

# SINONG(SIMON) ZHAN

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## EDUCATION

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### Northwestern University

Sept 2023 - Present

PhD in Electrical and Computer Engineering, advised by Prof. Qi Zhu

### University of California, Berkeley

August 2018 - December 2022

Bachelor of Arts in Computer Science and Applied Mathematics, advised by Prof. Sanjit Seshia

## RESEARCH INTERESTS

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My research lies at the intersection of Reinforcement Learning and Formal Methods, developing principled approaches to ensure safety, robustness, and verifiability in embodied cyber-physical systems. I focus on integrating formal verification techniques with learning-based control to provide guarantees while maintaining adaptability and performance. My work spans safe reinforcement learning with constraint satisfaction, delay-aware optimization under uncertainty, model-based approaches for certified learning, and neurosymbolic methods that combine symbolic reasoning with neural computation to achieve interpretable and verifiable intelligent systems. And my research has resulted in publications in some top tier conferences such as ICML, NeurIPS, ICLR, ICCPS, L4DC, FM, RV, IROS, etc.

## RESEARCH EXPERIENCE

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### IDEAS Lab, Northwestern University

Sep 2023 - Present

*Graduate Research Assistant*

*Advised by Prof. Qi Zhu*

- Developed safe and delay-robust reinforcement learning algorithms with formal verification for autonomous driving and safety-critical robotics, resulting in 2 ICML and 1 NeurIPS Spotlight papers.
- Designed novel inverse reinforcement learning frameworks using generative modeling (GANs, score matching) for stable imitation learning in stochastic environments.
- Explored neurosymbolic approaches with large language models to enhance interpretability and formal reasoning capabilities in autonomous systems and robotics applications.
- Built a comprehensive framework to evaluate and improve the safety of embodied AI agents, combining formal safety rules with multi-level testing (semantic, plan, and trajectory) in realistic simulation environments.

### University of California, Berkeley

Feb 2022 - April 2023

*Undergraduate Researcher & Research Assistant*

*Advised by Prof. Sanjit Seshia*

- Developed automated verification and control synthesis methods for complex robotics systems, specializing in path planning and trajectory optimization for underwater robots.
- Created SMT-based 3D bin-packing solver for design model checking, contributing to structured design automation pipelines and formal verification frameworks for NSF UUV Challenge.

### Human Computing Lab, ISCAS & XDiscovery Lab, Dartmouth

May 2019 - Sep 2021

*Research Assistant*

*Advised by Prof. Feng Tian, Prof. Teng Han, & Prof. Xing-Dong Yang*

- Designed VR-based interaction models with real-time feedback systems and developed novel microfluidics-based sensing technologies, resulting in CHI and UbiComp publications.
- Implemented self-supervised learning techniques for robust multi-modal sensor fusion in haptic interfaces, exploring fast-prototyping methods for human-computer interaction applications.

## INDUSTRY EXPERIENCE

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### Amazon

*Applied Scientist Intern*

June 2025 - Sep 2025

*Store Foundation AI Team*

- Developed multi-turn conversational agents for Rufus Shopping Assistant using state-of-the-art reinforcement learning algorithms and designed logic-based reward machines for human behavior simulation.
- Contributed to large-scale production systems serving millions of Amazon customers, optimizing LLM agent training pipelines for e-commerce applications and customer interaction workflows.

### CAS Ruiyi Technology Co., Ltd

*Software Developer*

May 2020 - Aug 2021

- Developed data analysis pipelines for medical device performance evaluation and robustness testing, building WeChat mini-programs for healthcare applications facilitating doctor-patient communication.
- Presented product demonstrations to hospital clients and investors, contributing to business development and conducting live demos for top-tier hospitals and healthcare organizations.

## ACADEMIC SERVICE

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**Conference Reviewer:** NeurIPS (2024-), ICML (2024-), ICLR (2024-), AAAI (2024-), L4DC (2024-), ASP-DAC (2024-), CVPR(2026-), ECC(2026-)

**Journal Reviewer:** Machine Learning Journal (Springer), IEEE Internet of Things Journal

**Program Committee:** ICCPS Artifact Evaluation Committee

## PUBLICATIONS (\* INDICATES EQUAL CONTRIBUTION)

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### Conference Papers

**Belief-Based Offline Reinforcement Learning for Delay-Robust Policy Optimization.** **Simon Sinong Zhan**, Qingyuan Wu, Frank Yang, Xiangyu Shi, Chao Huang, Qi Zhu. *The Fourteenth International Conference on Learning Representations (ICLR 2026)*.

