Tutorial proposal to IEEE CEC 2025

Pareto Optimization for Subset Selection: Theories and Practical Algorithms

Speakers:

Chao Qian, Nanjing University, China
(qianc@nju.edu.cn http://www.lamda.nju.edu.cn/qianc/)

Tutorial length:

Two hours

Level of the tutorial:

Advanced

Abstract:

Subset selection aims to select a subset from a total set of items for optimizing some given objective function while satisfying some constraints. It is NP-hard, and has applications in diverse areas, including machine learning, data mining, natural language processing, computer vision, information retrieval, etc. This tutorial will introduce a promising framework, Pareto optimization, for the subset selection problem. The main idea of Pareto optimization is to transform the subset selection problem into a bi-objective optimization problem, then employ a multi-objective evolutionary algorithm to solve it, and finally return the best feasible solution w.r.t. the original subset selection problem from the generated non-dominated solution set. We will show that it achieves the best-so-far theoretical and practical performances in several applications of subset selection. We will also introduce advanced variants of Pareto optimization for large-scale, noisy and dynamic subset selection. Finally, we will briefly review the recent progress on this topic.

Keywords: Subset selection, Pareto optimization, evolutionary multi-objective optimization, large-scale optimization, noisy optimization, dynamic optimization, theoretical analysis, empirical study

Significance of this tutorial:

1. This tutorial will show an important application of multi-objective evolutionary optimization.
2. This tutorial will show that in addition to good empirical performance, multi-objective evolutionary optimization can be well theoretically grounded.
3. For the general subset selection problem (which may have a large number of audience), this tutorial introduces a new powerful solver.

Outline of the tutorial

- Introduction (20 minutes)
- Pareto optimization for subset selection (30 minutes)

- Pareto optimization for large-scale subset selection (15 minutes)
- Pareto optimization for noisy subset selection (15 minutes)
- Pareto optimization for dynamic subset selection (15 minutes)
- Application on sparse regression, influence maximization, and maximum coverage (10 minutes)
- Conclusion and future directions (15 minutes)

Potential audience:

Potential audiences include those who are curios in evolutionary multi-objective optimization and theoretically grounded evolutionary algorithms, and those who are interested in subset selection as well as applying evolutionary algorithms to achieve state-of-the-art performance in machine learning, data mining, natural language processing, etc.

Expected number of participants: 50

Previously held versions of the proposed tutorial:

Chao Qian gave a tutorial "*Pareto Optimization for Subset Selection: Theories and Practical Algorithms*" at CEC'24.
Chao Qian gave a tutorial "*Pareto Optimization for Subset Selection: Theories and Practical Algorithms*" at PPSN'24.
Chao Qian gave a tutorial "*Pareto Optimization for Subset Selection: Theories and Practical Algorithms*" at CEC'23.
Chao Qian gave a tutorial "*Pareto Optimization for Subset Selection: Theories and Practical Algorithms*" at WCCI'22.
Aneta Neumann, Frank Neumann and Chao Qian gave a tutorial "*Evolutionary Submodular Optimisation"* at GECCO'22.
Chao Qian and Yang Yu gave a tutorial "*Pareto Optimization for Subset Selection: Theories and Practical Algorithms*" at CEC'21.
Aneta Neumann, Frank Neumann and Chao Qian gave a tutorial "*Evolutionary Submodular Optimisation"* at GECCO'21.
Chao Qian and Yang Yu gave a tutorial "*Pareto Optimization for Subset Selection: Theories and Practical Algorithms*" at PPSN'20.
Chao Qian and Yang Yu gave a tutorial "*Pareto Optimization for Subset Selection: Theories and Practical Algorithms*" at WCCI'20.
Chao Qian and Yang Yu gave a tutorial "*Pareto Optimization for Subset Selection: Theories and Practical Algorithms*" at CEC'19.
Yang Yu and Chao Qian gave a tutorial "*Pareto Optimization for Subset Selection: Theory and Applications in Machine Learning*" at WCCI'18.

A brief resume of the presenter:

Chao Qian is a Professor in the School of Artificial Intelligence, Nanjing University, China. He received the BSc and PhD degrees in the Department of Computer Science and Technology from Nanjing University. After finishing his PhD in 2015, he became an Associate Researcher

in the School of Computer Science and Technology, University of Science and Technology of China, until 2019, when he returned to Nanjing University as an Associate Professor. In 2024, he became a full Professor.

