Ikhyeon Cho

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Research Summary

My research aims to develop autonomous robots that learn from physical experience and adapt their behavior in real-world environments. My work has progressed from ground-robot perception and navigation systems to experience-based navigational affordance learning, and more recently to navigation policy learning. In parallel, I have developed methods for robust spatial perception and mapping, with an emphasis on real-time implementation and physical-robot validation.

Education

Korea University — Seoul, South Korea
Ph.D. Candidate, Mechanical Engineering — Expected Feb 2027
Advisor: Prof. Woojin Chung.
Dissertation title: *Robust Spatial Perception and Navigational Affordance Learning from Robot Experience*

Korea University — Seoul, South Korea
B.S., Mechanical Engineering — Mar 2015–Feb 2020
Exchange semester, Salzburg University of Applied Sciences, Austria · Fall 2018

Publications

Journal Articles

[J6] **Failure-Guided Exploration and Policy Distillation for Diffusion-Based Robot Navigation**
Seongjoon Moon, **Ikhyeon Cho**, Geonhyeok Park, Woojin Chung
IEEE Robotics and Automation Letters (RA-L) · Under review
Proposed a diffusion-policy training framework that combines expert imitation learning with GRPO-based reinforcement learning, integrating failure-guided exploration and successful-behavior distillation to enable navigation without inference-time guidance.

[J5] **Terrablox: Evidential Persistence Reasoning for Robot-Centric Elevation Mapping in Dynamic Urban Environments**
Ikhyeon Cho, Geonhyeok Park, Woojin Chung
IEEE Robotics and Automation Letters (RA-L) · Under review
Developed an evidential inference framework to maintain elevation maps as compact, persistent spatial memory for mobile robots operating in dynamic outdoor environments.

[J4] **MapGLoc: Robust LiDAR Global Localization on Dense 3D Maps for Mobile Robots**
Geonhyeok Park, **Ikhyeon Cho**, Jinwon Lee, Seongjoon Moon, Woojin Chung
IEEE Robotics and Automation Letters (RA-L) · Under review
Contributed to BEV-based representation learning that bridges the gap between sparse LiDAR scans and dense 3D maps through feature alignment, enabling robust matching across different viewpoints.

[J3] **Robust Multi-Agent Path Finding Method for Obstacles and Environmental Changes in Factory Environments**
Seihoon Park, Jinwon Lee, Geonhyeok Park, **Ikhyeon Cho**, Seongjoon Moon, Woojin Chung
Sensors, 2026 · link

[J2] **Learning Self-Supervised Traversability With Navigation Experiences of Mobile Robots: A Risk-Aware Self-Training Approach**
Ikhyeon Cho, Woojin Chung
IEEE Robotics and Automation Letters (RA-L), 2024 · Presented at ICRA@40 · link
Developed a risk-aware self-training framework that enables mobile robots to learn navigational affordances from limited driving experience and generalize traversability knowledge to previously unexperienced terrain.

[J1] **ODS-Bot: Mobile Robot Navigation for Outdoor Delivery Services**
Jinwon Lee, Geonhyeok Park, **Ikhyeon Cho**, Keundong Kang, Daehyun Pyo, Soohyun Cho, Minwoo Cho, Woojin Chung
IEEE Access, 2022 · link

Conference Papers

[C7] **Field Deployment of Self-Supervised Traversability Estimation in Outdoor Environments**
Ikhyeon Cho, Geonhyeok Park, Keundong Kang, Woojin Chung
International Conference on Ubiquitous Robots (UR), 2026

[C6] **Outdoor Mobile Robot Navigation System Leveraging 3D LiDAR-based Localization**
Geonhyeok Park, Soonhwan Kwon, **Ikhyeon Cho**, Woojin Chung
International Conference on Ubiquitous Robots (UR), 2026

[C5] **Object-Level Obstacle Map Management for Multi-Robot Navigation Systems in Semi-Static Environments**
Geonhyeok Park, Seihoon Park, Seongjoon Moon, **Ikhyeon Cho**, Jinwon Lee, Woojin Chung
International Conference on Ubiquitous Robots (UR), 2026