**Shop-R1: Rewarding LLMs to Simulate Human Behavior in Online Shopping via Reinforcement Learning.** Yimeng Zhang, Tian Wang, Jiri Gesi, Ziyi Wang, Yuxuan Lu, Jiacheng Lin, **Simon Zhan**, Vianne Gao, Ruochen Jiao, Junze Liu, Kun Qian, Yuxin Tang, Ran Xue, Houyu Zhang, Qingjun Cui, Yufan Guo, Dakuo Wang. *The Fourteenth International Conference on Learning Representations (ICLR 2026)*.

**Model-Based Reward Shaping for Adversarial Inverse Reinforcement Learning in Stochastic Environments.** **Simon Sinong Zhan**, Philip Wang, Qingyuan Wu, Yixuan Wang, Ruochen Jiao, Chao Huang, Qi Zhu. *Learning for Dynamics and Control Conference (L4DC 2026)*.

**Directly Forecasting Belief for Reinforcement Learning with Delays.** Qingyuan Wu\*, **Simon Sinong Zhan\***, Yuhui Wang\*, Yixuan Wang, Chung-Wei Lin, Chen Lv, Qi Zhu, Jurgen Schmidhuber, Chao Huang. *International Conference on Machine Learning (ICML 2025)*.

**Variational Delayed Policy Optimization.** Qingyuan Wu\*, **Simon Sinong Zhan\***, Yixuan Wang, Yuhui Wang, Chung-Wei Lin, Chen Lv, Qi Zhu, Chao Huang. *Conference on Neural Information Processing Systems (NeurIPS 2024) (Spotlight)*.

**Switching Controller Synthesis for Hybrid Systems Against STL Formulas.** Han Su, Shenghua Feng, **Simon Sinong Zhan**, Naijun Zhan. *International Symposium on Formal Methods (FM 2024)*.

**Case Study: Runtime Safety Verification of Neural Network Controlled System.** Frank Yang, **Simon Sinong Zhan**, Yixuan Wang, Chao Huang, Qi Zhu. *International Conference on Runtime Verification (RV 2024)*.

**State-wise safe reinforcement learning with pixel observations.** Simon Sinong Zhan, Yixuan Wang, Qingyuan Wu, Ruochen Jiao, Chao Huang, Qi Zhu. *Learning for Dynamics and Control Conference (L4DC 2024)*.

**Boosting Reinforcement Learning with Strongly Delayed Feedback Through Auxiliary Short Delays.** Qingyuan Wu, Simon Sinong Zhan, Yixuan Wang, Yuhui Wang, Chung-Wei Lin, Chen Lv, Qi Zhu, Jurgen Schmidhuber, Chao Huang. *International Conference on Machine Learning (ICML 2024)*.

**Kinematics-aware Trajectory Generation and Prediction with Latent Stochastic Differential Modeling.** Ruochen Jiao\*, Yixuan Wang\*, Xiangguo Liu, Simon Sinong Zhan, Chao Huang, Qi Zhu. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2024)*.

**Enforcing Hard Constraints with Soft Barriers: Safe Reinforcement Learning in Unknown Stochastic Environments.** Yixuan Wang, Simon Sinong Zhan, Ruochen Jiao, Zhilu Wang, Wanxin Jin, Zhuoran Yang, Zhaoran Wang, Chao Huang, Qi Zhu. *International Conference on Machine Learning (ICML 2023)*.

**Joint Differentiable Optimization and Verification for Certified Reinforcement Learning.** Yixuan Wang\*, Simon Sinong Zhan\*, Zhilu Wang, Chao Huang, Zhaoran Wang, Zhuoran Yang, Qi Zhu. *International Conference on Cyber-Physical Systems (ICCPs 2023)*.

