Jiayang Ren

Email: rjy12307@outlook.com

Portfolio: jiayang.site
Linkedin: linkedin.com/jiayang-ren
Google Scholar: V3QBv3cAAAAJ

Education

- **University of British Columbia** — Vancouver, Canada
  Ph.D. in Chemical Engineering, Advisor: Dr. Yankai Cao, GPA:98.0/100 — *Sep 2021 - Current*
- **Zhejiang University** — Hangzhou, China
  M.S. in Control Engineering, Advisor: Dr. Dong Ni, GPA: 88.9/100 — *Sep 2018 – June 2021*
- **Zhejiang University** — Hangzhou, China
  B.A. in Automation, GPA: 3.80/4.0 — *Sep 2014 – June 2018*

Research Interests

- Advancing Interpretable Artificial Intelligence (AI) for process modeling and control
- Developing advanced optimization algorithms for large-scale Interpretable AI models.
- Pursuing trust-worthy and responsible data-driven methods in high-stake domains such as energy and food Systems.

Journal Articles & Patents

- [**Optimization**]: **Ren, J.**, Hua, K. and Cao, Y. (2025). A Global Optimization Algorithm for K-Center Clustering of One Billion Samples. *Management Science*. Accepted
- [**Optimization**]: **Ren, J.** and Cao, Y. (2025). GO-Clustering.Jl: A Julia Package for Global Optimal Centroid-Based Clustering. *Informs Journal on Computing.* In Preparation for *Informs Journal on Computing*.
- [**Optimization**]: **Ren, J**., Valentín, O. and Cao, Y. (2025). A GPU-Accelerated Moving-Horizon Algorithm for Training Deep Classification Trees on Large Datasets. *Informs Journal on Computing*. Under Review
- [**Control**]: **Ren, J.**, Mao, Q., Zhao, T., and Cao, Y. (2025). Learning Model Predictive Control Laws using Interpretable Oblique Decision Trees with robust considerations. Submitted to *Automatica*.
- [**Control**]: Li*, C., **Ren*, J.**, Chen, Y., Zhang, X., Fang, Z. and Cao, Y. (2025). Hierarchical model predictive control for energy consumption regulation of industrial-scale circulation counter-flow paddy drying process. *Energy*. 321, 135431. (***co-first author**)
- [**Control**]: Okamoto, M., **Ren, J**., Mao, Q., Liu, J., and Cao, Y. (2024). Deep Learning-Based Approximation of Model Predictive Control Laws Using Mixture Networks. *IEEE Transactions on Automation Science and Engineering.* vol. 22: 2909-2922.
- [**Control**]: Li, Y., Wang, Y., Chen, Y., Lu, Y., Hua, K., **Ren, J.**, ... and Cao, Y. (2022) Deep-Learning-Based Predictive Control of Battery Management for Frequency Regulation. *Industrial & Engineering Chemistry Research.* 61(24): 8432-8442
- [**Process Engineering**]: **Ren, J.**, and Ni, D. (2021) A Real-Time Monitoring Framework for Wafer Fabrication Processes With Run-to-Run Variations. *IEEE Transactions on Semiconductor Manufacturing.* 34(4): 483-492.
- [**Process Engineering**]: **Ren, J.**, and Ni, D. (2020) A batch-wise LSTM-encoder decoder network for batch process monitoring. *Chemical Engineering Research and Design.* 164. 102-112
- [**PATENT**]: Ni, D., Zhu, F. and **Ren, J**. (2018) Plasma components spatial distribution method for real-time measurement and its device based on light spectrum image-forming.

Computer Science Conference Proceedings

- [**Machine Learning**]: Mao, Q., **Ren, J.**, Wang, Y., Zou, C., Zheng, J., Cao, Y. (2025). Differentiable Decision Tree via "ReLU+Argmin" Reformulation. *Advances in Neural Information Processing Systems (NeurIPS)*. Under Review.
- [**Machine Learning**]: Zou, C, **Ren, J.**, Mao, Q., Liu, J., Lai, M., Cao, Y. (2025). A Moving-Horizon Approximate Branch-and-Reduce Method for Deep Classification Trees. *Advances in Neural Information Processing Systems (NeurIPS)*. Under Review.
- [**Machine Learning**]: Liu, P., Hao, Z., Ren, X., Yuan, H., **Ren, J.**, & Ni, D. (2024). PAPM: A Physics-aware Proxy Model for Process Systems. *International Conference on Machine Learning (ICML) 2024*. pp. 31080-31105

- [**Machine Learning**]: **Ren, J**., Hua, K. and Cao, Y. (2022). Global Optimal K-Medoids Clustering of One Million Samples. *Advances in Neural Information Processing Systems (NeurIPS).* 35: 982-994.
- [**Machine Learning**]: Hua, K., **Ren, J**. and Cao, Y. (2022). A Scalable Deterministic Global Optimization Algorithm for Training Optimal Decision Tree. *Advances in Neural Information Processing Systems (NeurIPS).* 35: 8347-8359.
- [**Machine Learning**]: Shi, M., Hua, K., **Ren, J.**, and Cao, Y. (2022). Global Optimization of K-Center Clustering. *International Conference on Machine Learning (ICML) 2022.* pp. 19956-19966.

