

Simon Yu

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Education

Doctor of Philosophy in Electrical and Computer Engineering - University of Illinois Urbana-Champaign, GPA: 3.97 / 4.00 - Advisor: Professor Lui Raymond Sha	May 2026
Master of Science in Electrical and Computer Engineering - University of Illinois Urbana-Champaign, GPA: 3.97 / 4.00 - Advisor: Professor Lui Raymond Sha	May 2025
Bachelor of Science with Honors in Computer Engineering - University of Illinois Urbana-Champaign, GPA: 3.72 / 4.00 - Advisor: Professor Dr. Marco Caccamo - Minor: Computational Science and Engineering	May 2019

Research Interests

- **Cyber-Physical and Embedded Systems:** Robust and safe hardware-software platform for safety-critical tasks
- **Interpretable Machine Learning:** Neuro-symbolic model integrating deep learning with probabilistic circuits
- **Autonomous Driving:** Verifiable perception with LiDAR clustering enabling safety, redundancy, and efficiency
- **Unmanned Aerial Vehicles (UAVs):** Autopilot, maneuver automation, and geofencing with realistic constraints

Research Projects

NASA University Leadership Initiative (ULI): Robust Platform for Urban Air Mobility - Redesigned Biped platform to support both two-wheel ground chassis and Quanser helicopter aerial chassis - Integrated high-performance layer with Neural Probabilistic Circuit for interpretable learning and reasoning - Implemented high-assurance layer with geofencing mechanisms for mission safety and operational assurance - Demonstrated Biped prototype controlling Quanser at NASA ULI on-site review, with results published [2, 3]	May 2024 - May 2026
Neural Probabilistic Circuit (NPC) for Robust and Interpretable Perception - Developed end-to-end pipeline in PyTorch with attribute recognition, probabilistic circuit (PC), and joint training - Built custom PC codebase in PyTorch with LearnSPN Java integration for GPU inference and parameter learning - Created PyQt dataset labeling tool for attribute annotation and visualization tool for model interpretability - Trained and tested 200+ models across multiple datasets and ablation studies, with results published [1, 3, 5, 6]	Nov 2022 - Jul 2026
Biped Embedded Hardware-Software Platform for Robotics and Autonomy - Co-designed in KiCad and assembled self-balancing robotic hardware with ESP32, sensor suite, and custom PCB - Developed real-time firmware in C++/FreeRTOS with drivers, sensing/actuation, controllers, and planners - Created Qt desktop ground station software for telemetry, controller tuning, commands, and camera streaming - Assembled and deployed 15+ Bipeds in CS 431, supporting 40+ students in labs, with results published [2, 3]	Dec 2021 - Jun 2026
LiDAR Clustering for Robust and Verifiable Perception - Developed modular C/C++ API extending Depth Clustering for modern datasets (Waymo) and Apollo/CyberRT - Created Qt visualizer with parameter and camera frame/projection widgets for experiments and dataset analysis - Supported hardware deployment on ARM/Jetson platforms via cross-compilation for real-time experiments - Contributed to multiple publications on safe and redundant perception with framework as backbone [8 – 14]	Aug 2019 - May 2024
Unmanned Aerial Vehicle (UAV) Geofencing Trajectory Estimation Derived analytical trajectory model for estimating geofencing trajectories under realistic constraints	Jun 2018 - Jan 2020

- Developed geofencing algorithms for enforcing predefined geofence and performing evasive maneuvers
- Implemented framework in uavAP autopilot in C/C++ and validated through X-Plane and real-world flights
- Published results showing superior estimation and geofencing performance over existing models [3, 7, 16, 20]

Unmanned Aerial Vehicle (UAV) Flight Maneuver Automation

Jun 2018 - Jun 2019

- Designed and implemented in C/C++ maneuver planner for control overrides and flight maneuver automation
- Built flight analysis modules for automated maneuver logging, PID metrics analysis, and aircraft trim analysis
- Developed Qt user interface components for configuring, monitoring, and analyzing automated flight maneuvers
- Published results validating framework in X-Plane flight simulator and real-world flight tests [15, 18, 19]