**MicroFluID - A Reconfigurable RFID Platform for Robust Interaction Sensing Based on Microfluidics.** Wei Sun, Yuwen Chen, Yanjun Chen, Simon Sinong Zhan, Yixin Li, Jiecheng Wu, Teng Han, Feng Tian, Jingxian Wang, Haipeng Mi, Xing-Dong Yang. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT/UbiComp 2022)*.

**RElectrode: A Reconfigurable Electrode For Multi-Purpose Sensing Based on Microfluidics.** Wei Sun, Yanjun Chen, Simon Sinong Zhan, Teng Han, Feng Tian, Hongan Wang, Xing-Dong Yang. *ACM Conference on Human Factors in Computing Systems (CHI 2021)*.

## Workshop Papers

**Empowering autonomous driving with large language models: A safety perspective.** Yixuan Wang, Ruochen Jiao, Chengtian Lang, Simon Sinong Zhan, Chao Huang, Zhaoran Wang, Zhuoran Yang, Qi Zhu. *LLM Agent Workshop @ ICLR 2024*.

**See, Think, Act: Online Shopper Behavior Simulation with VLM Agents.** Yimeng Zhang, Ziyi Wang, Yuxuan Lu, Sinong Zhan, Jing Huang, Dakuo Wang. *SEA Workshop @ NeurIPS 2025*.

## Paper Preprint

**Inverse Delayed Reinforcement Learning.** Simon Sinong Zhan\*, Qingyuan Wu\*, Aria Ruan, Frank Yang, Philip Wang, Yixuan Wang, Ruochen Jiao, Chao Huang, Qi Zhu. *Under Review*.

**Token Buncher: Shielding LLMs from Harmful Reinforcement Learning Fine-Tuning.** Weitao Feng, Lixu Wang, Tianyi Wei, Jie Zhang, Chongyang Gao, Simon Sinong Zhan, Peizhuo Lv, Wei Dong. *Under Review*.

**SENTINEL: A Multi-Level Formal Framework for Safety Evaluation of LLM-based Embodied Agents.** Simon Sinong Zhan, Yao Liu, Philip Wang, Zinan Wang, Qineng Wang, Zhian Ruan, Xiangyu Shi, Xinyu Cao, Frank Yang, Kangrui Wang, Huajie Shao, Manling Li, Qi Zhu. *Under Review*.

**Efficient Multi-Step Reinforcement Learning with Expectation-Maximization Bootstrapping.** Qingyuan Wu, Yuhui Wang, Simon Sinong Zhan, Qi Zhu, Jurgen Schmidhuber, Chao Huang. *Under Review*.

**Shedding Light on VLN Robustness: A Black-box Framework for Indoor Lighting-based Adversarial Attack.** Chenyang Li, Wenbing Tang, Yihao Huang, **Sinong Simon Zhan**, Ming Hu, Xiaojun Jia, Yang Liu. *Under Review.*

## TEACHING EXPERIENCE

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**University of California, Berkeley**

*Teaching Assistant*

Fall 2022

*Math 128A: Numerical Analysis*

- Conducted weekly discussion sections and office hours for 40+ undergraduate students
- Graded assignments and provided detailed feedback on numerical methods and computational mathematics

## PATENTS

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**EMG-based Multi-target Control System.** Simon Zhan, Junjun Fan, Feng Tian, Wei Sun. Chinese Patent No. CN201710953534.X.

**Microfluidic Pipeline Composite Structure and Pattern Deformation System.** Wei Sun, Yanjun Chen, Simon Zhan, Teng Han, Feng Tian, Hongan Wang, Xing-Dong Yang. Chinese Patent No. CN202110377915.4.

**Fluid Pattern Reconfigurable System Based on Microfluidic Technology.** Wei Sun, Yanjun Chen, Simon Zhan, Teng Han, Feng Tian, Hongan Wang, Xing-Dong Yang. Chinese Patent No. CN202110378536.7.

## TECHNICAL SKILLS

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**Programming**

Python, C/C++, Lean FRO, CUDA, Java, R, Julia

**ML/AI Frameworks**

PyTorch, JAX, Hugging Face, Verl

**Optimization**

Gurobi, CVX, CasADi

**Tools**

Git, Docker, LATEX, Linux, Unity3D, MATLAB, Simulink

**Languages**

English (Native), Chinese (Native), German (Limited-proficiency)