[C4] **Graph-Based Local Coordination for Deadlock Prevention in Multi-AMR Systems**
Keundong Kang, Soonhwan Kwon, Seihoon Park, Seongjoon Moon, **Ikhyeon Cho**, Woojin Chung
International Conference on Ubiquitous Robots (UR), 2026

[C3] **Safe and Efficient Navigation of a Wheeled Mobile Robot in Dynamic Outdoor Environment**
Ikhyeon Cho, Jinwon Lee, Geonhyeok Park, Keundong Kang, Daehyun Pyo, Soohyun Cho, Minwoo Cho, Woojin Chung
International Conference on Ubiquitous Robots (UR), 2022

[C2] **Outdoor Navigation of a Mobile Robot in Crowded Environment**
Keundong Kang, Jinwon Lee, Soohyun Cho, **Ikhyeon Cho**, Geonhyeok Park, Minwoo Cho, Daehyun Pyo, Woojin Chung
International Conference on Ubiquitous Robots (UR), 2021

[C1] **Traversability Analysis in Outdoor Environments Using Incremental Elevation Grid Mapping**
Ikhyeon Cho, Woojin Chung
Conference on Information and Control Systems (CICS), 2021

Patents

[P1] **Mobile Robot Capable of Learning Risk-Aware Traversability via Accumulated Navigation Experience**
Woojin Chung, **Ikhyeon Cho**
U.S. Patent No. 12,782,960, Granted*, 2026* · link
KR Patent No. 10-2981134, Granted*, 2026* · link

[P2] **Mobile Robot Capable of Reliable Online Terrain Mapping in Dynamic Environments**
Woojin Chung, **Ikhyeon Cho**, Geonhyeok Park, Seongjoon Moon
KR Patent Application, Pending*, 2026*

Open-Source Software & Datasets

2026 **Terrablox official implementation**
Code will be released upon paper acceptance.

2024 **FastDEM elevation mapping engine** ★ 194
Real-time CPU-based elevation mapping for mobile robots, supporting LiDAR and RGB-D input.

2024 **TraverseSet LiDAR-inertial dataset** ★ 71
Dataset release for "Learning Self-Supervised Traversability With Navigation Experiences of Mobile Robots."

2023 **LeSTA official implementation** ★ 125
Code release for "Learning Self-Supervised Traversability With Navigation Experiences of Mobile Robots."

Research Experience

Industry Collaborations

On-Device Perception and Navigation for Next-Generation Collaborative Robots 2026–Present
Researcher | Collaboration with Doosan Robotics
Developing mobile autonomy capabilities to support precise navigation for manipulation tasks and safe, reliable operation in real-world workspaces.

Multi-Robot Perception and Navigation in Dynamic Factory Environments 2025
Project Lead | Collaboration with Hyundai Mobis
Integrated collaborative perception, autonomous navigation, and multi-agent path planning; validated the system on three physical robots and evaluated coordination separately with 100 simulated robots.

Real-Time Terrain Perception and Mapping for Lunar Rover Research 2025
Project Lead | Collaboration with Hyundai Motor Group, L Project Team
Led terrain-perception research for lunar-rover mobility, leveraging a self-developed real-time elevation-mapping framework for terrain assessment and validating it on a custom ground-based robot through outdoor field experiments.

Experience-Driven Navigational Affordance Learning for Outdoor Robots 2021–2022
Project Lead | Collaboration with Hyundai Motor Group, Robotics LAB
Developed and validated a self-supervised traversability learning approach using real robot navigation experience, leading to a first-author IEEE RA-L publication.

Research Projects

Uncertainty-Aware Active Exploration for 5D World Modeling 2026–Present
Researcher | Funded by the Ministry of Trade, Industry and Resources (MOTIR), South Korea
Developing uncertainty-aware active exploration methods for humanoid robots, combining geometric and semantic uncertainty to select informative observation targets and support closed-loop updates to 5D world models in manufacturing environments.

Sim-to-Real Evaluation of Mobile Robot Navigation Nov 2025–Jun 2026
Project Co-Lead | Collaboration with Korea Testing Laboratory (KTL)
Evaluated how robot dynamics mismatch affects navigation-controller assessments between simulation and hardware through robot-in-the-loop experiments with NVIDIA Isaac Sim.

