Xin Xia

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Education

University of Wisconsin–Madison **USA**
Ph.D. in Industrial Engineering; *Jan 2025 – Present*

Georgia Institute of Technology **USA**
M.Sc. in Electrical and Computer Engineering; *Sep 2020 – Aug 2022*

Tianjin University **China**
B.Eng. in Electrical Engineering and Automation; *Sep 2016 – Jun 2020*

Research Interests

Deep reinforcement learning; multi-agent systems; high-dimensional data analytics; quality control; unmanned aerial vehicles; language models; resilient supply chain systems. (Advisor: Prof. Kaibo Liu.)

Publications

Journal and Conference Papers

[P8] **X. Xia**, C. Zhang, K. Liu. "Learning Collision-Free Dispatch Policies for Route-Wise Decision-Dependent Anomaly Detection, " *Advances in Neural Information Processing Systems 2026*, accepted.

[P7] **X. Xia**, J. Guo, Z. Zheng, Y. Ma, C. Zhang, K. Liu. "Multi-Agent Reinforcement Learning for Anomaly Detection with Hierarchical Adaptive Sampling Strategy," *Technometrics*, conditionally accepted.

- Selected for presentation at 2025 IISE Annual Meeting, 2025 INFORMS Annual Meeting.
- IISE QCRE Best Track Paper Competition (Finalist), 2025.

[P6] **X. Xia**, Y. Wang, J. Zhou, G. Zhong, L. Cai, K.Liu, and C. Zhang, "KAPPA: A generic patent analysis framework with keyphrase-based portraits," INFORMS Journal on Data Science, major revision.

[P5] Y. Ma, **X. Xia**, C. Zhang, N. Chen. "Strengthening Supply Chain Resilience Through Coordinating Optimization of Product Design and Inventory Management: A Multi-Agent Deep Reinforcement Learning Approach," *Manufacturing & Service Operations Management*, submitted.

[P4] Y. Ma, J. Guo, **X. Xia**, C. Zhang. "Quality-Driven Multi-Agent Coordination in Multi-Stage Manufacturing Systems: A Distributionally Robust Bilevel Optimization Framework with Reinforcement Learning," *IISE Transcations*, under review.

[P3] Y. Ma, **X. Xia**, C. Zhang. "A Deep Reinforcement Learning Method Solving Bilevel Optimization for Product Design Considering Remanufacturing," *IEEE Transactions on Engineering Management*, vol. 72, pp. 573-590, 2025, doi: 10.1109/TEM.2025.3535771.

[P2] Y. Ma, **X. Xia**, P. Liu, and C. Zhang, "Bilevel joint optimization for product design changes with a resilient supply chain based on deep reinforcement learning," International Journal of Production Economics, vol. 290, Art. no. 109791, 2025, doi: 10.1016/j.ijpe.2025.109791.

[P1] H. D. Le, **X. Xia**, and Z. Chen, "Multi-agent causal discovery using large language models," arXiv preprint arXiv:2407.15073, 2024. doi: 10.48550/arXiv.2407.15073.

Patents

[PT2] P. Liu, **X. Xia**, Z. Yan, Y. Liu, J. Xiao. "Generation, implementation, electronic devices, and storage media for structured document information," Chinese Invention Patent, CN115205869A.

[PT1] P. Liu, L. Huang, X. Yu, **X. Xia**, Y. Liu, J. Xiao. "Method, implementation, devices, and storage media for monitoring of processor resources," Chinese Invention Patent, CN114661545A.

Research Experience

Tsinghua University — **Research Assistant**
Project: Multi-Agent Reinforcement Learning for Resilient Supply Chain System — *Feb 2023 – Jan 2025*

- Formulated a multi-echelon supply chain system for crowdsourcing manufacturing as a bilevel optimization model, with the crowdsourcing platform as the leader and supply-chain echelons as followers; studied the Stackelberg–Nash equilibrium under disruption risks.
- Developed a multi-agent reinforcement learning approach in which each follower learns to cooperate with neighboring agents from the same, upstream, and downstream echelons to improve system resilience.

Tsinghua University — **Research Assistant**
Project: Document Analysis with Keyphrase Prediction Based on a Pre-trained Language Model — *Mar 2023 – Jun 2023*

- Proposed an extractor-generator framework for keyphrase generation by incorporating a pretrained language model (T5-base) into the One2Set paradigm for absent keyphrase generation; developed a multi-task training paradigm to improve prediction quality.
- Improved the vanilla One2Set paradigm by introducing a keyword-code control mechanism and keyword-based padding strategy, alleviating duplicated prediction and "null" token over-estimation.
- Achieved state-of-the-art performance for predicting present and absent keyphrases on benchmark datasets including KP20K, Inspec, Krapivin, NUS, and SemEval. GitHub: SetPLM

Tsinghua University — **Research Assistant**
Project: A Deep Reinforcement Learning Method for Solving Bilevel Optimization Problem — *Sep 2022 – Mar 2023*

- Established a bilevel interactive optimization model based on Stackelberg game theory, treating product design as the leader and the remanufacturing process as the follower.
- Designed a bilevel deep reinforcement learning framework and integrated a specialized SAC algorithm, termed BSAC, to solve large-scale bilevel interactive optimization problems with high sample efficiency.
- Demonstrated the effectiveness and robustness of BSAC across diverse parameter settings and provided theoretical guarantees for convergence and optimality.

