Minku Kim

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https://min-ku.github.io/ minkukim min-ku

Education

Oregon State University *Corvallis, OR*
Ph.D. Candidate in Robotics *Sep 2025 – Current*

University of Pennsylvania *Philadelphia, PA*
M.S. in Mechanical Engineering and Applied Mechanics *Aug 2023 – May 2025*

- **Thesis**: Learning a Vision-Based Footstep Planner for Hierarchical Walking Control on Unstructured Terrain.
- **Committee**: Prof. Nadia Figueroa (Thesis Committee Chair), Prof. Pratik Chaudhari and Prof. Michael Posa.
- **GPA**: 4.0/4.0

Chung-Ang University *Seoul, Korea*
B.S. in Mechanical Engineering with honors *Mar 2017 – Feb 2023*

Research Experience

Figueroa Lab, GRASP Lab *Philadelphia, PA*
Graduate Research Assistant - Prof. Nadia Figueroa *Mar 2025 – Current*

- Developed a real-time GPU-accelerated system for 6D pose tracking and shape estimation using RGB-D input, combining Active Shape Model, ADMM optimization, and Stein Variational Gradient Descent for robust performance

Janus Intelligent Robots Lab, GRASP Lab *Philadelphia, PA*
Graduate Research Assistant - Prof. Antonio Loquercio *Dec 2024 – April 2025*

- Exploring meta-learning approaches that learn directly from model checkpoints to better optimize policy training on *Unitree GO2*

Dynamic Autonomy and Intelligent Robotics Lab, GRASP Lab *Philadelphia, PA*
Graduate Research Assistant - Prof. Michael Posa *Jan 2024 – May 2025*

- Proposed a vision-based hierarchical controller for *Cassie* in unstructured terrains utilizing a reinforcement learning footstep planner and low-level operational space controller
- Developed a full-stack RL pipeline in Drake, including training, sampling and deployment to hardware
- Benchmarked with a vision-based MPC footstep planner, achieving a reduction of 0.05 in mean square error for velocity tracking on flat terrains and demonstrated improved success rates across various terrains in simulation

Integrated Systems Design Lab *Seoul, Korea*
Research Intern - Prof. Hae-Jin Choi *Aug 2022 – Jan 2023*

- Constructed a data acquisition pipeline in MATLAB to collect and analyze real performance data from an electric vehicle (EV) reducer testbed using 3-axis accelerometers and current sensors
- Developed a real-time fault diagnosis model with 98% detection, utilizing feature extraction methods such as Wavelet Packet Decomposition, Mel-Frequency Cepstral Coefficients and STFT spectrogram

Artificial Intelligence for Mechanical Systems Lab *Seoul, Korea*
Undergraduate Research Assistant - Prof. Woochul Nam *June 2021 – Apr 2022*

- Implemented a hybrid vision-based UAV control system integrating a one-stage detection algorithm and Siamese network to track moving drones in visually complex environments
- Designed a custom loss function that improved small object detection by 5% and optimized model using quantization and pruning to achieve 30 fps real-time performance
- Built a terrain recognition algorithm for wearable device using stereo camera, employing point cloud semantic segmentation model for ground classification in dense forest environments

Teaching Experience

ESE 650: Learning in Robotics *Philadelphia, PA*
Graduate Teaching Assistant - Prof. Pratik Chaudhari *Jan 2025 – May 2025*

- Assisted in teaching a course of 120 students, including grading assignments and holding 3hr/week office hours, and creating a SLAM assignment using the KITTI Odometry Dataset.

MEAM 510: Design of Mechatronic System *Philadelphia, PA*
Graduate Teaching Assistant - Prof. Mark Yim, Dr. Jessica Weakly *Aug 2024 – Dec 2024*

- Assisted in teaching and managing a course of 100+ students, including leading recitation sessions, grading assignments and holding 3hr+/week office hours

Chung-Ang University Artificial Intelligence Association *Seoul, Korea*
Mentor *Apr 2021 – Sep 2021*

- Mentored 10+ basic track students in Machine Learning, Deep Learning and Computer Vision

Publications

Dynamic-ASM6D: Real-time 6D Object Pose and Shape Estimation via Active Shape Models and ADMM 2025
In Equivariant Systems: Theory and Applications in State Estimation, Artificial Intelligence and Control" workshop at RSS 2025 (Accepted)
Ho Jin Choi†, Yi-Hsuan Cheng†, **Minku Kim**† and Nadia Figueroa.

Dynamic-ASM6D: Real-time 6D Object Pose and Shape Estimation via Active Shape Models and ADMM 2025
In 9^{th} Annual Conference on Robot Learning, (Submitted)
Ho Jin Choi†, Yi-Hsuan Cheng†, **Minku Kim**† and Nadia Figueroa.

