 310 Introduction to Optimization Methods**
Served as Graduate Student Instructor and revamped the course with Python programming.

- Gave two lectures on Python programming and Pyomo.
- Added a machine learning module to the course.
- Designed weekly written assignments and Python programming problems.
- Made detailed walkthrough videos for all programming assignments.
- Held weekly office hours.

Fall 2019 **IOE 611 Nonlinear Programming**
Served as Graduate Student Instructor.

- Designed the first detailed rubric for homework assignments.
- Wrote an autograder for programming assignments.
- Held weekly office hours.

Services

Editorial Reviewer for

- Mathematical Programming (MP),
- Manufacturing and Service Operations Management (MSOM),
- Journal of Global Optimization (JOGO),
- Energy Systems.

Departmental IOE Graudate School Workshop, 2022.

- Got selected as a panelist.
- Shared my experiences in IOE with a selected group of undergraduate students from the states.

IOE Mentor-Mentee Program, 2019, 2022

- Mentored Ph.D. student Xinyu Fei and M.S. students Yizhou Wang, Baicen Liu, and Ting-Yu Lin.

External Session chair for 2022 INFORMS Optimization Society conference (IOS).
Session chair for 2021 INFORMS Annual Meeting.

Professional Skills

Languages Python, Julia, LaTeX, Mathematica, Shell Script, MATLAB, C++, C, Java, R, SQL.

Packages Gurobi, MOSEK, Polymake, Pyomo, PySpark, Networkx, scikit-learn, Tensorflow.