His research interests include artificial intelligence, evolutionary computation, and machine learning. He has published one book "Evolutionary Learning: Advances in Theories and Algorithms", and over 60 first/corresponding-authored papers in top-tier journals (PNAS, AIJ, ECJ, TEvC, Algorithmica, TCS) and conferences (AAAI, IJCAI, ICML, NeurIPS, ICLR). He has won the ACM GECCO 2011 Best Theory Paper Award, the IDEAL 2016 Best Paper Award, and the IEEE CEC 2021 Best Student Paper Award Nomination. He serves on the editorial board of Artificial Intelligence Journal, Evolutionary Computation Journal, IEEE Transactions on Evolutionary Computation, IEEE Computational Intelligence Magazine, etc. He is the founding chair of IEEE Computational Intelligence Society (CIS) Task Force on Evolutionary Learning, and was also the chair of IEEE CIS Task Force on Theoretical Foundations of Bio-inspired Computation. He has regularly given tutorials and co-chaired special sessions at CEC, GECCO and PPSN, given an Early Career Spotlight Talk at IJCAI 2022, and will be a Program Co-Chair of PRICAI 2025. He has successfully developed algorithms to solve complex optimization problems (e.g., supply chain, wireless network, and chip register optimization) in Huawei, and won Huawei Spark Award twice. He is a recipient of the National Science Foundation for Excellent Young Scholars (2020) and CCF-IEEE CS Young Computer Scientist Award (2023), and has hosted a National Science and Technology Major Project.

Evidence of scholarship in the area (* indicates that I am the corresponding author)

- Han Hu[#], Chao Qian[#], Ke Xue[#], Rainer Georg Jörgensen, Marco Keiluweit, Chao Liang, Xuefeng Zhu, Ji Chen, Yishen Sun, Haowei Ni, Jixian Ding, Weigen Huang, Jingdong Mao, Rong-Xi Tan, Jizhong Zhou, Thomas W. Crowther, Zhi-Hua Zhou, Jiabao Zhang, and Yuting Liang. *Reducing the uncertainty in estimating soil microbial derived carbon storage.* **Proceedings of the National Academy of Sciences (PNAS)**, 2024, 121(35): e2401916121. (**[#] Equal Contribution**)
- Ke Xue, Yutong Wang, Cong Guan, Lei Yuan, Haobo Fu, Qiang Fu, Chao Qian*, and Yang Yu. *Heterogeneous multi-agent zero-shot coordination by coevolution.* **IEEE Transactions on Evolutionary Computation**, in press.
- Liang Zhao, Xiaobin Huang, Chao Qian, and Qingfu Zhang. *Many-to-few decomposition: Linking r2-based and decomposition-based multiobjective efficient global optimization algorithms.* **IEEE Transactions on Evolutionary Computation**, in press.
- Zeqiong Lv, Chao Qian, and Yanan Sun. *Benchmarking analysis of evolutionary neural architecture search.* **IEEE Transactions on Evolutionary Computation**, in press.
- Zeqiong Lv, Chao Qian, Gary G. Yen, and Yanan Sun. *Analyzing the expected hitting time of evolutionary computation-based neural architecture search algorithms.* **IEEE Transactions on Emerging Topics in Computational Intelligence**, in press.