Unmanned Aerial Vehicle (UAV) Autopilot and Emulation Environment

Jun 2017 - Jun 2020

- Designed, implemented, and tuned cascaded PID controllers within uavAP autopilot framework in C/C++
- Developed maneuver planner and flight analysis autopilot modules for flight automation and data collection
- Built Qt ground station widgets in uavEE emulation environment with ROS for mission control and analysis
- Co-authored peer-reviewed publication presenting formalized design and evaluation of uavAP framework [15]

Autonomous Helicopter Autopilot

Oct 2016 - Dec 2017

- Designed servomotor mapping and channel mixing interface for actuating helicopter swashplate
- Implemented and tuned cascaded PID controllers for controlling aircraft position, velocity, and attitude
- Integrated existing path-planning and path-following frameworks for trajectory and 3D waypoint tracking
- Developed in C/C++ and integrated with high-fidelity flight simulator via serial communication

Publications

[1] Neural Probabilistic Circuits: Enabling Compositional and Interpretable Predictions through Logical Reasoning Jul 2026

Simon Yu*, Weixin Chen*, Huajie Shao, Lui Sha, Han Zhao

Springer Nature Machine Learning Journal (MLJ)

doi.org/10.48550/arXiv.2501.07021

**Co-first authors with equal contributions*

[2] Biped: A Unified Embedded Hardware-Software Platform for Urban Air Mobility and Autonomous Applications

Jun 2026

Simon Yu, Steven Zhu, Lui Sha, Or D. Dantsker

AIAA Aviation Forum

doi.org/10.2514/6.2026-4493

[3] Safe and Robust Autonomy in Cyber-Physical Systems

May 2026

Simon Yu

Doctoral Dissertation, Illinois Digital Environment for Access to Learning and Scholarship (IDEALS)*

**Approved for deposit*

[4] Weakly-Supervised Disentangled Representation Learning via Filter-Based Adaptive Swapping Jan 2026

Zhenyu Zong, Qidi Wang, **Simon Yu**, Hongpeng Cao, Yanbing Mao, Han Zhao, Lui Sha, Huajie Shao

Transactions on Machine Learning Research (TMLR)

openreview.net/forum?id=K69rKKozZU

[5] VISAT: Benchmarking Adversarial and Distribution Shift Robustness in Traffic Sign Recognition with Visual Attributes