Learning a Vision-Based Footstep Planner for Hierarchical Walking Control 2025
In IEEE-RAS 24th International Conference on Humanoid Robots, (Submitted)
Minku Kim, Brian Acosta, Pratik Chaudhari and Michael Posa.

Projects

Comparative Analysis of MPC, LQR and RL-Based Footstep Planners in Uneven Terrains *Philadelphia, PA*
Mar 2024 – May 2024
Team Leader

- Implemented MLP-based Reinforcement Learning footstep planner and Model Predictive Controller footstep planner and created *Cassie* simulation environment in Drake
- Benchmarked velocity tracking and success rates of RL, LQR and MPC controller across varied terrain

Optimization-based Estimation of Obstacles from Human Demonstration using Control Lyapunov Function and Control Barrier Functions *Philadelphia, PA*
Oct 2023 – Dec 2023
Team Member

- Developed and presented a poster on CLF-CBF-QP optimization-based algorithm to estimate obstacle position and size from human demonstrations
- Leveraged Gaussian Mixture Models and Gaussian Mixture Regression to probabilistically learn parameters

Inverse-Kinematics Control for 7-DOF Manipulator *Philadelphia, PA*
Team Leader *Oct 2023 – Dec 2023*

- Created a vision-based pick-and-place algorithm for 7-DOF *Franka Emika Panda* manipulator
- Utilized inverse kinematics with gradient-based optimization and real-time perception feedback to pick and stack static and dynamically moving blocks

Mobile Wheeled-Robot for Autonomous Navigation *Philadelphia, PA*
Team Leader *Oct 2023 – Dec 2023*

- Implemented a PID motor control for a mobile robot using encoders, integrating Vive sensor, infrared (IR)

detection circuit, and ToF sensors, with inter-chip communication via I2C protocol
- Achieved localization via Vive system, wall-following, and IR beacon detection for autonomous navigation

Chung-Ang University Artificial Intelligence (CUAI) Association *Seoul, Korea*
Team Leader *Oct 2023 – Dec 2023*
- Created a real-time logo detector and an automatic mosaic algorithm using object detection for Youtube videos, with a web crawling-based data collection pipeline
- Developed a multi-modal algorithm for emotion prediction using video detection, speech and tone recognition

CDIC Competition *Seoul, Korea*
Team Member *Oct 2023 – Dec 2023*
- Developed an AI-based surveillance mobile platform for real-time child safety in daycare centers
- Implemented a multi-modal detection model using real CCTV videos and audio to identify child abuse

X-Corps Research Festival *Seoul, Korea*
Team Leader *Oct 2023 – Dec 2023*
- Designed a mobile application for energy prosumers and a solar-tracking controller to optimize efficiency
- Developed a rooftop solar panel installation algorithm using semantic segmentation with an aerial image api
- Implemented an energy supply and demand, and price prediction model using metadata from KEPCO

Honors and Awards

Oregon State University College of Engineering (COE) Scholarship *2025*
Awarded to PhD students by the College of Engineering

Penn Engineering Outstanding Research Award *2025*
Awarded to Master students by the School of Engineering and Applied Science

CUAI 4^{th} Advanced Track Excellent Completion *2022*
Only non-CS major applicant in top 3 out of 29 applicants

Chung-Ang University Da Vinci Software Institute Excellence Award *2021*
Winter Conference Smart Factory

Chung-Ang University Da Vinci Software Institute Encouragement Award *2021*
Summer Conference Smart Factory

Academic Excellence Scholarship *2021*
Chung-Ang University

Technical Skills

Programming Languages: Python, C/C++, MATLAB

Software/Frameworks: Pytorch, Tensorflow, ROS, Drake, MuJoCo, Isaac-Sim, Bazel, Git, Docker, SLURM

CAD: CATIA, Solidworks, 3D WOX, Fusion 360

Voluntary and Extra-Curricular Activities

Mechanical Engineering and Applied Mechanics Mentorship Program *Philadelphia, PA July*
Mentor *2024 – Aug 2024*
- Mentored incoming students on research opportunities, coursework, and work-study processes at Penn

Korean Graduate Student Association (KoGSA) *Philadelphia, PA Oct 2023*
Treasurer *– Current*
- Organized 4+ events accommodating 50+ students each and authored grants to secure funding

Republic of Korea Army *Namyangju, Korea Sep*
Missile Command, 1100 Battalion, Air Defense *2018 - May 2020*
- Served as a squad counselor and leader, completing military service with an honorable discharge