- Dan-Xuan Liu, Yu-Ran Gu, Chao Qian*, Xin Mu, and Ke Tang. *Migrant resettlement by evolutionary multi-objective optimization.* **IEEE Transactions on Artificial Intelligence**, in press.
- Chao Qian. *Can evolutionary clustering have theoretical guarantees?* **IEEE Transactions on Evolutionary Computation**, 2024, 28(5): 1220-1234.
- Yu-Ran Gu, Chao Bian, Miqing Li, and Chao Qian*. *Subset selection for evolutionary multi-objective optimization*. **IEEE Transactions on Evolutionary Computation**, 2024, 28(2): 403-417.
- Guiying Li, Peng Yang, Chao Qian, Richang Hong, and Ke Tang. *Stage-wise magnitude-based pruning for recurrent neural networks*. **IEEE Transactions on Neural Networks and Learning Systems**, 2024, 35(2): 1666-1680.
- Shengcai Liu, Ning Lu, Wenjing Hong, Chao Qian, and Ke Tang. *Effective and imperceptible adversarial textual attack via multi-objectivization*. **ACM Transactions on Evolutionary Learning and Optimization**, 2024, 4(3): 16.
- Yi-Xiao He, Yu-Chang Wu, Chao Qian, and Zhi-Hua Zhou. *Margin distribution and structural diversity guided ensemble pruning.* **Machine Learning**, 2024, 113: 3545-3567.
- Yi-Xiao He, Dan-Xuan Liu, Shen-Huan Lyu, Chao Qian*, and Zhi-Hua Zhou. *Multi-class imbalance problem: A multi-objective solution.* **Information Sciences**, 2024, 680: 121156.
- Chao Qian, Dan-Xuan Liu, Chao Feng, and Ke Tang. *Multi-objective evolutionary algorithms are generally good: maximizing monotone submodular functions over sequences*. **Theoretical Computer Science**, 2023, 943: 241-266.
- Chao Qian, Dan-Xuan Liu, and Zhi-Hua Zhou. *Result diversification by multi-objective evolutionary algorithms with theoretical guarantees*. **Artificial Intelligence**, 2022, 309: 103737.
- Chao Qian. *Multi-objective evolutionary algorithms are still good: Maximizing monotone approximately submodular minus modular functions*. **Evolutionary Computation**, 2021, 29(4): 463-490.
- Chao Qian, Chao Bian, Yang Yu, Ke Tang, and Xin Yao. *Analysis of noisy evolutionary optimization when sampling fails*. **Algorithmica**, 2021, 83(4): 940-975.
- Chao Qian. *Distributed Pareto optimization for large-scale noisy subset selection*. **IEEE Transactions on Evolutionary Computation**, 2020, 24(4): 694-707.
- Chao Bian, Chao Qian*, Ke Tang, and Yang Yu. *Running time analysis of the (1+1)-EA for robust linear optimization*. **Theoretical Computer Science**, 2020, 843: 57-72.
- Chao Qian, Yang Yu, Ke Tang, Xin Yao, and Zhi-Hua Zhou. *Maximizing submodular or monotone approximately submodular functions by multi-objective evolutionary algorithms*. **Artificial Intelligence**, 2019, 275: 279-294.
- Chao Qian, Chao Bian, Wu Jiang, and Ke Tang. *Running time analysis of the (1+1)-EA for OneMax and LeadingOnes under bit-wise noise*. **Algorithmica**, 2019, 81(2): 749-795.
- Chao Qian, Jing-Cheng Shi, Ke Tang, and Zhi-Hua Zhou. *Constrained monotone k-submodular function maximization using multi-objective evolutionary algorithms with theoretical guarantee.* **IEEE Transactions on Evolutionary Computation**, 2018, 22(4): 595-608.

