Kunlei **Lian**

Staff Data Scientist

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Education

University of Arkansas — *Arkansas, USA*

Ph.D. in Industrial Engineering — *2012 - 2017*

- Proposed an improved algorithm framework based on multi-directional local search to approximate the Pareto frontier of multi-objective optimization problems and applied it to solve the multi-objective consistent vehicle routing problems.
- Studied the impact of improving service consistency on transportation costs in vehicle routing problems with repeatable customer demands using a large neighborhood search heuristic.
- Suggested a branch-and-price algorithm to solve the consistent vehicle routing problem to minimize traveling costs.

Huazhong University of Science and Technology — *Wuhan, China*

M.S. in Industrial Engineering — *2019 - 2012*

- Designed a tabu search and imperialist competitive algorithm to solve the process planning optimization problem.
- Developed an imperialist competitive algorithm to address the mixed-model U-shaped assembly line balancing and sequencing problem.
- Proposed an improved imperialist competitive algorithm to solve the integrated process planning and scheduling problem.

B.S. in Industrial Engineering — *2005 - 2009*

- Implemented a hybrid genetic algorithm and simulated annealing to identify the best machining operations sequence for prismatic parts. (Outstanding Bachelor's Thesis Award)

Work Experience

Walmart Inc. — *Bentonville, Arkansas*

Staff Data Scientist — *Jan. 2020 - Present*

- Supported the global logistics team to determine the optimal ocean carriers that minimize total transportation costs, achieved approximately $90 million cost savings for fiscal year 2021.
- Designed and developed a column generation based distributed optimization engine to solve the load consolidation problem for Walmart's inbound network.
- Implemented constructive heuristic algorithms to solve the virtual pallet building problem in grocery distribution centers.

Sr. Data Scientist — *Jan. 2019 - Jan. 2020*

- Designed and developed a profiling application prototype supporting grocery distribution centers to achieve optimal item assignments to slots. Acquired basic knowledge of frontend/backend development.
- Upgraded legacy MIP-based optimization engine to identify optimal carriers and load quantities for Walmart's ocean procurement process in fiscal year 2020. Improved modeling capability and constraint flexibility to incorporate operational and strategic considerations. Facilitated managerial decision making by providing onsite optimization support throughout hundreds of bidding cycles. Achieved $30 million operational cost savings, significant labor hour reduction and improved company global supply chain balance and stability.

Data Scientist — *Aug. 2016 - Jan. 2019*

- Built a column-generation-based optimization engine within a rolling horizon framework to assign drivers to tractors with the objective of maximizing tractor utilization and minimizing driver split-seat. Achieved $4 million labor cost savings and $8 million operational cost savings annually.
- Migrated legacy truckload optimization COBOL code to Java, reducing data processing time from 10 minutes to 10 seconds. Developed heuristic algorithms to solve instances with large amount of orders, resulting in saving of 14 trucks daily.
- Implemented a column-generation-based optimization engine to estimate store-level customer purchase probability based on historical transaction data. Built a MIP engine to decide optimal offer set for each category at store level.

Global Business Processes Intern — *May. 2016 - Aug. 2016*

- Worked on implementation and validation of next generation inventory optimization model for Walmart U.S. and achieved 8% improvement over the current system during pilot store testing. Led data platform migration from Teradata to Hadoop, responsible for data ETL and Hive query implementation.

China Railway Siyuan Survey and Design Group CO., LTD. *Wuhan, China*

Operations Research Analyst Intern *May. 2009 - Aug. 2009*

- Implemented a metaheuristic algorithm to identify the optimal maintenance warehouse locations within a railway network.

Patents

GPU-enabled Safety Stock Optimization Engine *Filed*

Shuohao Wu, Richard Ulrich, Dong Xu, Jingying Zhang, **Kunlei Lian**, Clifford Bolinger, Jackie Guan *2019*

- One key decision within retailing industry is inventory management and this invention aims to provide a solution on the optimal safety stock level settings across the chain such that the total inventory cost can be reduced, while not affecting the total sales.
- The model is a stochastic optimization where it tries to minimize the total cost and solve for the associated optimal safety stock settings. The randomness comes from the variance in demand for each item at each store in each day. We proposed and developed a Monte Carlo Simulation-based optimization model. We employ GPU based computing module to significantly enhance the computational efficiency and a set of machine learning models to leverage the historical data patterns with impact to safety stock to further boost result accuracy.

