

YAO(JUSTIN) LIU

Phone: (+1) 213-994-3439 / E-mail: jliu3548@usc.edu / Justinliu1119.github.io/ GitHub

EDUCATION

University of Southern California

B.S. Electrical and Computer Engineering (Honors)

B.S. Applied & Computational Mathematics

Aug. 2021 – May 2025

GPA: 3.86

University of California, Berkeley

Ph.D. Electrical Engineering & Computer Sciences (EECS)

Starting Aug. 2026

Research Interests: Embodied Agents, Online Decision-Making, Multi-Agent Systems, Cyber-Physical Systems

Relevant Coursework: Probability Theory, Statistics, Distributed Systems & IoT, Real Analysis, PDE, Numerical Methods, Machine Learning, Reinforcement Learning (Coursera), Linear Systems, Algorithms, OOP, Embedded Systems, Digital Circuits

EXPERIENCE

Design Automation of Intelligent Systems Lab, Northwestern University

July 2024 — Present

Research Assistant, Prof. Qi Zhu's Group

- **Multi-Agent Systems via Diffusion Predictive Modeling and Selective Communications:**

Co-developed a conditional diffusion model that infers global state from local views and limited communication for a team of heterogeneous robots; designed a MARL framework enabling heterogeneous robots to coordinate resource exploration, extraction, and transport in NASA's ISRU challenge; co-designed a closed-loop system where diffusion-based predictions guide MARL policies, reducing inter-agent communication by leveraging diffusion inference uncertainty.

- **Safe Embodied LLM-Agent via Temporal Logic:**

Developed SENTINEL, a multi-level safety framework for embodied LLM agents that integrates temporal logic safety constraints into task planning, with semantic, plan, and trajectory-level verification; Enabled LLMs for collision-aware navigation planning in physics-informed environments; Implemented computation-tree-based checking in VirtualHome and AI2-THOR to detect unsafe states, ordering violations, and timed hazards with interpretable counterexamples.

Autonomous Networks Research Group, USC

Summer 2024 — Present

Research Assistant, Prof. Bhaskar Krishnamachari's Group

- **Fairness in Cooperative Multi-Agent Systems:**

Designed a multi-agent RL framework to learn Eisenberg-Gale equilibrium task allocation for fair and efficient agent-task service under partial observability; Integrated attention-based GNN message passing to enable relational reasoning over local agent-entity interactions; Developed a stochastic online algorithm that dynamically assigns agents to sequentially discovered goal sets based on the Eisenberg-Gale convex program.

Computational Optimization Laboratory, Stanford University

Summer 2024 — Present

Research Assistant, Prof. Yinyu Ye's Group

- **Arrow-Debreu Competitive Equilibrium: Online Stochastic Optimization:**

Developed action-history-dependent online optimization algorithms via certainty-equivalent & sample average approximation methods to sequentially compute equilibrium prices and allocations under incomplete agent information; Established regret $O(\log n)$ and constraint violation $O(1)$, demonstrating enhanced performance over static algorithms.

Energy Efficient Secure Sustainable Computing Group, USC

Aug. 2023 — Present

Research Assistant, Prof. Peter Beerel's Group

- **Conditional Diffusion Framework for Wildfire Origin and Spread Prediction:**

Co-designed a conditional diffusion model integrating ALERTCalifornia video, active-fire maps, and geospatial layers with a cross-attention UNet to infer ignition and spread; Collaborated on formulating a unified bird's-eye-view representation of fire scenes via camera-pose-based projection; Designed a real-time Unreal Engine rendering system for wildfire spread.

- **Distributed Inference & Adversarial Detection:**

Co-developed a dynamic partial-redundancy scheme for secure distributed ML inference robust against Byzantine faults; Derived closed-form bounds on the inferences needed for 99% attack detection confidence under low redundancy (2-5%) and proved a negligible detection gap between independent and centralized RNG schedulers, validated on GPT-2.

Radio Lab, Yale University

Sep. 2025 — Present

Research Assistant, Prof. Dionysis Kalogerias' Group

- **Zeroth-Order Robust Multi-Agent Policy Learning:**

Formulated a min-max adversarial multi-agent reinforcement learning algorithm that enables decentralized agents to remain robust against targeted observation attacks; Integrated zeroth-order gradient estimators to optimize policies for non-differentiable, non-convex objectives under worst-case observation perturbations.