Coordinated Multi-Robot Planning for Large-Scale Indoor Operations 2023–2024
Researcher | Funded by the Ministry of Trade, Industry and Energy (MOTIE), South Korea
Developed kinodynamically informed graph representations for multi-agent path finding, incorporating robot motion constraints into discrete multi-robot planning.

Learning-Based Autonomous Navigation System for Complex Urban Environments 2021–2025
Researcher | Funded by the National Research Foundation of Korea (NRF)
Developed environmental perception methods spanning terrain understanding, object recognition and tracking, and map updating, and integrated these capabilities with navigation and behavior-selection components into a unified autonomous robot system.

Agile Navigation Among Moving Pedestrians 2020–2022
Researcher | Funded by the Ministry of Trade, Industry and Energy (MOTIE), South Korea
Integrated a DT-RRT-based collision-avoidance planner into a ROS-based mobile robot navigation system and evaluated its operation on physical hardware for navigation in crowded pedestrian environments.

Autonomous Mobile Carrier for Greenhouse Harvesting Operations 2020
Researcher | Funded by the Ministry of Agriculture, Food and Rural Affairs (MAFRA), South Korea
Evaluated localization reliability in greenhouse environments and integrated obstacle-aware safe stopping into an autonomous crop-transport robot with remote operator intervention.

Research Mentoring

Mentored 11 students at Korea University: 2 undergraduates, 8 M.S. students, and 1 Ph.D. student.

Current

Michael Kang (Undergraduate)	2026–Present
Gahyun Seo (Undergraduate)	2026–Present
Minjun Kang (M.S.)	2026–Present
Soonhwan Kwon (M.S.)	2025–Present
Seongjoon Moon (Ph.D.)	2023–Present

Former

Seihoon Park (M.S. → ROBROS)	2024–2026
Boogeon Kim (M.S. → Korea Aerospace Industries)	2023–2025
Jinhyuk Lee (M.S. → Hyundai Mobis)	2023–2025
Chanhee Lee (M.S. → LIG Nex1)	2023–2024
Changju Hwang (M.S. → Samsung Electronics)	2023–2024
Daehyun Pyo (M.S. → Mobiltech)	2020–2022

Teaching

MECH386: Introduction to Electrical Engineering

Teaching Assistant, Korea University — Fall 2020, Fall 2022

Conducted instrumentation labs and developed instructional materials in English.

MECH463: Microprocessor Programming

Teaching Assistant, Korea University — Spring 2021, Spring 2022

Led English-language laboratory sessions on microcontroller programming and embedded systems.

MECH210: Computer-Aided Mechanical Drawing

Teaching Assistant, Korea University — Fall 2021

Supervised CAD assembly project labs, held office hours, and graded project assignments.

Academic Service

Journal Reviewer

IEEE Robotics and Automation Letters (RA-L)	2026
IEEE Transactions on Field Robotics (T-FR)	2026
IEEE Transactions on Vehicular Technology (T-VT)	2026
IEEE Access	2024, 2026

Conference Reviewer

IEEE International Conference on Robotics and Automation (ICRA)	2026, 2027

Honors & Awards

Awards

Academic Excellence Award (Highest Honors), Korea University	Spring 2018
Academic Excellence Awards (Honors), Korea University	Fall 2015, Spring 2016

Scholarships

Teaching Assistant Scholarship, Korea University	Fall 2020, Spring and Fall 2021–2022
Research Assistant Scholarship, Korea University	Spring 2020
BK21PLUS Scholarship, National Research Foundation of Korea	Spring 2020
Merit-Based Scholarship (Full Tuition), Korea University	Fall 2018

Technical Skills

Programming & Software Engineering: Modern C++ (templates, multithreading, performance optimization), Python
Robotics & Simulation: ROS / ROS 2, NVIDIA Isaac Sim, Gazebo
Libraries & Frameworks: PyTorch / LibTorch, GTSAM, OpenCV, Eigen
Hardware & Platforms: NVIDIA Jetson, 2D/3D LiDAR, RGB-D cameras, IMUs, GNSS
Development Tools: Linux, CMake, Git, Docker

References

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Kitae Kim, Ph.D.
Assistant Professor, Department of Biological and Agricultural Engineering
North Carolina State University, USA
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