Georgia Institute of Technology — **Graduate Student**
Project: Dynamic Scheduling of Berth and Quay Crane with Deep Reinforcement Learning — *Jul 2022 – Sep 2022*

- Formulated the berth-quay problem as a bilevel optimization model, with the upper level focused on berth scheduling and the lower level addressing dynamic quay-crane assignment.
- Developed a multi-task framework derived from the bilevel model and introduced a PPO-based deep reinforcement learning algorithm, BQCPPO, for large-scale berth-quay coordination in port environments.
- Demonstrated superior performance of BQCPPO over baselines including genetic algorithms, particle swarm optimization, and FIFO rules. GitHub: BerthRL

Ping An Technology — **AI Researcher Intern**
Project: A Multi-modal Document Understanding Method Based on a Language Model — *Sep 2021 – Dec 2021*

- Designed and implemented an end-to-end document understanding method for extracting key-value pairs from OCR results in document images across business scenarios such as ID cards, vehicle certificates, and medical records.
- Integrated semantic entity recognition and relation extraction into a unified document understanding task; fine-tuned the pretrained model with limited data and achieved 89% accuracy.

Tianjin University — **Undergraduate Student**
Project: Generative model for a Integrated Energy System — *Dec 2019 – Jun 2020*

- Designed a scenario generation method based on generative adversarial networks to capture relationships across wind, photovoltaic, heating, and power subsystems and generate representative scenarios for park integrated energy systems.

- Implemented a DCGAN model with Wasserstein distance as the loss function; used one year of historical subsystem data for training and applied K-means clustering to identify typical scenarios for follow-up analysis. GitHub: DCGAN

Professional Experience

Industrial Statistics and Data Analytics Lab, Tsinghua University **Beijing, China**
Research Assistant *Sep 2022 – Jan 2025*

- Conducted research at the interface of optimization, including bilevel programming and mixed-integer programming, and deep learning, including deep reinforcement learning and natural language processing, with applications to industrial scenarios such as manufacturing, supply chain systems, and crowdsourcing. Adviced by Prof. Chen Zhang.
- Wrote and revised book chapters on machine learning, reinforcement learning, and Monte Carlo tree search algorithms for *Machine Learning: Industrial Big-Data Analysis* (ISBN: 9787302608226), published by Tsinghua University Press.
- Maintained the official website of the Industrial Statistics and Data Analytics Lab.

Ping An Technology (Shenzhen) Co., Ltd. **Shenzhen, China**
AI Researcher Intern *Aug 2021 – May 2022*

- Conducted research on document understanding by reproducing LayoutXLM, a multimodal pretrained language model proposed by Microsoft, and adapting it to business scenarios requiring structured information extraction from OCR outputs.
- Designed an efficient dataset annotation pipeline for document understanding tasks, including relation extraction and semantic entity recognition, and constructed datasets from multiple document scenarios, such as ID cards, vehicle certificates, and medical records.
- Developed invention patents on end-to-end document understanding with Transformer-based pretrained models and resource-utilization monitoring based on ZooKeeper.

Additional Projects

Tabular Analysis for Patient Health Record Classification with Pretrained Language Models GitHub: TAP

- Developed a patient outcome prediction model for tabular data, including data preprocessing, feature engineering, model training, and evaluation.
- Designed a BERT-based classifier for tabular prediction and compared it with a baseline MLP model; empirical results showed that the model with a pretrained embedding layer outperformed the vanilla model.

Deep Reinforcement Learning for the Mini Game 2048 GitHub: 2048

- Implemented a DQN algorithm to train an agent for 2048 games, using the first 10,000 random actions and states as the training set and TensorBoard for visualization.

Skills

Languages: Chinese (native); English (TOEFL 101; GRE verbal 158/170, quantitative 170/170, analytical writing 3.5)

Programming: Python; C++ (project); MATLAB (project); C; R; Assembly

Algorithms: Machine learning (notes); deep learning (notes); reinforcement learning (notes); natural language processing, including pretrained language models, fine-tuning, and prompt engineering; robotics, including histogram filters, Kalman filters, particle filters, SLAM, and search algorithms (notes)

Neural Network Frameworks: PyTorch; TensorFlow; Keras

Developer Tools: Anaconda; Visual Studio; PyCharm; Git; Docker; Linux; LaTeX; Overleaf