

# Kwang Hak Kim

Ph.D. Student, University of California San Diego, La Jolla, CA  
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## EDUCATION

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**Ph.D. Student in Mechanical and Aerospace Engineering**  
University of California San Diego, La Jolla, CA

Sept. 2022 – Jun. 2027 (expected)

**M.S. in Mechanical Engineering**  
University of California San Diego, La Jolla, CA

Sept. 2022 – May 2024  
GPA: 3.84/4.00

**B.S. in Aerospace Engineering**  
The University of Texas at Austin, Austin, TX

Aug. 2016 – May 2020  
GPA: 3.82/4.00

## RESEARCH EXPERIENCE

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**Graduate Student Researcher**  
Nonlinear and Adaptive Control Laboratory (UCSD)  
*Advisors: Prof. Miroslav Krstić and Prof. Mamadou Diagne*

La Jolla, CA  
Sept. 2022 — Present

- Developed novel **stabilization and safety-critical control strategies** for **nonholonomic underactuated vehicles**
- Designed safety filters for **autonomous traffic management** on aircraft carrier decks, and **presented results** to **ONR** program managers and **NAWCAD** in invited technical discussions
- Constructed **globally strict CLFs** for unicycle and Dubins vehicle models, enabling smooth time-invariant, inverse-optimal, adaptive, and prescribed/fixed-time stabilization
- Designed novel smooth robust CBFs for high-relative-degree systems to guarantee **collision avoidance with unknown moving obstacles**
- Introduced a constant-sum high-order CBF framework that guarantees **safety between parallel boundaries** by eliminating loss of control authority
- Extending stabilization and safety-critical control frameworks to **broader classes of nonholonomic vehicle models**, including higher-fidelity and three-dimensional systems

**Undergraduate Research Assistant**  
Autonomous Systems Group (UT Austin)  
*Advisor: Prof. Ufuk Topcu*

Austin, TX  
Jun. 2019 — Feb. 2020

- Studied **multi-agent logistics and coordination** in confined environments such as warehouses
- Designed state-based controllers for **multi-quadcopter systems** using Slugs (reactive synthesis)
- Implemented and evaluated controllers in **AirSim** using custom **Unreal Engine** simulation environments using Python

**Undergraduate Research Assistant Intern**  
eXtreme Energy Laboratory (Seoul National Uni.)  
*Advisor: Prof. Jai Ick Yoh*

Seoul, South Korea  
Jun. 2019 — Feb. 2020

- Analyzed the impact velocity and precision of a **needleless syringe design** for medical applications
- Researched and experimented **extreme temperature endurance materials** for electrodes

## OTHER EXPERIENCES AND PROJECTS

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**Instructional Assistant (UCSD)**  
*Nonlinear Systems (MAE 281A) and Linear Control (MAE 142B)*

La Jolla, CA  
Jan. 2025 — Jun. 2025

- Awarded **MAE PhD Outstanding Teaching Assistant of the Year**, recognized for exceptional student support and instructional contributions.
- Led weekly discussion sections and office hours to clarify complex concepts and collaborated with faculty to refine course materials and provide consistent learning outcomes across sections.

**NASA's 2020 RASC-AL Competition Finalist (Theme 5)**  
*Project Autoponics - Team Lead*

Austin, TX  
Aug. 2019 — Jun. 2020

- Led the design and presentation of an autonomous plant habitat for the Lunar Gateway, **secured \$11,000 funding** from the National Institute of Aerospace

**Aerial Robotics Autonomy Protocol Project**  
*Aerial Robotics Course Project*

Austin, TX  
Jan. 2020 — May 2020

- Developed a **C++ autonomy stack** for a quadcopter using 3D A\* path planning and polynomial trajectory smoothing

**Republic of Korea Air Force**  
Air Defense Artillery Brigade

South Korea  
Oct. 2020 — Jul. 2022

- Led training of 20+ recruits in technical maintenance and tactical protocols

## SKILLS

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- **Autonomy & control:** Lyapunov-based methods (CLF/CBF), quadratic program (QP) safety filters, adaptive control, inverse-optimal control, PID, LQR, linear MPC
- **Learning-based methods:** Reinforcement learning methods (policy gradient, actor–critic, Q-learning, SARSA)
- **Signals & data analysis:** Filtering methods (low/high-pass), spectral analysis (DFT/FFT), system identification
- **Software:** MATLAB, Python, C++, Simulink, ROS 2, Git, SolidWorks
- **Languages:** English (native), Korean (native)

## PUBLICATIONS

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### Journal Papers

- [J1] **K. H. Kim**, M. Diagne and M. Krstić, “*Constant-Sum High-Order Barrier Functions for Safety Between Parallel Boundaries*,” in IEEE Control Systems Letters, vol. 9, pp. 1447-1452, 2025

### Conference Papers

- [C1] **K. H. Kim**, M Diagne, M Krstić, “*Robust Control Barrier Function Design for High Relative Degree Systems: Application to Unknown Moving Obstacle Collision Avoidance*,” in American Control Conference (ACC), Denver, CO, 2025
- [C2] E. Zapien Ramos, **K. H. Kim**, M. Krstić, A. J. Rosengren, “*Safety-Critical Control Using Fully Nonlinear Equations of Relative Motion for Formation Flying in Cislunar Space*,” in AIAA SciTech Forum, 2026

### Manuscripts in Review

- [R1] V Todorovski, **K. H. Kim**, A Astolfi, and M Krstić, “*Nonholonomic Robot Parking by Feedback—Part I: Modular Strict CLF Designs*,” submitted to IEEE Transactions on Automatic Control, Available: arXiv:2511.15119
- [R2] **K. H. Kim**, V Todorovski, and M Krstić, “*Nonholonomic Robot Parking by Feedback—Part II: Nonmodular, Inverse Optimal, Adaptive, Prescribed/Fixed-Time and Safe Designs*,” submitted to IEEE Transactions on Automatic Control, Available: arXiv:2511.15219
- [R3] M Krstić, **K. H. Kim**, and V Todorovski, “*Dubins Vehicle Stabilization: Deadbeat Parking and Asymptotic ‘Spinaway’*,” submitted to Automatica.
- [R4] **K. H. Kim**, V Todorovski, and M Krstić, “*Inverse Optimal Feedback and Gain Margins for Unicycle Stabilization*,” submitted to the American Control Conference (ACC) 2026, Available: arXiv:2509.25563
- [R5] V Todorovski, **K. H. Kim**, and M Krstić, “*Modular Design of Strict Control Lyapunov Functions for Global Stabilization of the Unicycle in Polar Coordinates*,” submitted to the American Control Conference (ACC) 2026, Available: arXiv:2509.25575
- [R6] M Krstić, V Todorovski, **K. H. Kim**, and A Astolfi, “*Integrator Forwarding Design for Unicycles with Constant and Actuated Velocity in Polar Coordinates*,” submitted to the American Control Conference (ACC) 2026, Available: arXiv:2509.25579
- [R7] M Krstić, **K. H. Kim**, and V Todorovski, “*Half-Global Deadbeat Parking for Dubins Vehicle*,” submitted to the American Control Conference (ACC) 2026, Available: arXiv:2509.25571

## INVITED TALKS

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- RoboGrads Feed the Intellect (FTI) Seminar Nov. 2024
- MAE Student Seminar Nov. 2024

## AWARDS

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- MAE PhD Outstanding Teaching Assistant of the Year (UCSD) Jun. 2025
- Steve K. Sin Endowed Presidential Scholarship in Engineering (UT Austin) Jan. 2020
- University Honors (UT Austin) Aug. 2016 - May 2020