- Chao Qian, Yang Yu, Ke Tang, Yaochu Jin, Xin Yao, and Zhi-Hua Zhou. *On the effectiveness of sampling for evolutionary optimization in noisy environments.* **Evolutionary Computation**, 2018, 26(2): 237-267.
- Chao Qian, Yang Yu, and Zhi-Hua Zhou. *Analyzing evolutionary optimization in noisy environments.* **Evolutionary Computation**, 2018, 26(1): 1-41.
- Yang Yu, Chao Qian, and Zhi-Hua Zhou. *Switch analysis for running time analysis of evolutionary algorithms.* **IEEE Transactions on Evolutionary Computation**, 2015, 19(6): 777-792.
- Chao Qian, Yang Yu, and Zhi-Hua Zhou. *An analysis on recombination in multi-objective evolutionary optimization.* **Artificial Intelligence**, 2013, 204: 99-119.
- Shukuan Wang, Ke Xue, Lei Song, Xiaobin Huang, and Chao Qian*. *Monte Carlo tree search based space transfer for black box optimization.* In: **Advances in Neural Information Processing Systems 37 (NeurIPS'24)**, Vancouver, Canada, 2024. (**Spotlight**)
- Ke Xue, Ruo-Tong Chen, Xi Lin, Yunqi Shi, Shixiong Kai, Siyuan Xu, and Chao Qian*. *Reinforcement learning policy as macro regulator rather than macro placer.* In: **Advances in Neural Information Processing Systems 37 (NeurIPS'24)**, Vancouver, Canada, 2024.
- Shengjie Ren, Chao Bian, Miqing Li, and Chao Qian*. *A first running time analysis of the strength Pareto evolutionary algorithm 2 (SPEA2).* In: **Proceedings of the 18th International Conference on Parallel Problem Solving from Nature (PPSN'24)**, Hagenberg, Austria, 2024, pp.295-312.
- Dan-Xuan Liu and Chao Qian*. *Biased Pareto optimization for subset selection with dynamic cost constraints.* In: **Proceedings of the 18th International Conference on Parallel Problem Solving from Nature (PPSN'24)**, Hagenberg, Austria, 2024, pp.236-251.
- Ke Xue, Rongxi Tan, Xiaobin Huang, and Chao Qian*. *Offline multi-objective optimization.* In: **Proceedings of the 41st International Conference on Machine Learning (ICML'24)**, Vienna, Austria, 2024, pp.55595-55624.
- Ren-Jian Wang, Ke Xue, Cong Guan, and Chao Qian*. *Quality-diversity with limited resources.* In: **Proceedings of the 41st International Conference on Machine Learning (ICML'24)**, Vienna, Austria, 2024, pp.51984-52001.
- Yu-Chang Wu, Shen-Huan Lyu, Haopu Shang, Xiangyu Wang, and Chao Qian*. *Confidence-aware contrastive learning for selective classification.* In: **Proceedings of the 41st International Conference on Machine Learning (ICML'24)**, Vienna, Austria, 2024, pp.53706-53729.
- Chao Qian, Ke Xue, and Ren-Jian Wang. *Quality-diversity algorithms can provably be helpful for optimization.* In: **Proceedings of the 33rd International Joint Conference on Artificial Intelligence (IJCAI'24)**, Jeju Island, South Korea, 2024, pp.6994-7002.
- Chao Bian, Shengjie Ren, Miqing Li, and Chao Qian*. *An archive can bring provable speed-ups in multi-objective evolutionary algorithms.* In: **Proceedings of the 33rd International Joint Conference on Artificial Intelligence (IJCAI'24)**, Jeju Island, South Korea, 2024, pp.6905-6913.
- Shengjie Ren, Zhijia Qiu, Chao Bian, Miqing Li, and Chao Qian*. *Maintaining diversity provably helps in evolutionary multimodal optimization.* In: **Proceedings of the 33rd**

International Joint Conference on Artificial Intelligence (IJCAI'24), Jeju Island, South Korea, 2024, pp.7012-7020.

- Dan-Xuan Liu, Yi-Heng Xu, and Chao Qian*. *Peptide vaccine design by evolutionary multi-objective optimization.* In: **Proceedings of the 33rd International Joint Conference on Artificial Intelligence (IJCAI'24)**, Jeju Island, South Korea, 2024, pp.6967-6975.
- Chengrui Gao, Haopu Shang, Ke Xue, Dong Li, and Chao Qian*. *Towards generalizable neural solvers for vehicle routing problems via ensemble with transferrable local policy.* In: **Proceedings of the 33rd International Joint Conference on Artificial Intelligence (IJCAI'24)**, Jeju Island, South Korea, 2024, pp.6914-6922.
- Zeqiong Lv, Chao Bian, Chao Qian, and Yanan Sun. *Runtime analysis of population-based evolutionary neural architecture search for a binary classification problem.* In: **Proceedings of the 26th ACM Conference on Genetic and Evolutionary Computation (GECCO'24)**, Melbourne, Australia, 2024, pp.358-366.
- Ke Xue, Ren-Jian Wang, Pengyi Li, Dong Li, Jianye Hao, and Chao Qian*. *Sample-efficient quality-diversity by cooperative coevolution.* In: **Proceedings of the 12th International Conference on Learning Representations (ICLR'24)**, Vienna, Austria, 2024. **(Spotlight, top 5%)**
- Xiaobin Huang, Lei Song, Ke Xue, and Chao Qian*. *Stochastic Bayesian optimization with unknown continuous context distribution via kernel density estimation.* In: **Proceedings of the 38th AAAI Conference on Artificial Intelligence (AAAI'24)**, Vancouver, Canada, 2024.
- Tianhao Lu, Chao Bian, and Chao Qian*. *Towards running time analysis of interactive multi-objective evolutionary algorithms.* In: **Proceedings of the 38th AAAI Conference on Artificial Intelligence (AAAI'24)**, Vancouver, Canada, 2024.
- Yunqi Shi, Ke Xue, Lei Song, and Chao Qian*. *Macro placement by wire-mask-guided black-box optimization.* In: **Advances in Neural Information Processing Systems 36 (NeurIPS'23)**, New Orleans, LA, 2023.
- Chao Bian, Yawen Zhou, Miqing Li, and Chao Qian*. *Stochastic population update can provably be helpful in multi-objective evolutionary algorithms.* In: **Proceedings of the 32nd International Joint Conference on Artificial Intelligence (IJCAI'23)**, Macao, SAR, China, 2023.
- Ren-Jian Wang, Ke Xue, Haopu Shang, Chao Qian*, Haobo Fu, and Qiang Fu. *Multi-objective optimization-based selection for quality-diversity by non-surrounded-dominated sorting*. In: **Proceedings of the 32nd International Joint Conference on Artificial Intelligence (IJCAI'23)**, Macao, SAR, China, 2023.
- Dan-Xuan Liu, Xin Mu, and Chao Qian*. *Human assisted learning by evolutionary multi-objective optimization*. In: **Proceedings of the 37th AAAI Conference on Artificial Intelligence (AAAI'23)**, Washington, DC, 2023.
- Yu-Ran Gu, Chao Bian, and Chao Qian*. *Submodular maximization under the intersection of matroid and knapsack constraints.* In: **Proceedings of the 37th AAAI Conference on Artificial Intelligence (AAAI'23)**, Washington, DC, 2023.
- Lei Song, Ke Xue, Xiaobin Huang, and Chao Qian*. *Monte Carlo tree search based variable*