ACADEMIC SERVICE

Conference Reviewer, IEEE Intelligent Vehicles Symposium (IV)

2026

PUBLICATIONS (* Indicates equal contribution; † Indicates alphabetical order)

1. **Yao Liu**, S. Mohanty, E. Ondula, Bhaskar Krishnamachari. *DISPATCH: Decentralized Informed Spatial Planning and Task Assignment for Cooperative Heterogeneous Agents*. Submitted to **IEEE RAL 2026**. <https://arxiv.org/abs/2511.17915>
2. Simon S. Zhan*, **Yao Liu***, Philip Wang*, Z. Wang, Q. Wang, Z. Ruan, X. Shi, X. Cao, Frank Yang, K. Wang, Huajie Shao, Manling Li, Qi Zhu. *SENTINEL: A Multi-Level Formal Framework for Safety Evaluation of LLM-based Embodied Agents*. Under Review. <https://nu-ideas-lab.github.io/Sentinel>
3. Xuan Zhou, U. Muhan, **Yao Liu**, Peter Beerel. *An Efficient Distributed Inference Framework for IoT Systems with Byzantine Fault Detection*. **GLSVLSI 2025**. <https://dl.acm.org/doi/10.1145/3716368.3735230>
4. Yue Hu, G. Datta, K. Beerel, **Yao Liu**, Peter Beerel. *Let's Roll: Synthetic Dataset Analysis for Pedestrian Detection Across Different Shutter Types*. **IEEE SIPS 2024**. <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=10768224>
5. Anthony Goeckner, Weihe Gao, **Yao Liu**, Alessandro Pinto, Qi Zhu. *Quiet Multi-Agent Systems via Predictive World Modeling and Selective Communications*. In submission.
6. Zizhan Tang*, **Yao Liu***, Jiexi Liu. *Predictive Modeling in AUV Navigation: A Perspective from Kalman Filtering*. Submitted to **IEEE IV 2026**.
7. **Yao Liu**, Bryan Shaddy, Assad Oberai, Peter Beerel. *Visualization of Wildfire Spread and Smoke Using Unreal Engine*. In preparation.
8. C. Chen†, **Yao Liu†**, J. Yang†, Z. Yang†, Yinyu Ye. *Adaptive Online Pricing for Arrow-Debreu Markets*. In preparation.
9. **Yao Liu**, Dionysis Kalogerias. *Zeroth-Order Adversarial Min-Max Multi-Agent Reinforcement Learning*. In preparation.
10. Xi Jia, X. Zhang, C. Feng, L. Liu, **Yao Liu**, A. Xia, Yue Ma. *Exploring the Associations between Teacher and Student Depression: Evidence from Rural Primary Schools in China*. Under review at the **International Journal of Education**.

TEACHING EXPERIENCE

- Course Producer, EE 202: Linear Circuits, USC** Fall 2023 – Spring 2025
Led lab sections, delivered hands-on guidance, and explained course concepts through office hours & exam review.
- Course Grader, EE 301: Linear Systems; MATH 245: Math of Phys & Eng I, USC** Fall 2024
Graded homework assignments & lab reports.

PROJECT EXPERIENCES

- LMSYS Chatbot Arena Human Preference Predictions** Summer 2024
Kaggle Competition
- Developed a robust reward modeling system to predict human preferences of LLMs (Gemma-2-9b and Llama-3.1-8b) using advanced Parameter-Efficient Fine-Tuning techniques; Designed a weighted ensemble inference engine that aggregated model predictions, significantly reducing log-loss against the competition baseline.
- Predictive Modeling for Safe AUV Navigation** Spring 2024
International Mathematical Contest in Modeling
- Developed a safe navigation pipeline for AUVs by combining multi-buoy TDOA multilateration with Kalman filtering to achieve noise-robust localization and trajectory prediction; formulated scenario-specific uncertainty-propagation models (normal navigation vs. propulsion failure) to generate principled, time-varying search regions for recovery operations.

HONORS and GRANTS

- Discover Scholar Distinction, **USC** Spring 2025
- Gold Medalist, **Kaggle—Chatbot Arena Human Preference Predictions** Summer 2024
- Honorable Mention, **Mathematical Contest in Modeling (COMAP)** Spring 2024
- Ming Hsieh Institute Undergraduate Scholar, **USC (top 5 research scholars in Electrical Engineering)** Spring 2024
- Academic Achievement Award, **USC** Spring 2024 – Spring 2025
- Provost Research Scholarship, **USC** Spring 2024
- W.V.T. Rusch Engineering Honors Degree, **USC** Fall 2023
- Richardson CURVE Award, **USC** 2022 – 2024
- Dean's List, **USC** Spring 2022 – Spring 2025

PROFESSIONAL SKILLS

- Languages:** Python (NumPy, CVXPY, TensorFlow, PyTorch), C/C++, Verilog & HDL, MATLAB, HTML
- Robotics:** OpenCV, OpenAI Gymnasium, Alfred, ROS2 VirtualHome, BEHAVIOR-1K, MPE, MuJoCo, NVIDIA Isaac Sim
- Machine Learning:** Reinforcement Learning, Diffusion Models, Online Learning, SGD, Adaboost, Transformer
- DevOps/Tools:** Git, CVXPY, Unity, Unreal Engine, Simulink, Docker, AWS, Firebase, REST APIs, MySQL