Oct 2025

Simon Yu, Peilin Yu, Hongbo Zheng, Huajie Shao, Han Zhao, Lui Sha

arXiv Preprint

doi.org/10.48550/arXiv.2510.26833

- [6] **Neural Probabilistic Circuits: An Overview** Jun 2025
Simon Yu*, Weixin Chen*, Huajie Shao, Lui Sha, Han Zhao
 Workshop on Tractable Probabilistic Modeling (TPM), Conference on Uncertainty in Artificial Intelligence (UAI)
openreview.net/forum?id=cBoYAtNwrg
**Co-first authors with equal contributions*
- [7] **Geofencing Trajectory Estimation for Small-Scale Fixed-Wing UAVs** May 2025
Simon Yu
 Master's Thesis, Illinois Digital Environment for Access to Learning and Scholarship (IDEALS)
hdl.handle.net/2142/129339
- [8] **Perception Simplex: Verifiable Collision Avoidance in Autonomous Vehicles Amidst Obstacle Detection Faults** May 2024
 Ayoosh Bansal, Hunmin Kim, **Simon Yu**, Bo Li, Naira Hovakimyan, Marco Caccamo, Lui Sha
 Journal of Software Testing, Verification and Reliability (STVR)
doi.org/10.1002/stvr.1879
- [9] **Taming Algorithmic Priority Inversion in Mission-Critical Perception Pipelines** Jan 2024
 Shengzhong Liu, Shuochao Yao, Xinzhe Fu, Rohan Tabish, **Simon Yu**, Ayoosh Bansal, Heechul Yun, Lui Sha, Tarek Abdelzaher
 Communications of the ACM
doi.org/10.1145/3610801
- [10] **Verifiable Obstacle Detection** Dec 2022
 Ayoosh Bansal, Hunmin Kim, **Simon Yu**, Bo Li, Naira Hovakimyan, Marco Caccamo, Lui Sha
 IEEE International Symposium on Software Reliability Engineering (ISSRE)
doi.org/10.1109/ISSRE55969.2022.00017
- [11] **Synergistic Redundancy: Towards Verifiable Safety for Autonomous Vehicles** Sep 2022
 Ayoosh Bansal, **Simon Yu**, Hunmin Kim, Bo Li, Naira Hovakimyan, Marco Caccamo, Lui Sha
 arXiv Preprint
arxiv.org/abs/2209.01710v1
- [12] **LiDAR Cluster First and Camera Inference Later: A New Perspective Towards Autonomous Driving** Nov 2021
 Jiyang Chen, **Simon Yu**, Rohan Tabish, Ayoosh Bansal, Shengzhong Liu, Tarek Abdelzaher, Lui Sha
 arXiv Preprint
doi.org/10.48550/arXiv.2111.09799
- [13] **Real-Time Task Scheduling for Machine Perception in Intelligent Cyber-Physical Systems** Aug 2021
 Shengzhong Liu, Shuochao Yao, Xinzhe Fu, Huajie Shao, Rohan Tabish, **Simon Yu**, Ayoosh Bansal, Heechul Yun, Lui Sha, Tarek Abdelzaher
 IEEE Transactions on Computers
doi.org/10.1109/TC.2021.3106496
- [14] **On Removing Algorithmic Priority Inversion from Mission-Critical Machine Inference Pipelines*** Feb 2021
 Shengzhong Liu, Shuochao Yao, Xinzhe Fu, Rohan Tabish, **Simon Yu**, Ayoosh Bansal, Heechul Yun, Lui Sha, Tarek Abdelzaher
 IEEE Real-Time Systems Symposium (RTSS)
doi.org/10.1109/RTSS49844.2020.00037
**Recipient of the Outstanding Paper Awards by the RTSS 2020 Program Committee*

- [15] **uavAP: A Modular Autopilot Framework for UAVs** Jun 2020
 Mirco Theile, Or D. Dantsker, Richard Nai, Marco Caccamo, *Simon Yu*
 AIAA Aviation Forum
doi.org/10.2514/6.2020-3268
- [16] **Trajectory Estimation for Geo-Fencing Applications on Small-Size Fixed-Wing UAVs** Jan 2020
*Simon Yu**, Mirco Theile*, Or D. Dantsker, Marco Caccamo
 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
doi.org/10.1109/IROS40897.2019.8967579
**Co-first authors with equal contributions*
- [17] **Continued Development and Flight Testing of a Long-Endurance Solar-Powered Unmanned Aircraft: UIUC-TUM Solar Flyer** Jan 2020
 Or D. Dantsker, Mirco Theile, Marco Caccamo, *Simon Yu*, Moiz Vahora, Renato Mancuso
 AIAA Science and Technology (SciTech) Forum
doi.org/10.2514/6.2020-0781
- [18] **Flight Maneuver Automation for System Analysis of Small Fixed-Wing UAVs** Jun 2019
Simon Yu
 Undergraduate Senior Thesis, Illinois Digital Environment for Access to Learning and Scholarship (IDEALS)
hdl.handle.net/2142/104050
- [19] **Flight Testing Automation to Parameterize Unmanned Aircraft Dynamics** Jun 2019
 Or D. Dantsker, *Simon Yu*, Moiz Vahora, Marco Caccamo
 AIAA Aviation Forum
doi.org/10.2514/6.2019-3230
- [20] **Kinematic Model for Fixed-Wing Aircraft with Constrained Roll-Rate** Sep 2018
 Mirco Theile, *Simon Yu*
 Illinois Digital Environment for Access to Learning and Scholarship (IDEALS)
hdl.handle.net/2142/101442

