

# Kai Yun

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## RESEARCH INTEREST

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My research is focused on **safe and high-performance control** of autonomous robots in the wild.  
My methodology encompasses **control theory**, **deep learning**, and their **intersection**.  
My vision is to develop a **unified framework** for highly reactive robot controllers in complex, dynamic environments.

## EDUCATION

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**Carnegie Mellon University**, Pittsburgh, PA Class of 2025 (Expected)  
Master of Science in **Mechanical Engineering - Research** 4.00/4.00  
Advisors: Dr. Changliu Liu (Robotics Institute), Dr. John M. Dolan (Robotics Institute)  
Studies Funded by Google Project (Full Tuition Support) Nov 2024 — May 2025

**University of California, Berkeley**, Berkeley, CA Class of 2023  
Bachelor of Science in **Mechanical Engineering** 3.68/4.00  
Minor in **Electrical Engineering and Computer Science (EECS)**  
Military Service (Leave of Absence) 2019 — 2020

## PUBLICATIONS & PREPRINTS

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\* Equal Contribution

- [1] Yifan Sun, Rui Chen, **Kai S. Yun**, Yikuan Fang, Sebin Jung, Weiye Zhao, Changliu Liu, “SPARK: A Toolbox for Safe Humanoid Autonomy and Teleoperation”. [Website](#).
- [2] **Kai S. Yun**, Rui Chen, Chase Dunaway, John M. Dolan, Changliu Liu, “Safe Control of Quadruped in Varying Dynamics via Safety Index Adaptation”. Submitted to 2025 IEEE International Conference on Robotics and Automation (ICRA), [arxiv.org:2409.09882](https://arxiv.org/abs/2409.09882), 2024, [Video](#).
- [3] Simin Liu\*, **Kai S. Yun\***, John M. Dolan, Changliu Liu, “Synthesis and Verification of Robust-Adaptive Safe Controllers”. Published in [European Control Conference \(ECC\)](#), 2024, **Oral Presentation** in Stockholm, Sweden.
- [4] Tianhao Wei, Luca Marzari\*, **Kai S. Yun\***, Hanjiang Hu\*, Peizhi Niu\*, Xusheng Luo, Changliu Liu, “ModelVerification.jl: a Comprehensive Toolbox for Formally Verifying Deep Neural Networks”. [arxiv.org:2407.01639](https://arxiv.org/abs/2407.01639), 2024, [GitHub](#).

## SKILLS

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- **Area of expertise:** Humanoids, Quadrupeds, Quadrotors, Safety Index, Control Barrier Function, Control Lyapunov Function, Adversarial Training, Model Learning, Safe Reinforcement Learning, Model-based Reinforcement Learning, Optimal Control, Hybrid Control, Adaptive Control, Robust Control, System Identification, Polynomial Optimization.
- **Physical Robots/Machines:** Unitree G1, Unitree Go2, Pixhawk Drones, CrazyFlie, Sawyer, F1Tenth, Tanks.
- **Libraries:** PyTorch, TensorFlow, Isaac Sim, Gazebo, OpenAI Gym, PyBullet, Mosek, CasADi, PX4, Ray, Numpy.
- **Programming/OS/Tools:** Python, MATLAB, Julia, C++, ROS, ROS2, Linux, Git, Docker.
- **Other skills:** Jetson, OptiTrack, Vicon, OpenSim, SolidWorks, L<sup>A</sup>T<sub>E</sub>X, Simulink, CAN Bus, MoTeC, Scuba Diving.
- **Languages:** Fluent in English, Korean.

## RESEARCH EXPERIENCE

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**Intelligent Control Lab** (Robotics Institute at CMU) Pittsburgh, PA  
Advisors: Dr. Changliu Liu, Dr. John M. Dolan Jun 2023 — Present

- Research on safe humanoid autonomy and [teleoperation](#) on Unitree G1 platform [1].
- Research on learning-based safe rapid navigation of quadrotors in forests using vision inputs [ongoing].
- Research on adaptive safe controller for quadrupeds in varying dynamics (Unitree Go2) [2].
  - Safety Index Adaptation deployment on a package-carrying quadruped for obstacle avoidance.
- Research on algorithm development for synthesizing safe controllers for robotic systems. [3]
  - Devised an optimization algorithm that generates robust-adaptive control barrier functions given uncertain systems.
- Developed [ModelVerification.jl](#), a Julia library containing state-of-the-art neural network verification algorithms. [4]
- Research on developing and deploying a neural control barrier function for [quadrotor-pendulum hardware](#).
- Additional Roles: Lab Manager, Lab Safety Coordinator, Robot Manager (Unitree G1, Go2)

