Zhongyu Zhang

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Education

University of Alberta (2023.01–2026.12) Edmonton, Alberta, Canada
PhD candidate Process Control (Supervised by Prof. Zukui Li & Prof. Biao Huang)

University of Alberta (2020.09–2022.12) Edmonton, Alberta, Canada
MSc's Degree Process Control GPA: 3.8/4.0 (Supervised by Prof. Zukui Li)

Shandong University (2016.09–2020.06) Jinan, Shandong, China
BEng's Degree Automation GPA: 4.17/5

Technical Skills

- **Programming & Data:** Python, PyTorch, NumPy, SciPy, scikit-learn, MATLAB, Git
- **Optimization & Control:** Pyomo, GAMS, LP, NLP, MILP, MINLP, PID, Model Predictive Control
- **Machine Learning:** Physics-Informed Neural Networks, Time-Series Modeling, Regression, Classification
- **Cloud & Software:** Databricks, JavaScript, React, Node.js, Express, MySQL

Industrial Experience

DCS Laboratory Development and Industrial Training (May 2026 – Present) —— **SUPCON Technology**

SUPCON ECS-700 | Distributed Control Systems (DCS) | Process Control | PID | Cascade Control

- Completed hands-on training led by SUPCON engineers and participated in on-site commissioning of the ECS-700 industrial distributed control system and coupled-tank level-control hardware.
- Collaborating with the laboratory team to design course experiments that teach DCS fundamentals, engineering software configuration, and closed-loop process control using the industrial platform.

Student Researcher (Feb. 2024 – Jun. 2026) ———————————————— **Teck Resources Limited**

KIVCET Furnace Feed Optimization (Jan. 2025 – Jun. 2026)

Robust Optimization | Soft Sensor Modeling | Neural Networks | NLP | SLSQP Solver | Databricks

- Collaborated with senior process control engineers at Trail Smelter to develop a Databricks-based decision-support pipeline combining plant data, machine-learning estimates of residue composition, and optimization to recommend furnace feed adjustments.
- Translated operational requirements into an uncertainty-aware optimization model balancing residue utilization, feed moisture, chemistry targets, and equipment constraints.
- Simulations improved feed element-ratio target compliance by 63% and increased monthly residue utilization by several hundred tonnes versus manual operation.

MPC Model Health Monitoring (Feb. 2024 – Jan. 2025)

Model Predictive Control (MPC) | System Identification | Correlation Analysis | Frequency Response | SVM | Databricks

- Worked with Teck engineers to migrate a model-plant mismatch monitoring toolbox from a local application to Databricks and integrate it into daily reporting for two industrial MPC systems.
- Combined five complementary analytics methods to detect when controller models no longer matched plant behaviour and identify the affected input-output relationships.
- Automated data processing and interactive HTML reporting to present operating KPIs, process trends, and model-health alerts in one place for engineering review.

Research Projects

Robust Machine Learning for Corrupted and Underrepresented Data (2025–Present)

Optimization under Uncertainty | **Python** | **LP** | **NLP** | **Pyomo** | **GAMS** | **CBC Solver** | **CONOPT Solver**

- Developed two complementary robust-learning methods that either filter unreliable samples or emphasize rare but valuable operating conditions using partial optimal transport and distributionally robust optimization.
- For corrupted measurements and labels, automatically excluded unreliable samples, improving process fault-classification accuracy from 57% to 77% and reducing soft-sensor RMSE by 57%.
- For underrepresented or shifted operating regimes, emphasized difficult but informative samples, reducing degraded-regime prediction RMSE by 37% and improving sensor-drift classification accuracy from 68% to 73%.

Data-Driven Petroleum Composition Inference from Routine Measurements (2024–2026)

Molecular Composition Analysis | **Python** | **Neural Networks** | **NLP** | **Pyomo** | **OMLT** | **IPOPT Solver**

- Co-developed data-driven methods to infer detailed molecular compositions of petroleum streams from limited, routinely available laboratory measurements, reducing reliance on costly specialized analysis.
- Combined neural networks, database matching, and property-constrained optimization to reconstruct chemically realistic compositions for both naphtha and heavy gas-oil fractions.
- Achieved an average R^2 of 0.957 across 44 naphtha test samples; on 21 heavy gas-oil test samples, the inferred molecular patterns closely matched high-resolution measurements while reproducing key bulk properties near routine measurement accuracy.

