# 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: 3.819/4.0

## RELEVANT COURSE TOPICS

**Mathematics & Software:** Data Structure, Algorithm & OOP, Calculus I&II&III, Linear Algebra, Probability Theory, Statistics, IoT, ODE&PDE, Complex Analysis, Number Theory, Convex Learning, PAC Learning, Convergence Analysis

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

## 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 (accepted)

[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"*, 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 (remote) | Advisor: Prof. Yinyu Ye* *Stanford University*

- Co-developed and simulated an adaptive online optimization algorithm using Sampled Average Approximation (SAA) for revealed parameters and Certainty Equivalent (CE) settings to determine optimal prices and allocations for achieving market equilibrium
- Achieved regret $O(log(n))$ and constraint violation $O(1)$ using the online adaptive Certainty Equivalent algorithm and Sample Averaged Approximation, outperforming the static pricing model benchmarked against the offline oracle
- Achieved convergence in a revealed parameter setting via Sampled Average Approximation (SAA), 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 optimized detection probability for stochastic attacks on single and multiple devices that guarantees 99% confidence intervals with minimal redundant overhead
  - Substantiated the number of inferences required for detection converges to an upper bound with low redundancy overhead, showing the gap between independent and centralized RNG methods remains minimal across varying redundancy ratios
- **Optimized Computing for Training Object Detection Models**
  - 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
  - Assisted in training and object detection models (YOLOv8 & DETR): enhanced pedestrian detection accuracy by utilizing real and synthetic, achieving comparable performance under RS and GS conditions without requiring RS correction
  - 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(remote) | Advisor: Prof. Qi Zhu* *Northwestern University*

- Explored 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
- Investigated frameworks for enforcing safety in reinforcement learning using bi-level optimization, incorporating soft barriers, and optimizing policies based on inferred reward functions

## PROFESSIONAL EXPERIENCE

**University of Southern California** *Los Angeles, CA*

- **EE 301:** Linear System, *Grader* *Fall 2024*
- **MATH 245:** Mathematics of Physics and Engineering I, *Grader* *Fall 2023-Spring 2024*
- **EE202:** Linear Circuits, *Course Producer* *Fall 2023-Spring 2024*

**Tsinghua University & MetaCam Tech** *May 2023 - Aug. 2023*
*Software Intern | Advisor: Prof. Hongwei Chen & Dr. Chengyang Hu* *Beijing, China*
- Assisted in implementing a spatial-adaptive CNN architecture that significantly improved imaging quality by effectively mitigating optical aberrations through the 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*
- Fine-tuned the *Gemma-2 9b* and *Llama-3.1-8B* LLMs via QLoRA (Quantized Low-Rank Adaptation), to significantly reduce memory footprint and accelerate training processes
- Adjusted hyperparameters such as learning rate, sequence length, dropout rates, and layer freezing to optimize model performance and computational efficiency across different training and inference scenarios
- Conducted comprehensive model evaluations by logistic loss to assess accuracy and probability calibration to ensure predictions alignment with user preferences and optimized chatbot-human interaction quality

**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

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| **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 5 top 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:** C/C++, Python, MATLAB, MySQL, Verilog&HDL, Assembly
**Software/Hardware:** TensorFlow, CVXpy, Pytorch, Arduino, FPGA, Timing-Design, Altium Designer, SolidWorks, AutoCAD