Presentations and Talks

- Biped: A Unified Embedded Hardware-Software Platform for Urban Air Mobility and Autonomous Applications** Jun 2026
Simon Yu, Steven Zhu, Lui Sha, Or D. Dantsker
 AIAA Aviation Forum, San Diego, California, United States
- Safe and Robust Autonomy in Cyber-Physical Systems** Mar 2026
Simon Yu
 Doctoral Defense, Urbana, Illinois, United States
- Certiably Safe and Robust Perception for Urban Air Mobility** May 2025
 Ayoosh Bansal, Mikael Yeghiazaryan, *Simon Yu*, Jiawei Zhang
 NASA ULI On-Site Demonstration, Reno, Nevada, United States
- Robust, Interpretable, and Safe Machine Learning Perception with Neural Probabilistic Circuit** Mar 2025
Simon Yu, Weixin Chen, Huajie Shao, Lui Sha, Han Zhao
 UIUC-TUM Workshop on Cyber-Physical Systems, Urbana, Illinois, United States
- Thrust 1 Demo Update: AVIATE Demo Plan** Feb 2025
 Lui Sha, Mikael Yeghiazaryan, *Simon Yu*, Ayoosh Bansal
 NASA ULI AVIATE Seminar, Urbana, Illinois, United States

Certiably Safe and Robust Perception for Learning-Enabled Autonomy Ayoosh Bansal, <i>Simon Yu</i> , Lui Sha NASA ULI Annual Review 2024, Urbana, Illinois, United States	Oct 2024
Certiably Safe and Robust Perception for Learning-Enabled Autonomy Ayoosh Bansal, <i>Simon Yu</i> , Lui Sha NASA ULI Annual Review 2023, Urbana, Illinois, United States	Nov 2023
VISAT: Using Visual Attributes to Benchmark Image Recognition Robustness under Adversarial Attack and Distribution Shift <i>Simon Yu</i> , Peilin Yu, Hongbo Zheng, Huajie Shao, Han Zhao, Lui Sha NASA ULI AVIATE Seminar, Urbana, Illinois, United States	Jun 2023
Trajectory Estimation for Geo-Fencing Applications on Small-Size Fixed-Wing UAVs Mirco Theile, <i>Simon Yu</i> , Or D. Dantsker, Marco Caccamo IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Cotai, Macao, China	Oct 2019
uavEE: A Modular, Power-Aware Emulation Environment for Rapid Prototyping and Testing of UAVs Mirco Theile, Or D. Dantsker, Richard Nai, Marco Caccamo, <i>Simon Yu</i> Autonomous and Cyber-Physical Systems Seminar, Urbana, Illinois, United States	Sep 2019
Flight Testing Automation to Parameterize Unmanned Aircraft Dynamics Or D. Dantsker, <i>Simon Yu</i> , Moiz Vahora, Marco Caccamo Autonomous and Cyber-Physical Systems Seminar, Urbana, Illinois, United States	Sep 2019
Trajectory Estimation for Geo-Fencing Applications on Small-Size Fixed-Wing UAVs Mirco Theile, <i>Simon Yu</i> , Or D. Dantsker, Marco Caccamo Autonomous and Cyber-Physical Systems Seminar, Urbana, Illinois, United States	Sep 2019
Flight Maneuver Automation for System Analysis of Small Fixed-Wing UAVs <i>Simon Yu</i> ECE Undergraduate Research Symposium, Urbana, Illinois, United States	May 2019

Honors and Awards

Full Member, Sigma Xi, The Scientific Research Honor Society • Nominated by members in recognition of at least two primary-author articles published in refereed venues	Feb 2026
Outstanding Paper Awards, IEEE Real-Time Systems Symposium (RTSS) • Awarded to papers by the RTSS 2020 Program Committee for their high-quality research contributions [14]	Dec 2020
Indira Gunda Saladi Engineering Research Scholarship • Awarded yearly to one student involved in research projects with independent thinking	Oct 2018
Member, Institute of Electrical and Electronics Engineers (IEEE) • Affiliated as active member of the largest organization for advancements in electrical and computer engineering	Sep 2018
Member, IEEE Eta Kappa Nu, Illinois Alpha Chapter • Initiated students in the top third of their class by GPA who complete ten hours of community service	Apr 2018
Member, Tau Beta Pi, Illinois Alpha Chapter • Initiated students in the top fifth of their class by hours who complete social, professional, and service events	Apr 2018
Dean's List of Academic Excellence, The Grainger College of Engineering • Awarded to students with a top 20 percent GPA within their college	Mar 2018
Bruce C. Mather Memorial Scholarship • Awarded to students dedicated to completing rigorous work towards earning an engineering degree	Sep 2017