selection for high dimensional Bayesian optimization. In: **Advances in Neural Information Processing Systems 35 (NeurIPS'22)**, New Orleans, LA, 2022. **(Spotlight, top 5%)**

- Ke Xue, Jiacheng Xu, Lei Yuan, Miqing Li, Chao Qian*, Zongzhang Zhang, and Yang Yu. Multi-agent dynamic algorithm configuration. In: **Advances in Neural Information Processing Systems 35 (NeurIPS'22)**, New Orleans, LA, 2022. **(Spotlight, top 5%)**
- Chao Bian and Chao Qian*. *Better running time of the non-dominated sorting genetic algorithm ii (nsga-ii) by using stochastic tournament selection.* In: **Proceedings of the 17th International Conference on Parallel Problem Solving from Nature (PPSN'22)**, Dortmund, Germany, 2022.
- Zi-An Zhang, Chao Bian, and Chao Qian*. *Running time analysis of the (1+1)-EA using surrogate models on OneMax and LeadingOnes.* In: **Proceedings of the 17th International Conference on Parallel Problem Solving from Nature (PPSN'22)**, Dortmund, Germany, 2022.
- Yu-Chang Wu, Yi-Xiao He, Chao Qian*, and Zhi-Hua Zhou. *Multi-objective evolutionary ensemble pruning guided by margin distribution.* In: **Proceedings of the 17th International Conference on Parallel Problem Solving from Nature (PPSN'22)**, Dortmund, Germany, 2022.
- Jia-Liang Wu, Haopu Shang, Wenjing Hong, and Chao Qian*. *Robust neural network pruning by cooperative coevolution.* In: **Proceedings of the 17th International Conference on Parallel Problem Solving from Nature (PPSN'22)**, Dortmund, Germany, 2022.
- Chao Qian. *Towards theoretically grounded evolutionary learning*. In: **Proceedings of the 31st International Joint Conference on Artificial Intelligence (IJCAI'22)**, Vienna, Austria, 2022. (**Early Career Paper**)
- Haopu Shang, Jia-Liang Wu, Wenjing Hong, and Chao Qian*. *Neural network pruning by cooperative coevolution.* In: **Proceedings of the 31st International Joint Conference on Artificial Intelligence (IJCAI'22)**, Vienna, Austria, 2022.
- Chao Bian, Yawen Zhou, and Chao Qian*. *Robust subset selection by greedy and evolutionary Pareto optimization.* In: **Proceedings of the 31st International Joint Conference on Artificial Intelligence (IJCAI'22)**, Vienna, Austria, 2022.
- Yutong Wang, Ke Xue, and Chao Qian*. *Evolutionary diversity optimization with clustering-based selection for reinforcement learning*. In: **Proceedings of the 10th International Conference on Learning Representations (ICLR'22)**, Virtual, 2022.
- Fei-Yu Liu and Chao Qian*. *Prediction guided meta-learning for multi-objective reinforcement learning*. In: **Proceedings of the 2021 IEEE Congress on Evolutionary Computation (CEC'21)**, Krakow, Poland, 2021. (**Best Student Paper Award Nomination**)
- Chao Bian, Chao Qian*, Frank Neumann, and Yang Yu. *Fast Pareto optimization for subset selection with dynamic cost constraints.* In: **Proceedings of the 30th International Joint Conference on Artificial Intelligence (IJCAI'21)**, Virtual, 2021.
- Ke Xue, Chao Qian*, Ling Xu, and Xudong Fei. *Evolutionary gradient descent for non-convex optimization*. In: **Proceedings of the 30th International Joint Conference on Artificial Intelligence (IJCAI'21)**, Virtual, 2021.