**Hybrid Robotics Lab** (Mechanical Engineering at UC Berkeley)

Berkeley, CA

Advisor: Dr. Koushil Sreenath

Aug 2021 — Apr 2022

- Research on safe reinforcement learning for worst-case scenarios. [\[Report\]](#)
  - Devised a safe RL algorithm called *PPO-Worst-Case*, to ensure safety constraints are met in the worst-case scenarios.
  - Reformulated the constrained Markov Decision Process to work with worst-case observations.

**PROFESSIONAL EXPERIENCE**

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**Tesla, Inc.**

Palo Alto, CA

Vehicle Dynamics / Software Engineering Intern

May 2022 — Aug 2022

- Developed a correlation framework for comparing subjective vehicle evaluation and objective test data.
- Analyzed vehicle dynamics data to improve the ride, handling, and steering experiences of Models S, 3, and Semitruck.
- Tested Tesla vehicles and competitor vehicles with sensors and robots. Conducted vehicle tests on proving grounds.
- Developed automated ticketing, reporting, and logging systems utilizing internal software and corresponding API.

**NeuroCore.ai**

Seoul, South Korea

Reinforcement Learning Engineering Intern

Oct 2020 — Jul 2021

- Designed and developed RL training and deployment frameworks, which increased training efficiency by 84%.
- Developed simulators for Supply Chain Management (SCM) tasks for semiconductor manufacturers.
- These are currently deployed in South Korean semiconductor manufacturers, such as SK Hynix.

**TEACHING & LEADERSHIP EXPERIENCE**

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**Robotics Institute at Carnegie Mellon University**

Pittsburgh, PA

Manager/Developer — [RoboticsKnowledgebase](#)

Oct 2024 — Present

Supported by Google DEI Fund for *Supporting More Inclusive Research Pathways in Robotics***Mechanical Engineering Department at CMU**

Pittsburgh, PA

Teaching Assistant — *Dynamic Systems and Controls (24.352)*

Aug 2024 — Present

**Robotics Institute at Carnegie Mellon University**

Pittsburgh, PA

Research Mentor — [Robotics Institute Summer Scholars \(RISS\)](#)

May 2024 — Aug 2024

**Mechanical Engineering Department at UC Berkeley**

Berkeley, CA

Teaching Assistant — *Statistics and Data Science for Engineers (ENG 178)*

Jan 2023 — May 2023

**Republic of Korea Army**

South Korea

Squad Leader, Sergeant, K-1 Tank Mechanic — *Combat Service Support (CSS)*

Jan 2019 — Aug 2020

**SELECTED COURSES**

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**Carnegie Mellon University**

Provably Safe Robotics (16.883), Optimal Control &amp; Reinforcement Learning (16.745), Advanced Control Systems Integration (24.774), Engineering Optimization (24.785), Biomechanics of Human Movement (24.663).

**UC Berkeley**

Deep Reinforcement Learning (CS 285), Nonlinear Systems (EE C222), Machine Learning (CS 189), Robotic Manipulation &amp; Interaction (EECS C106B), Vehicle Dynamics and Control (ME 131), Dynamic Systems &amp; Feedback (ME 132), Mechatronics Design (ME 102B), Experimentation and Measurements (ME 103).

**ACADEMIC PROJECTS**

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- **Balancing an Inverted Pendulum on Quadrotor (16.745; 2024).** Used LQR to balance an inverted pendulum on a quadrotor in flight. The quadrotor was built with PX4 firmware. [\[Video\]](#)
- **Extended Kalman Filter (EKF) for Autonomous Racing (EECS C106B; 2023).** Implemented EKF system identification for tire loads and side-slip angles for a lateral stability MPC for the [Indy Autonomous Challenge](#).
- **Model-based Reinforcement Learning (MBRL) for Trajectory Optimization (CS 285; 2022).** Developed an image-based model-learning algorithm using MBRL to locally approximate the linear dynamics and cost function for iterative LQR. [\[Report\]](#)
- **Dart-launching Robot (EECS C106A; 2022).** Devised a method to track dart boards with computer-vision and launch darts using spring-actuated dart-launcher with Sawyer manipulator for bullseye. [\[Website\]](#)