

# Kai S. 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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**Massachusetts Institute of Technology**, Cambridge, MA

Class of 2029 (Expected)

Doctor of Philosophy in **Mechanical Engineering**

Advisor: Dr. Navid Azizan

**Carnegie Mellon University**, Pittsburgh, PA

Class of 2025

Master of Science in **Mechanical Engineering**

Advisors: Dr. Changliu Liu, Dr. John M. Dolan

\* *Best Master's Research Paper 2025 Commencement Award*

\* *ATK-Nick G. Vlahakis Fellowship*, 2024 — 2025

**University of California, Berkeley**, Berkeley, CA

Class of 2023

Bachelor of Science in **Mechanical Engineering**

Minor in **Electrical Engineering and Computer Science (EECS)**

Military Service (Leave of Absence, 2019 — 2020)

## PUBLICATIONS & PREPRINTS

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\* Equal Contribution

[C1] **Kai S. Yun**, Navid Azizan, “ATOM-CBF: Adaptive Safe Perception-Based Control under Out-of-Distribution Measurements”. Accepted to Learning for Dynamics and Control Conference (L4DC), 2026. Preprint at [arxiv.org:2511.08741](https://arxiv.org/abs/2511.08741), 2025.

[C2] **Kai S. Yun**, Rui Chen, Chase Dunaway, John M. Dolan, Changliu Liu, “Safe Control of Quadruped in Varying Dynamics via Safety Index Adaptation”. Published in 2025 IEEE *International Conference on Robotics and Automation (ICRA)*, Oral Presentation in Atlanta, Georgia, 2025, [Website](#).

[C3] Simin Liu\*, **Kai S. Yun\***, John M. Dolan, Changliu Liu, “Synthesis and Verification of Robust-Adaptive Safe Controllers”. Published in *European Control Conference (ECC)*, Oral Presentation in Stockholm, Sweden, 2024.

[C4] Tianhao Wei, Hanjiang Hu\*, Luca Marzari\*, **Kai S. Yun\***, Peizhi Niu\*, Xusheng Luo, Changliu Liu, “ModelVerification.jl: a Comprehensive Toolbox for Formally Verifying Deep Neural Networks”. Published in 2025 *International Conference on Computer Aided Verification (CAV)*, 2025, [GitHub](#).

[P1] Yifan Sun, Rui Chen, **Kai S. Yun**, Yikuan Fang, Sebin Jung, Feihan Li, Bowei Li, Weiy Zhao, Changliu Liu, “SPARK: A Modular Benchmark for Humanoid Robot Safety”. Preprint at [arxiv.org:2502.03132](https://arxiv.org/abs/2502.03132), 2025, [Website](#).

[P2] Yifan Sun, Rui Chen, **Kai S. Yun**, Yikuan Fang, Sebin Jung, Weiy Zhao, Changliu Liu, “Safe Humanoid Autonomy and Teleoperation with Safe Set Algorithm”. Extended abstract published in *Joint 10th IFAC Symposium on Mechatronic Systems and 14th Symposium on Robotics*, 2025.

## RESEARCH EXPERIENCE

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**Laboratory for Information & Decision Systems (MIT)**

Cambridge, MA

Advisor: Dr. Navid Azizan

Aug 2025 — Present

- Research on perception-based safe control theory under out-of-distribution measurements [C1].
- Research on learning-based robust and adaptive control of quadrotors.

**Intelligent Control Lab** (Robotics Institute at CMU)

Pittsburgh, PA

Advisors: Dr. Changliu Liu, Dr. John M. Dolan

Jun 2023 — Jul 2025

- Research on safe humanoid autonomy and toolbox development (Unitree G1 platform) [P1, P2].
- Research on adaptive safe controller for quadrupeds in varying dynamics (Unitree Go2 platform) [C2].
- Research on algorithm development for synthesizing robust-adaptive safe controllers for robotic systems [C3].
- Developed [ModelVerification.jl](#), a Julia library containing state-of-the-art neural network verification algorithms [C4].

**Hybrid Robotics Lab** (Mechanical Engineering at UC Berkeley)  
**Advisor:** Dr. Koushil Sreenath

Berkeley, CA  
Aug 2021 — Apr 2022

- Research on *PPO-Worst-Case*, a novel safe reinforcement learning algorithm for worst-case scenarios.
- Developed simulations for legged robots in safety-critical scenarios.

## PROFESSIONAL EXPERIENCE

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### Tesla, Inc.

*Vehicle Dynamics / Software Engineering Intern*

Palo Alto, CA  
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

*Reinforcement Learning Engineering Intern*

Seoul, South Korea  
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 & SERVICE EXPERIENCE

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### Robotics Institute at CMU

*Manager/Developer — RoboticsKnowledgebase (Funded by Google)*

Pittsburgh, PA

Oct 2024 — Jul 2025

*Teaching Assistant — F1Tenth Autonomous Racing (16.663)*

Jan 2025 — May 2025

*Robot Manager, Lab Manager — Intelligent Control Lab*

Jan 2025 — May 2025

*Lab Server Manager — DRIVE Lab*

Jun 2024 — May 2025

*Research Mentor — Robotics Institute Summer Scholars (RISS)*

May 2024 — Aug 2024

Mentee: Chase Dunaway (Undergraduate at New Mexico Tech → Ph.D. at MIT)

### Mechanical Engineering Department at CMU

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

Pittsburgh, PA

Aug 2024 — Dec 2024

### Mechanical Engineering Department at UC Berkeley

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

Berkeley, CA

Jan 2023 — May 2023

### Republic of Korea Army

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

South Korea

Jan 2019 — Aug 2020

**Reviewer:** IEEE Robotics and Automation Letters

## SKILLS

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- **Area of expertise:** Humanoids, Quadrupeds, Quadrotors, Safety Index, Control Barrier Function, Control Lyapunov Function, Model Learning, Safe Reinforcement Learning, Optimal Control, Adaptive Control, 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, Scuba Diving.
- **Languages:** Fluent in English & Korean.

## SELECTED COURSES

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### Carnegie Mellon University

Provably Safe Robotics (16.883), Optimal Control & 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 & Interaction (EECS C106B), Vehicle Dynamics and Control (ME 131), Dynamic Systems & Feedback (ME 132), Mechatronics Design (ME 102B), Experimentation and Measurements (ME 103).