Publications

Thesis

- Kunlei Lian. "Service consistency in vehicle routing." *University of Arkansas* (2017). Ph.D. dissertation
- Kunlei Lian. "Colonial competitive algorithm and its applications in optimization of discrete manufacturing systems." *Huazhong University of Science and Technology* (2012). M.S. thesis

Under Review

- Jianzhao Wu, Kunlei Lian, Yelin Deng, Chaoyong Zhang, Yaping Ren, Shuaikun Zhang, Jiahao Sun. "Multi-objective parameter optimization of fiber laser welding considering energy consumption and bead geometry." Submitted to *Energy*
- Chang Lv, Chaoyong Zhang, Kunlei Lian, Yaping Ren, Leilei Meng. "A two-echelon fuzzy clustering based heuristic for large-scale bike sharingrepositioning problem." Submitted to the *European Journal of Operational Research*

Journal Article

- Chunjiang Zhang, Jiawei Tan, Kunkun Peng, Liang Gao, Weiming Shen, Kunlei Lian. "A discrete whale swarm algorithm for a hybrid flow-shop scheduling problem with limited buffers." *Robotics and Computer-Integrated Manufacturing* (2020).
- Chang Lv, Chaoyong Zhang, Kunlei Lian, Yaping Ren, and Leilei Meng. "A hybrid algorithm for the static bike-sharing re-positioning problem based on an effective clustering strategy." *Transportation Research Part B: Methodological* 140 (2020): 1-21.
- Yang Xie, Kunlei Lian, Qiong Liu, Chaoyong Zhang, and Hongqi Liu. "Digital twin for cutting tool: Modeling, application and service strategy." *Journal of Manufacturing Systems* (2020).
- Chunjiang Zhang, Yin Zhou, Kunkun Peng, Xinyu Li, Kunlei Lian, and Suyan Zhang. "Dynamic flexible job shop scheduling method based on improved gene expression programming." *Measurement and Control* (2020).
- Kunlei Lian, Ashlea Bennett Milburn, and Ronald L. Rardin. "An improved multi-directional local search algorithm for the multi-objective consistent vehicle routing problem." *IIE Transactions* 48, no. 10 (2016): 975-992.
- Chuanjun Zhu, Jing Cao, Chaoyong Zhang, Kunlei Lian. "Applying modified colonial competitive algorithm to solve minimal hitting set problems." *China Mechanical Engineering* 26, no. 7 (2015): 917-923
- Kunlei Lian, Chaoyong Zhang, Liang Gao, and Xinyu Shao. "A modified colonial competitive algorithm for the mixed-model U-line balancing and sequencing problem." *International Journal of Production Research* 50, no. 18 (2012): 5117-5131.
- Kunlei Lian, Chaoyong Zhang, Liang Gao, and Xinyu Li. "Integrated process planning and scheduling using an imperialist competitive algorithm." *International Journal of Production Research* 50, no. 15 (2012): 4326-4343.
- Kunlei Lian, Chaoyong Zhang, Xinyu Shao, and Liang Gao. "Optimization of process planning with various flexibilities using an imperialist competitive algorithm." *The International Journal of Advanced Manufacturing Technology* 59, no. 5-8 (2012): 815-828.
- KunLei Lian, ChaoYong Zhang, XinYu Shao, and YaoHui Zeng. "A multi-dimensional tabu search algorithm for the optimization of process planning." *Science China Technological Sciences* 54, no. 12 (2011): 3211-3219.
- Kun Zhang, Hui Liu, and Kunlei Lian. "Application of bee colony optimization algorithm in warehouse facility location of rail transit network." *Modern Urban Transit* 1, (2011): 63-66
- Fuping Deng, Chaoyong Zhang, kunlei Lian and Shaotan Xu. "An adaptive ant colony optimization for solving assembly line balancing problem." *China Mechanical Engineering* 22, no. 16 (2011):1949-1953, 1959.
- Kunlei Lian, Chaoyong Zhang, Liang Gao, Shaotan Xu, and Yi Sun. "A cooperative simulated annealing algorithm for the optimization of process planning." *In Advanced Materials Research*, vol. 181, pp. 489-494. Trans Tech Publications Ltd, 2011.
- Kunlei Lian, Chaoyong Zhang, Liang Gao and Chaoyang Zhang. "An improved genetic algorithm for multi-objective dynamic scheduling optimization." *Machine Design and Manufacturing Engineering* 39, no. 3 (2010):13-17, 21