Engineering Conference Proceedings

- [**Control**]: **Ren, J.**, Mao, Q., Zhao, T., and Cao, Y. (2025). Exact Learning of Model Predictive Control Laws using Oblique Decision Trees with Linear Predictions. *Conference on Decision and Control (CDC) 2025.* Accpeted.
- [**Machine Learning**]: Wang, Y., Kumar, A., **Ren, J.**, You, P., Seth, A., Gopaluni, R.B. and Cao, Y. (2024). Interpretable Data-Driven Capacity Estimation of Lithium-ion Batteries. *IFAC-PapersOnLine.* 58(14), pp.139-144.
- [**Machine Learning**]: **Ren, J.**, Hua, K., Trajano, H., and Cao, Y. (2023). Global Optimal Explainable Models for Biorefining. *Computer Aided Chemical Engineering.* 52: 1339-1346.
- [**Process Engineering**]: **Ren, J.**, and Ni, D. (2019) Real-time Fault Detection System for Multiphase Plasma Etching Process using OES, Two-Step Division and Change Stage Alignment Method. *2019 Chinese Automation Congress (CAC).* pp. 599-604.

Research Experience

- **Learning Optimal Control Laws via Interpretable Machine Learning Models** — Vancouver, Canada
  Research Assistant, PhD Student Advisor: Dr. Yankai Cao — *Aug 2024 – Present*
  - Developed learning-based Model Predictive Control (MPC) laws using oblique decision trees with linear predictions at the leaf nodes.
  - Achieved control performance competitive with both traditional MPC and neural networks based controllers.
  - Delivered significant online speedups: over 1,000x faster than MPC and 10x faster than neural network equivalents.
- **Large-Scale Optimization Algorithms for Interpretable Machine Learning Models** — Vancouver, Canada
  Research Assistant, PhD Student Advisor: Dr. Yankai Cao — *Sep 2021 – Present*
  - Designed global optimization algorithms for large-scale interpretable machine learning tasks (e.g., K-Means, K-Medoids, K-Center clustering, and Decision Trees) with datasets containing up to one billion samples.
  - Developed reduced-space spatial branch-and-bound algorithms with customized lower bounding strategies, scenario relaxations, problem-specific bound tightening, and sample reduction techniques.
  - Accelerated solution processes using hybrid CPU-GPU parallel computing to fully utilize modern hardware architectures.
- **Real-Time Fault Detection and Diagnosis for Batch Processes** — Hangzhou, China
  Research Assistant, Master's Student Advisor: Dr. Dong Ni — *Sep 2018 – Jun 2021*
  - Applied multivariate statistical analysis (e.g., PCA) and time-series models (e.g., SARIMA, LSTM) to model variable dependencies in industrial batch processes.
  - Developed a SARIMA-based drift compensation framework and a differential weighted distance-based phase alignment method, improving fault detection rates by 50% and reducing model complexity by 10 fold.
  - Designed an LSTM Encoder-Decoder architecture for real-time monitoring of nonlinear behaviors in batch processes, doubling the fault detection rate without increasing the false alarm rate.
- **Dynamic Spectral Feature Extraction for Plasma Etch Processes** — Hangzhou, China
  Research Assistant, Undergraduate Student Advisor: Dr. Dong Ni — *Oct 2017 – Jun 2018*
  - Extracted dynamic behavior using PCA and spectral peak information via wavelet decomposition.
  - Combined temporal and spectral information to derive dynamic spectral features for process monitoring.
  - Validated the method on optical emission spectra from plasma etching, enabling real-time process state detection aligned with underlying chemical mechanisms.

Work Experience

- **BC Hydro and Power Authority** — Vancouver, Canada
  Intern Research Engineer — *Aug 2023 - April 2024*
  - Hydro resource scheduling: developed scalable optimization techniques (e.g., Mesh Adaptive Direct Search) to determine the optimal value of water storage for hydro resource planning.
- **Samsung (China) Research and Development Co., Ltd** — Hangzhou, China
  Intern Software Engineer — *Apr 2017 – Sept 2017*
  - Ported the device tree seeking and reading API from the Linux kernel to U-Boot using C language.

Teaching Experience

- Teaching Assistant: UBC CHBE366 Chemical Engineering Lab (Data Analysis Lab, 200 students) 01/2023 - 05/2025
- Mentor: Mitacs Globalink Program - Deep learning-based Control (2 student) 05/2023 - 08/2025
- Mentor: Mitacs Globalink Program - Global Optimization for Clustering Models (1 student) 07/2024 - 10/2024

Honors & Awards

- AICHE CAST Director's Student Presentation Award Finalists 2025
- Westcoast Energy Inc Jack Davis Scholarship in Energy Studies 2024-2025
- Josephine T Berthier Fellowship 2023-2024
- Petrov Family Graduate Scholarship in Chemical and Biological Engineering 2022-2023
- University of British Columbia Affiliate Fellowship 2022-2023
- NeurIPS 2022 Scholar Award 2022
- 17th Informs Annual Conference, Data Mining Workshop - Best Theoretical Paper 2022
- Zhejiang University Scholarship for Outstanding Students 2018-2021

Professional Services

- **Senssion Chair**: Canadian Chemical Engineering Conference 2022 - Artificial Intelligence and Machine Learning in Process Systems Engineering Session
- **Poster Presentation**: TrustML Workshop 2023, NeurIPS 2022, ICML 2022
- **Oral Presentation**: AICHE 2024, BCUSC 2024, ADCHEM 2024, CCEC 2022, INFORMS 2022
- **Journal Reviewer**: IEEE Transactions on Industrial Informatics, IEEE Transactions on Automation Science and Engineering
- **Conference Reviewer**: CDC 2025, ICLR 2025, BigData 2024, ACMMM 2024, CIKM 2024, ICLR 2024, CIKM 2023, NeurIPS 2023, ICML 2022
- **Others**: IET Cyber-Systems and Robotics, Blog Writer for General Audience

Skills & Interests

- **Knowledge**: Optimization, Machine learning, Control theory and application
- **Programming**: Julia, Python, MPI and GPU Parallel Programming, CPLEX, Gurobi, Matlab, C, SQL
- **Hobbies**: Photography, Cooking, Aerobic Sports (e.g., hiking, jogging, swimming, cycling, etc.)