- Chao Feng and Chao Qian*. *Multi-objective submodular maximization by regret ratio minimization with theoretical guarantee*. In: **Proceedings of the 35th AAAI Conference on Artificial Intelligence (AAAI'21)**, Virtual, 2021.
- Fei-Yu Liu, Zi-Niu Li, and Chao Qian*. *Self-guided evolution strategies with historical estimated gradients*. In: **Proceedings of the 29th International Joint Conference on Artificial Intelligence (IJCAI'20)**, Yokohama, Japan, 2020.
- Chao Qian, Hang Xiong, and Ke Xue. *Bayesian optimization using pseudo-points*. In: **Proceedings of the 29th International Joint Conference on Artificial Intelligence (IJCAI'20)**, Yokohama, Japan, 2020.
- Chao Qian, Chao Bian, and Chao Feng. *Subset selection by Pareto optimization with recombination*. In: **Proceedings of the 34th AAAI Conference on Artificial Intelligence (AAAI'20)**, New York, NY, 2020.
- Chao Bian, Chao Feng, Chao Qian*, and Yang Yu. *An efficient evolutionary algorithm for subset selection with general cost constraints*. In: **Proceedings of the 34th AAAI Conference on Artificial Intelligence (AAAI'20)**, New York, NY, 2020.
- Chao Feng, Chao Qian*, and Ke Tang. *Unsupervised feature selection by Pareto optimization*. In: **Proceedings of the 33rd AAAI Conference on Artificial Intelligence (AAAI'19)**, Honolulu, HI, 2019.
- Chao Bian, Chao Qian*, and Ke Tang. *A general approach to running time analysis of multi-objective evolutionary algorithms*. In: **Proceedings of the 27th International Joint Conference on Artificial Intelligence (IJCAI'18)**, Stockholm, Sweden, 2018, pp.1405-1411.
- Chao Qian, Yang Yu, and Ke Tang. *Approximation guarantees of stochastic greedy algorithms for subset selection*. In: **Proceedings of the 27th International Joint Conference on Artificial Intelligence (IJCAI'18)**, Stockholm, Sweden, 2018, pp.1478-1484.
- Chao Qian, Chao Feng, and Ke Tang. *Sequence selection by Pareto optimization*. In: **Proceedings of the 27th International Joint Conference on Artificial Intelligence (IJCAI'18)**, Stockholm, Sweden, 2018.
- Chao Qian, Guiying Li, Chao Feng, and Ke Tang. *Distributed Pareto optimization for subset selection*. In: **Proceedings of the 27th International Joint Conference on Artificial Intelligence (IJCAI'18)**, Stockholm, Sweden, 2018.
- Chao Qian, Yibo Zhang, Ke Tang, and Xin Yao. *On multiset selection with size constraints*. In: **Proceedings of the 32nd AAAI Conference on Artificial Intelligence (AAAI'18)**, New Orleans, LA, 2018.
- Chao Bian, Chao Qian*, and Ke Tang. *Towards a running time analysis of the (1+1)-EA for OneMax and LeadingOnes under general bit-wise noise*. In: **Proceedings of the 15th International Conference on Parallel Problem Solving from Nature (PPSN'18)**, Coimbra, Portugal, 2018.
- Chao Qian, Chao Bian, Yang Yu, Ke Tang, and Xin Yao. *Analysis of noisy evolutionary optimization when sampling fails*. In: **Proceedings of the 20th ACM Conference on Genetic and Evolutionary Computation (GECCO'18)**, Kyoto, Japan, 2018.
- Chao Qian, Jing-Cheng Shi, Yang Yu, Ke Tang, and Zhi-Hua Zhou. *Subset selection under noise*. In: **Advances in Neural Information Processing Systems 30 (NIPS'17)**, Long Beach,

CA, 2017.

