Jiayang Ren

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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

- Intersection of Large-Scale Global Optimization, Machine Learning and Control

Conference Proceedings

- [**NeurIPS 2022**]: **Ren, J**., Hua, K. and Cao, Y. (2022). Global Optimal K-Medoids Clustering of One Million Samples. Advances in Neural Information Processing Systems. Accepted.
- [**NeurIPS 2022**]: 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. Accepted.
- [**ICML 2022**]: Shi, M., Hua, K., **Ren, J.**, and Cao, Y. (2022). Global Optimization of K-Center Clustering. International Conference on Machine Learning. pp. 19956-19966.
- [**FOCAPO/CPC 2023**]: Okamoto, M., **Ren, J.**, and Cao, Y. (2022). Approximation of Nonlinear Model Predictive Control Using Mixture Density Networks. Foundations of Computer Aided Process Operations / Chemical Process Control 2023. Under Review.
- [**CAC 2019**]: **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.

Journal Articles & Patents

- [**Operations Research**]: **Ren, J.**, Hua, K. and Cao, Y. (2022). A Parallelization-enabled Global Optimization Algorithm for K-Center Clustering of One Billion Samples. Operations Research. Submitted.
- [**IECR**]: 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
- [**IEEE TSM**]: **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.
- [**CHERD**]: **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.

Research Experience

- **Global Optimization Algorithms for Large-Scale Machine Learning** — Vancouver, Canada
  Research Assistant, Advisor: Dr. Yankai Cao — *Sep 2021 - Current*
  - Explore the **global optimal solutions of large scale machine learning problems** (e.g. ten million or one billion samples, typically 100 times SOTA), including K-Means, K-Medoids, K-Center, and Decision Tree.
  - Tailor the **reduced-space spatial branch and bound strategy** for clustering and decision tree training.
  - Develop efficient **lower bounding methods using scenario relaxation techniques**, such as scenario linear relaxation, scenario Lagrange decomposition and so on.
  - Investigate the structures of problems to design corresponding **bound tightening** and **sample reduction** methods to reduce the search space.
  - GPU and CPU enabled Parallel Computing for accelerating the solving process.

- **Real-time Fault Detection and Diagnosis System for Batch Processes** Hangzhou, China
  Research Assistant, Advisor: Dr. Dong Ni *Sep 2018 – June 2021*
  - Deployed **Multivariate Statistical Analysis** methods like PCA and **Time Series Analysis** methods like SARIMA, LSTM in the system to capture the correlations among multiple variances.
  - Proposed a **differential weighted distance based phase aligning** method to solve the uneven phase duration problem in the multi-phase batch process.
  - Proposed a **SARIMA based state drift forecast-compensation framework** for batch process monitoring to solve the batch-to-batch state drifting problem in the continuous batch process, improving the fault detection rate by 50%, reducing the total model numbers for the factory level by 10x.
  - Proposed a **LSTM-Encoder Decoder network and the corresponding monitoring method** to solve the non-linear problem in the batch process, improving the fault detection rate by 100% under the same false alarm rate.
- **Dynamic spectral feature extraction for plasma etch process** Hangzhou, China
  Research Assistant, Advisor: Dr. Dong Ni *Oct 2017 – Jun 2018*
  - Employed **PCA** to extract dynamic information, **wavelet composition** to extract spectral peaks.
  - Combined dynamic information and spectral peaks to extract **dynamic spectral feature**.
  - Applied the method to optical emission spectral flow of plasma etch process, effectively obtained ma state in real-time and was proved to be consistent with the reaction mechanism

Work Experience

- **Shanghai Huali Microelectronics Corporation** Shanghai, China
  Intern Software Engineer, Director: Xiong Shao *Dec 2019 – Jun 2020*
  - **Fault detection system design**: design and validate a real-time fault detection system for industrial-scale semiconductor manufacturing processes.
  - **Data acquisition and preprocess**: acquire and denoise data streams from Hadoop databases in a real-time manner
  - **Process modeling**: compare performance of different models including state space, PCA, Neural network based model.
  - **Algorithm implementation**: implement a PCA based fault detection algorithm with machine adjustments, improve the fault detection rate by 50% and enlarge model suitability from 1 machine to one cluster of machines ($\sim$ 10 machines).
- **Samsung Semiconductor (China) Research and Development Co.,Ltd** Hangzhou, China
  Intern Software Engineer *Apr 2017 – Sept 2017*
  - Transplanted the **device tree seeking and reading API from Linux kernel** to U-Boot using C language

Awards

- University of British Columbia Affiliate Fellowship 2022-2023
- China Scholarship Council Doctoral Scholarship 2021-2025
- Zhejiang University Scholarship for Outstanding Students 2018-2021

Professional Services

- **INFORMS 2022**: 2022 CORS/INFORMS International Conference, Oral Presenter
- **ICML 2022**: Thirty-ninth International Conference on Machine Learning, Reviewer, Post Presenter
- **IET CSR**: IET Cyber-Systems and Robotics, Blog Writer for the General Audience

Skills & Interests

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