Illinois Engineering Achievement Scholarship

Apr 2017

- Awarded to students with a 3.0 GPA and above, and with great performance in school work

James Scholar, The Grainger College of Engineering

Jan 2017

- Awarded to students with a 3.5 GPA and above, who participated in honor projects and activities

Personal Projects

Chameleon: Versatile Website Framework and Gallery Manager

Aug 2023 - Nov 2024

- Created modular HTML/CSS/JavaScript framework hosting 3+ sites with configurable and reusable components
- Implemented core components including galleries, picture viewer, and page viewer for content embedding
- Integrated services including LLMs, x86 and Python emulations, Git server, and remote management consoles
- Developed cross-platform gallery manager in Qt for large-scale edits with HTTP/SSH-based synchronization

Termlink: Fallout Terminal and Tandy Radio Shack TRS-80 Microcomputers

Jul 2024 - Oct 2024

- Recreated Fallout in-game terminal in C/C++/ncurses, reproducing password-hacking gameplay and mechanics
- Extended program into general file explorer with text viewer, hex dump, and in-game entries from JSON files
- Built audio engine for game sounds and serial interface for streaming program UI to physical TRS-80 computer
- Debugged TRS-80 hard drive controller fault in error amplifier and compiled C programs on restored system

config-utils: Cross-Platform Configuration Synchronization Utility

Aug 2022 - Oct 2024

- Implemented entirely in Bash for managing and syncing system configuration files across UNIX-based systems
- Supported targeted configuration files configurable based on OS/host/user using Git and rsync as backends
- Developed subcommands for status checks, push/pull, upgrade, and direct CLI editing of meta configuration
- Reduced setup time for new machines from hours to minutes, ensuring consistent system environments at scale

Entrepreneurship

Co-Founder, Multipled LLC

May 2023 - Present

- Founded startup to commercialize and extend existing Biped design into general, modular embedded platform
- Developed next-gen prototype with advanced sensor and power systems with 3D-printed chassis in FreeCAD
- Showcased new prototype controlling Quanser helicopter chassis live in 2025 NASA ULI on-site demo event
- Authored documentation and conference publications detailing system design and experimental results [2, 3]

Teaching and Research

Graduate Teaching Assistant, ECE 110 Introduction to Electronics

Jan 2026 - May 2026

- Conducted weekly electronics lab sessions, supervising equipment, experiments, and team-based activities
- Delivered lab instructions, guided hands-on activities, and assisted in debugging problematic student circuits
- Answered student questions on lab assignments and homework, clarifying theory and practical applications
- Graded lab reports and final projects, providing feedback to students on proposal, implementation, and results

Graduate Teaching Assistant, CS 431 Embedded Systems

Jan 2024 - May 2024

- Rewrote and modernized lab curriculum with Biped platform, authoring instructions and 9 new lab assignments
- Designed progressive lab modules from low-level hardware drivers to high-level controllers and planners
- Updated lecture slides, created new homework and exams, and supervised grading by undergraduate assistants
- Taught lab sessions by giving instructions, answering questions, assisting with debugging, and grading demos

Graduate Research Assistant, Cyber-Physical Systems Integration Lab (CPSIL)

Aug 2019 - May 2026

- Conducted research on safe autonomous systems, focusing on embedded platforms and robust perception
- Designed hardware-software prototypes, performed large-scale experiments in simulated and real-world settings
- Authored and reviewed conference and journal publications, contributed to presentations and grant proposals
- Developed, documented, and released open-source codebases for published research prototypes and experiments

Undergraduate Teaching Assistant, ECE 110 Introduction to Electronics Aug 2016 - Dec 2016

- Assisted graduate teaching assistants in running lab sessions and ensuring smooth execution of experiments
- Delivered lab instructions, guided hands-on activities, and assisted in debugging problematic student circuits
- Answered student questions on lab assignments and homework, clarifying theory and practical applications
- Supported grading of lab reports and provided feedback to help students improve their lab tasks and projects

Undergraduate Teaching Assistant, CS 101 Introduction to Computing Feb 2016 - May 2016

