

Yao (Justin) Liu

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EDUCATION BACKGROUND

University of Southern California, Los Angeles, CA

Expected May 2025

B.S. in Electrical Engineering (Honors Degree) | B.S. in Applied and Computational Mathematics | GPA: 3.844/4.0

RELEVANT COURSE TOPICS

Mathematics & Software: Data Structure, Algorithm & OOP, Calculus III, Linear Algebra, Probability Theory, Statistics, IoT, ODE & PDE, Number Theory, Machine Learning, Convex Optimization, Convergence Analysis, Real Analysis(IP), Discrete Math (IP)

Hardware: Electromagnetics, Embedded Systems, Linear Circuit, Analog/Digital Electronics, Signals&Systems, Quantum Mechanics

PUBLICATIONS

- [1]. Yue Hu, Gourav Datta, Kira Beerel, **Yao Liu**, Peter Beerel. "Let's Roll: Synthetic Dataset Analysis for Pedestrian Detection Across Different Shutter Types", IEEE SiPS 2024 (published)
- [2]. Xiyuan Jia, Xinwu Zhang, Cindy Feng, Lucia Liu, **Yao Liu**, Anton Xia, Yue Ma "Exploring the Associations between Teacher and Student Depression: Evidence from Rural Primary School Students in China", the International Journal of Education (under review)

WORKING MANUSCRIPTS

- [1]. Caihua Chen, **Yao Liu**, Zhan Yang, Jiawen Yang, Yinyu Ye (alphabetical order) "Online Pricing for Arrow-Debreu Market"
- [2]. Xuan Zhou, **Yao Liu**, Peter Beerel "An Efficient Distributed Inference Framework For IoT Systems with Byzantine Fault Detection"

RESEARCH EXPERIENCE

Arrow-Debreu Equilibrium: Adaptive Online Stochastic Optimization

May 2024 - Present

Research Assistant | Advisor: Prof. Yinyu Ye

Stanford University

- Co-developed an adaptive online optimization algorithm via Sampled Average Approximation (SAA) and Certainty Equivalent (CE) to determine optimal prices & allocations in a setting without complete knowledge about agents' parameters
- Established regret $O(\log(n))$ & constraint violation $O(1)$ through the online adaptive Certainty Equivalent and Sampled Average Approximation algorithm, outperforming the static pricing model benchmarked against the offline oracle
- Achieved decision variable convergence via SAA to the offline optimal solution; implemented a decoupling method to balance the SAA parameters and the CE learned dual prices for faster convergence and robust decision-making

Energy Efficient Secure Sustainable Computing Group

Aug. 2023 - Present

Research Assistant | Advisor: Prof. Peter Beerel

University of Southern California

- **Distributed Inference & Malicious Device Detection**
 - Proposed and developed a dynamic pseudo-random number generator (PRNG) with a tunable period to mitigate the risk of unsuccessful detection by preventing attackers from exploiting PRNG periodicity
 - Validated the detection probability for stochastic attacks on single and multiple devices with minimal computational overhead, achieving 99% confidence levels through optimized dynamic redundancy allocation
 - Substantiated the number of inferences for detection converges to an upper bound with low redundancy overhead, establishing negligible performance gaps between independent and centralized RNG methods across varying redundancy ratios
- **Correction-Free Optimization for Object Detection via Synthetic and Real Data**
 - Developed an algorithm to create Rolling Shutter (RS) effects by amalgamating successive rows from sequences of high frame rate Global Shutter (GS) images, which were generated using Unreal Engine 5
 - Trained object detection models (YOLOv8 & DETR) on paired (RS & GS) synthetic datasets to improve detection, classification & localization; Fine-tuned on paired real datasets via Cross-Entropy & Smooth L1 Loss to bridge domain gap
 - Validated the proposed pipeline on the corresponding real-world datasets, demonstrating substantial improvements in precision (13.1%), recall (53.1%), and mean Average Precision (30.3%)

Design Automation of Intelligent Systems Lab

July 2024 - Present

Research Assistant | Advisor: Prof. Qi Zhu

Northwestern University

- Investigated Markov Decision Processes with augmented state spaces to handle time delays, analyzing their impact on maintaining the Markovian property and improving reinforcement learning efficiency in delayed environments
- Conducted offline RL research for Imitation Learning to train RL models on offline datasets and fine-tuning with online dataset.
- Implemented and tested offline RL algorithms via D3RLPy, which facilitates offline learning and imitation learning tasks