Quantifying Process Tolerance to Uncertainty with Neural Networks (2023–2025)

Physics-Informed Neural Networks (PINNs) | **Python** | **DeepXDE** | **CNN** | **NLP** | **Pyomo** | **OMLT** | **IPOPT Solver**

- Developed neural-network methods to map constraint-satisfying operating regions and quantify how much variation in process conditions a system can tolerate without violating operating limits.
- Extended the approach from steady-state systems to time-varying processes, using physics-informed surrogate models and classifiers to handle nonlinear, disconnected, and high-dimensional operating regions.
- Achieved up to 27$\times$ faster evaluation than conventional solver-based methods in benchmark process case studies, while maintaining over 95% accuracy in classifying feasible operating trajectories.

Physics-Informed Modeling and Dose Optimization for Renal Anemia Treatment (2022–2024)

Model Predictive Control (MPC) | **Physics-Informed Neural Networks (PINNs)** | **Python** | **DeepXDE** | **LSTM** | **NLP** | **IPOPT Solver**

- Developed a physics-informed neural network that combines sparse clinical data with physiological equations to estimate patient-specific parameters and predict haemoglobin response to EPO treatment; evaluated using records from 291 patients.
- Converted the personalized model into a fast control-oriented surrogate and integrated it with zone model predictive control to optimize EPO dose schedules while maintaining haemoglobin within a target range.
- Reduced prediction RMSE by 44–48% compared with LSTM and restored haemoglobin to the target range following simulated bleeding and infection disturbances in a two-year virtual-patient study.

Publications

- Z. Zhang, B. Huang, Z. Li. Distributionally robust optimization for Gaussian mixture model ambiguity under moment variations. Computers & Chemical Engineering (2026): 109833.
- S. Li, Z. Li, Z. Zhang, et al. Database-driven and property-constrained inference of molecular composition of petroleum fractions from routine experimental data[J]. Chemical Engineering Journal, 2026: 176448.

- Z. Zhang, B. Huang, Z. Li. Simultaneous Outlier-Exclusion and Distributionally Robust Learning through Partial Optimal Transport. Computers & Chemical Engineering (2025): 109408.
- S. Li, Z. Zhang, Z. Li, G. Cai, L. Zhang, Q. Shi. Molecular composition reconstruction of naphtha fractions through data-driven modeling and interpretable optimization. Chemical Engineering Science (2025): 122655.
- Z. Zhang, B. Huang, Z. Li. Dynamic Process Flexibility Analysis Using Neural Networks and a Volumetric Flexibility Index. Industrial & Engineering Chemistry Research. 2025, 64, 7452–7465.
- Z. Zhang, S. Yang, B. Huang, Z. Li. Novel Feasible Set Learning and Process Flexibility Analysis Method Using Deep Neural Networks. Industrial & Engineering Chemistry Research. 2024, 63, 11516–11529.
- Z. Zhang, and Z. Li. Model Predictive Control for Renal Anemia Treatment through Physics-informed Neural Network. IFAC-PapersOnLine 58.14 (2024): 307–312.
- Z. Zhang, Z. Li. Haemoglobin Response Modelling under Erythropoietin Treatment: Physiological Model-Informed Machine Learning Method. The Canadian Journal of Chemical Engineering. 2023, 101, 4307–4319.
- Z. Zhang, B. Huang, Z. Li. The Two Faces of Outliers in Robust Learning: Exclusion and Emphasis via Partial Optimal Transport. (Under Preparation)

Presentations

Distributionally Robust Optimization for Gaussian Mixture Model Ambiguity Under Moment Variations

- Oral presentation in American Institute of Chemical Engineers (AIChE) Annual Meeting on November 3 2025, Boston, Massachusetts, U.S.

Decision-focused Learning Considering Solution Robustness under Data Uncertainty

- Oral presentation in Canadian Chemical Engineering Conference (CSChE 2025) on October 7, 2025, Montreal, Quebec, Canada

Dynamic Process Operational Flexibility Analysis Using Neural Networks

- Poster presentation in Canadian Chemical Engineering Conference (CSChE 2024) on October 6–9, 2024, Toronto, Ontario, Canada

Model Predictive Control for Renal Anemia Treatment through Physics-Informed Neural Network

- Poster presentation in 12th IFAC International Symposium on Advanced Control of Chemical Processes (ADCHEM) on July 14–17, 2024, Toronto, Ontario, Canada

A Novel Volumetric Flexibility Index Calculation Method Using Physics-Informed Neural Networks

- Oral presentation in American Institute of Chemical Engineers (AIChE) Annual Meeting on November 9 2023, Orlando, Florida, U.S.

Awards

- Graduate Students' Association Academic Travel Grant (2025)
- Captain Thomas Farrell Greenhalgh Memorial Graduate Scholarship (2023)
- Graduate Students' Association Academic Travel Grant (2023)

Teaching Assistant Experience

- CHE 574 Process Optimization (Winter 2026)
- CHE 358 Process Data Analytics and Machine Learning (Spring/Summer 2024)