- Assisted graduate teaching assistants in managing weekly lab sessions and supporting instruction
- Guided students through programming assignments in Python, reinforcing lab objectives and goals
- Addressed student questions on coding, debugging, and homework during labs and office hours
- Supported grading of assignments and provided constructive feedback to improve coding practices

Student Mentoring

Alex Tanthiptham, Undergraduate Research Assistant Sep 2023 - May 2024

- Supervised Alex's contributions to Biped hardware, including part replacement and design of a new IMU module
- Managed Alex's involvement in ML research, including labeling, training, literature review, and paper revisions

Rahim Masood Khan, Undergraduate Research Assistant Aug 2023 - May 2024

- Supervised Rahim's work on ML research, including implementation and integration of probabilistic circuits
- Advised Rahim in evaluating joint neural probabilistic circuit models and reviewing counterfactual explanations

Tommy Tang, Undergraduate Research Assistant Aug 2023 - May 2024

- Supervised Tommy's contributions to ML research, including labeling, model tuning, and probabilistic circuits
- Guided Tommy in creating experiments for testing model robustness and performance under adversarial attacks

Trusha Vernekar, Project Coordinator and Undergraduate Research Assistant Jul 2023 - May 2024

- Supervised Trusha as project coordinator, assisting and reporting progress of 2+ undergraduate research groups
- Managed Trusha's contributions to Biped hardware, synthetic traffic-sign dataset, labeling, and model training

Lucas Zhou, Undergraduate Research Assistant and CS 431 Course Grader Jul 2023 - May 2024

- Supervised Lucas' work on model training/testing and creating synthetic traffic-sign datasets in Unreal Engine
- Managed Lucas' role as CS 431 course grader in grading homework/exam and assisting with student inquiries

Steven Zhu, System Designer and CS 431 Graduate Teaching Assistant Dec 2021 - May 2023

- Supervised Steven's involvement in developing Biped, including KiCad design, prototyping, and assembly
- Advised Steven's graduate teaching assistantship for CS 431 in deploying and teaching new Biped-based labs

Conference Reviews

Reviewer in 2024 Neural Information Processing Systems (NeurIPS) May 2024

- Nominated by NeurIPS 2024 Program Chair Committee
- Peer-reviewed 5 paper submissions in Datasets and Benchmarks Track with rebuttal discussions

Reviewer in 2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) Mar 2019

- Requested by IROS 2019 Associate Editor
- Peer-reviewed 1 paper submission in Aerial Robot Track

Service and Leadership

Lab Designer and Maintainer, CS 431 Embedded Systems Jan 2022 - May 2026

- Designed and adopted Biped platform as new lab curriculum, replacing old ball-balancing and Arduino systems
- Supervised hardware assembly, testing, and ongoing maintenance of 15+ Bipeds used across multiple semesters
- Trained incoming graduate teaching assistants and coordinated with university IT to maintain lab workstations
- Ensured continuity and upkeep of lab infrastructure after transitioning out of active teaching assistant role

Lab Administrator, Cyber-Physical Systems Integration Lab (CPSIL)

Aug 2019 - May 2026

- Organized and maintained lab space, establishing clean, functional work areas for research groups
- Configured, upgraded, and managed lab machines and GPU clusters, including access control and scheduling
- Directed day-to-day operations to ensure reliable lab infrastructure for ongoing research projects and tasks
- Recruited, interviewed, and mentored undergraduate students, forming and managing multiple research teams

Site Manager, University Residential Technology Services

Aug 2016 - May 2017

- Provided on-site technical support and troubleshooting for residents in university residence halls
- Maintained daily operations of residential computer labs, ensuring availability and reliability of resources
- Monitored and serviced printers, computers, and other equipment in computer labs to minimize downtime
- Supervised and coordinated with student staff on lab maintenance and basic technical support tasks

Skills

Programming Languages: C/C++ , Python, Bash, LaTeX, Java, MATLAB, JavaScript, HTML, CSS**Development Frameworks:** Git, CMake, Qt, FreeRTOS, PyTorch, KiCad, FreeCAD, Apollo/CyberRT, ROS**Hardware Platforms:** ESP32, Arduino, Raspberry Pi, NVIDIA Jetson TX1/TX2/Xavier/Orin