- Chao Qian, Jing-Cheng Shi, Yang Yu, Ke Tang and Zhu-Hua Zhou. *Optimizing ratio of monotone set functions.* In: **Proceedings of the 26th International Joint Conference on Artificial Intelligence (IJCAI'17)**, Melbourne, Australia, 2017.
- Chao Qian, Jing-Cheng Shi, Yang Yu, and Ke Tang. *On subset selection with general cost constraints.* In: **Proceedings of the 26th International Joint Conference on Artificial Intelligence (IJCAI'17)**, Melbourne, Australia, 2017.
- Chao Qian, Chao Bian, Wu Jiang, and Ke Tang. *Running time analysis of the (1+1)-EA for OneMax and LeadingOnes under bit-wise noise*. In: **Proceedings of the 19th ACM Conference on Genetic and Evolutionary Computation (GECCO'17)**, Berlin, Germany, 2017.
- Jing-Cheng Shi, Chao Qian, and Yang Yu. *Evolutionary multi-objective optimization made faster by sequential decomposition*. In: **Proceedings of the 2017 IEEE Congress on Evolutionary Computation (CEC'17)**, San Sebastian, Spain, 2017.
- Chao Qian, Jing-Cheng Shi, Yang Yu, Ke Tang, and Zhi-Hua Zhou. *Parallel Pareto optimization for subset selection.* In: **Proceedings of the 25th International Joint Conference on Artificial Intelligence (IJCAI'16)**, New York, NY, 2016.
- Chao Qian, Ke Tang, and Zhi-Hua Zhou. *Selection hyper-heuristics can provably be helpful in evolutionary multi-objective optimization*. In: **Proceedings of the 14th International Conference on Parallel Problem Solving from Nature (PPSN'16)**, Edinburgh, Scotland, 2016.
- Chao Qian, Yang Yu, and Zhi-Hua Zhou. *Subset selection by Pareto optimization.* In: **Advances in Neural Information Processing Systems 28 (NIPS'15)**, Montreal, Canada, 2015.
- Chao Qian, Yang Yu, and Zhi-Hua Zhou. *Pareto ensemble pruning.* In: **Proceedings of the 29th AAAI Conference on Artificial Intelligence (AAAI'15)**, Austin, TX, 2015.
- Chao Qian, Yang Yu, and Zhi-Hua Zhou. *On constrained Boolean Pareto optimization.* In: **Proceedings of the 23rd International Joint Conference on Artificial Intelligence (IJCAI'15)**, Buenos Aires, Argentina, 2015.
- Yang Yu, Chao Qian. *Running time analysis: Convergence-based analysis reduces to switch analysis*. In: **Proceedings of the 2015 IEEE Congress on Evolutionary Computation (CEC'15)**, Sendai, Japan, 2015.
- Chao Qian, Yang Yu, Yaochu Jin, and Zhi-Hua Zhou. *On the effectiveness of sampling for evolutionary optimization in noisy environments.* In: **Proceedings of the 13th International Conference on Parallel Problem Solving from Nature (PPSN'14)**, Ljubljana, Slovenia, 2014.
- Chao Qian, Yang Yu, and Zhi-Hua Zhou. *On algorithm-dependent boundary case identification for problem classes.* In: **Proceedings of the 12th International Conference on Parallel Problem Solving from Nature (PPSN'12)**, Taormina, Italy, 2012.
- Chao Qian, Yang Yu, and Zhi-Hua Zhou. *An analysis on recombination in multi-objective evolutionary optimization.* In: **Proceedings of the 13th ACM Conference on Genetic and Evolutionary Computation (GECCO'11)**, Dublin, Ireland, 2011. **(Best Theory Paper**

Award)

- Chao Qian, Yang Yu, and Zhi-Hua Zhou. *Collisions are helpful for computing unique input-output sequences.* In: **Proceedings of the 13th ACM Conference on Genetic and Evolutionary Computation (GECCO'11)**, Dublin, Ireland, 2011.