Conference Article

- Chang Lv, Chaoyong Zhang, and Kunlei Lian. "A hybrid variable neighborhood search algorithm based on grouping strategies for the static bike sharing re-positioning problem." *In 2020 International Conference on Urban Engineering and Management Science (ICUEMS)*, pp. 454-459. IEEE, 2020.
- Yuxiang Lian, Leilei Meng, Yifeng Wang, Chaoyong Zhang, Yibo Wei, and Kunlei Lian. "A Hybrid Colonial Competitive Algorithm for the Integrated Process Planning and Scheduling Problem." *In 2020 International Conference on Urban Engineering and Management Science (ICUEMS)*, pp. 117-123. IEEE, 2020.
- Biao Yuan, Chaoyong Zhang, Kunlei Lian, and Xinyu Shao. "A hybrid honey-bees mating optimization algorithm for assembly sequence planning problem." *In 2012 8th International Conference on Natural Computation*, pp. 1135-1140. IEEE, 2012.
- Kunlei Lian, Zhang Chaoyong, Gaoa Liang, and Shaoa Xinyu. "Single row facility layout problem using an imperialist competitive algorithm." *In Proceedings from the 41st International Conference on Computers & Industrial Engineering*. 2011.
- Yi Sun, Min Liu, Chaoyong Zhang, Liang Gao, and Kunlei Lian. "New high performing hybrid particle swarm optimization for permutation flow shop scheduling problem with minimization of makespan." *In 2010 IEEE International Conference on Industrial Engineering and Engineering Management*, pp. 1706-1710. IEEE, 2010.
- Kunlei Lian, Chaoyong Zhang, Xinyu Li, and Liang Gao. "An effective hybrid genetic simulated annealing algorithm for process planning problem." *In 2009 Fifth International Conference on Natural Computation*, vol. 5, pp. 367-373. IEEE, 2009.

Presentations

- Kunlei Lian, Ashlea B. Milburn and Ronald L. Rardin, 2015. "Study on a multi-objective periodic vehicle routing problem with service consistency", *INFORMS Annual Meeting*, Philadelphia, PA (November 1 – 4, 2015)
- Kunlei Lian, Ashlea B. Milburn and Ronald L. Rardin, 2015. "Study on a multi-objective periodic vehicle routing problem with service consistency", *IIE Annual Conference & Expo*, Nashville, Tennessee (May 30 – June 2, 2015)
- Kunlei Lian, Ashlea B. Milburn and Ronald L. Rardin, 2014. "Vehicle routing problem with service consistency: a multi-objective approach", *INFORMS Annual Meeting*, San Francisco, California (November 9 – 12, 2014)
- Kunlei Lian, Ashlea B. Milburn and Ronald L. Rardin, 2014. "Study on home health care nursing routing problem", *IIE Annual Conference & Expo, Montreal*, Canada (May 31 – June 3, 2014)
- Kunlei Lian, Ashlea B. Milburn and Ronald L. Rardin, 2013. "Patient-focused considerations in home health nursing routing problems", *INFORMS Annual Meeting, Minneapolis*, Minnesota (October 6 – 9, 2013)

Reviews

Journal Journal of Industrial Engineering International, completed: 14
Journal International Journal of Production Research, completed: 13
Journal Journal of Heuristics, completed: 5
Journal Applied Soft Computing, completed: 4
Journal European Journal of Operational Research, completed: 3
Journal Computer and Industrial Engineering, completed: 3
Journal Journal of Industrial and Production Engineering, completed: 3
Journal Swarm and Evolutionary Engineering, completed: 2
Journal Expert Systems with Applications, completed: 1
Journal Computers & Operations Research, completed: 1
Journal Mathematical Problems in Engineering, completed: 1

Honors & Awards

University of Arkansas

2015 Recipient, IIE E.J. Sierleja Memorial Fellowship *Arkansas, U.S.A*

Huazhong University of Science and Technology

2009 Recipient, Graduate Fellowship *Wuhan, China*
2009 1/38, Academic Achievement Award *Wuhan, China*
2012 1/38, Master's Thesis Award *Wuhan, China*
2009 5/38, Outstanding Graduate Student Award *Wuhan, China*
2009 3/35, Bachelor's Thesis Award *Wuhan, China*
2007 Recipient, Meritorious Winner of Mathematical Contest in Modeling *Wuhan, China*