PROFESSIONAL EXPERIENCE

University of Southern California

Los Angeles, CA

- **EE 301:** Linear System, Grader
- **EE202:** Linear Circuits, Course Producer
- **MATH 245:** Mathematics of Physics and Engineering I, Grader

Fall 2024

Fall 2023 - Spring 2024

Fall 2023 - Spring 2024

- Implemented a spatial-adaptive CNN architecture to improve imaging quality by effectively mitigating optical aberrations through precise removal of Point Spread Functions (PSFs)
- Simulated a raytracing and superposition algorithm to create PSF-convoluted images, simulating real-world optical aberrations
- Enhanced a spatial-adaptive CNN by using PSF-convoluted synthetic data, improving correction of spatially variant blur and chromatic dispersion; achieved a 1.7% improvement in restoration over state-of-the-art methods

PROJECT EXPERIENCES

LMSYS - Chatbot Arena Human Preference Prediction – Kaggle Competition Aug. 2024

- Implemented Quantized Low-Rank Adaptation (QLoRA) for efficient fine-tuning LLMs (Gemma-2-9b and Llama-3.1-8b)
- Applied gradient-based optimization techniques (AdamW, gradient accumulation) with hyperparameter tuning (learning rate, warm-up steps, dropout regularization) to minimize log loss, ensuring accurate prediction probability calibration during training
- Developed ensemble methods by mathematically combining model predictions from fine-tuned models, weighting them based on validation scores and achieving improved performance in human preference prediction

Model-Based Submersible Navigation – International Mathematical Contest in Modeling Feb. 2024

- Led a team of three to design and implement Time Difference of Arrival (TDOA) and Kalman Filtering Algorithms to compute the precise location of the submarine and predict its future during communication loss
- Implemented the Kalman Filtering model to optimize trajectory predictions, reduce noise impact, and improve localization accuracy
- Developed a probabilistic search model for offline submersibles, employing Maximum Likelihood Estimation (MLE) to define initial search areas and patterns based on Kalman-filtered predictions

Automated Grocery Management: A Perspective On Sustainability Jan. - May 2024

- Led a 3-member team to design and implement an embedded fridge management system, featuring local and remote IOS APP UI to record expiration dates, storage locations, and fridge temperature
- Established communication protocols such as SPI, UART, I2C, and the parallel communication between devices such as temperature sensor, keypad, and barcode scanner with Atmega328p microcontroller
- Developed an application for real-time synchronization of grocery items using Firebase, featuring: 1) real-time item updates transmitted via Raspberry Pi; and 2) local fridge temperature monitoring

LEADERSHIP & INVOLVEMENT

USC Inspire Creativity Initiative 501(c)(3) Feb. 2022 - Present

Founder & President

Los Angeles, CA

- Founded Inspire Creativity Initiative at USC, documented STEM curricula, and taught 30+ lessons to inspire STEM creativity
- Hosted annual mathematics competitions with the USC Math Club for high school students and organized speaker workshops

Stanford FSI—Rural Education Action Program June 2020 - May 2023

Student Researcher(remote) | Advisor: Mr. Yue Ma

Palo Alto, CA

- Created a WeChat Mini Program to promote TaoLi Online (an online learning system developed by REAP) in China's rural areas
- Investigated the relationship between teachers' and students' mental health from cross-section sampling (105 rural schools, 8299 students in 311 classes) of the Patient Health Questionnaire
- Assisted in performing multivariate regression analysis and conditional correlation analysis to infer the impact of teacher depression on student subgroups, wrote the method section of the paper (currently under review by the International Journal of Education)

AWARDS AND HONORS

Gold Medalist, Kaggle--Chatbot Arena Human Preference Predictions Aug. 2024

Honorable Mention, Mathematical Contest in Modeling, COMAP May 2024

Ming Hsieh Institute Undergraduate Scholar (Awarded to the top 5 Research Scholars in Electrical Engineering) May 2024

Academic Achievement Award, USC Jan. 2024 - Present

Provost Research Scholarship, USC Jan. 2024

W.V.T. Rusch Engineering Honors Degree, USC Nov. 2023

Richardson CURVE Award, USC 2022 – 2024

Dean's List, USC Jan. 2022 – Present

Life Membership, California Scholarship Federation May 2021

SKILLS

Programming Languages: Python(Numpy, Cvxpy, TensorFlow, PyTorch), Julia, MATLAB, SQL, R, Verilog & HDL, C/C++

Techniques: ML, CV, time & space complexity analysis, data cleaning, web scraping, regression models, network/graph analysis

ML: Random Forest, Stochastic Gradient Descent, Adaboost, Logistic Regression, LightGBM, Transformer(GPT, BERT), GAN