Hyeokjoon Kwon

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Research Interests

Multimodal Perception for Physical Interaction; Epistemic Uncertainty Estimation; Active Perception

Education

Carnegie Mellon University Pittsburgh, USA
M.S. in Robotics · GPA 4.11/4.0 *Sep 2025 – Present*

- Relevant Coursework: Advanced Computer Vision (16-820), Localization and Mapping (16-833), Introduction to Robot Learning (16-831), Fundamentals of Human-Robot Interaction (16-701)

Korea Advanced Institute of Science and Technology (KAIST) Daejeon, Korea
B.S./M.S. in Aerospace Engineering, GPA 3.9/4.3 (B.S., GPA 3.73/4.3) *Feb 2021*

- M.S. Thesis: *Low-thrust Spacecraft Trajectory and Guidance Law Design Using Reinforcement Learning*

Publications

- **(Under Review) H. Kwon**[*], J. Cai[*], R. Li[*], K. Bhandari, G. Hemkumar, P. Maheshwari, Y. Qiu, Y. Zhang, S. Scherer, W. Wang (2026). "TartanMatch: Towards Universal Dense Correspondence Across Modalities." *arXiv preprint arXiv:2610.14513*. [arXiv] [Website] [Code]
- **(Conference Proceedings) H. Kwon**, S. Oghim, H. Bang (2022). "Autonomous Guidance for Multi-revolution Low-thrust Orbit Transfer via Reinforcement Learning." *Proceedings of the AAS/AIAA Space Flight Mechanics Meeting*, AAS 21-315, pp. 783–798. [Paper]
- **(Peer-reviewed Article)** D. Y. Lee, **H. Kwon**, D. Lee, H. Lee, Y. Jung, J. Jeong, S. Park, S. Lee, J. H. Park, M. Tahk, H. Bang, J. Ahn (2021). "Performance Analysis of an Integrated Navigation of an Airborne AESA Radar." *Journal of the Korean Society for Aeronautical & Space Sciences*, 49(4), pp. 281–290. [link]

Research Experience

AirLab, Carnegie Mellon University Pittsburgh, USA
Graduate Research Assistant (Supervisors: Sebastian Scherer, Wenshan Wang) *Sep 2025 – Present*

- **Multimodal Representation Learning for Dense Correspondences.** Led TartanMatch [arXiv], a single model for dense correspondence between any pair of RGB, event, thermal, depth, and LiDAR; designed and implemented the architecture and training recipe extending RGB-based universal flow models (e.g., UFM) to matching both within and across modalities, and curated pixel-aligned simulated and real multi-sensor datasets.
- **Casualty Localization and Re-Identification for Search & Rescue (DARPA Triage Challenge).** Leading an end-to-end system that detects, localizes, and re-identifies casualties to support rapid triage by first responders, combining monocular RGB SLAM with external sensors; using contrastive objectives to learn discriminative representations for target re-identification.

Aerospace Systems & Control Lab, KAIST Daejeon, Korea
Research Assistant (Supervisor: Hyochoong Bang) *Feb 2019 – Feb 2021*

- **Reinforcement Learning for Orbit Transfer.** Led research on low-thrust spaceflight guidance for continuous orbit transfer using reinforcement learning, addressing key limitations of traditional trajectory optimization such as high computational cost and sensitivity to initial guesses.
- **CubeSat for Earth Observation.** Defined mission requirements and link budget for a 3U CubeSat (RANDEV).
- **Sensor Fusion for Pose Estimation.** Designed a GNSS/IMU EKF for airborne radar pose estimation.

Work Experience (Selected)

The Boeing Company Seoul, Korea
Machine Learning Researcher *Mar 2024 – Jul 2025*

- **1M Parts Recognition.** Developed a classifier for over 1 million unique categories of aerospace parts (fasteners, bearings, etc.) using metric and representation learning; planned for deployment to Boeing Distribution Services.
- **Vision-Based Inspection for Wing Manufacturing.** Developed inspection algorithms for B-777X and B-787 wing production: tracked hole and fastener locations on B-777X wings via homography estimation with learning-based feature matching, validated with a quantitative evaluation method; designed the data collection process at B-787 wing factories and developed anomaly detection for foreign object debris on composites and air entrapment in sealants, using prompt-based video segmentation to accelerate annotation.

Nearthlab Inc. Seoul, Korea
Machine Learning Engineer *Jan 2022 – Mar 2024*

- **Perception for Autonomous Drone Flight.** Developed and deployed a rotated object detection algorithm for autonomous inspection on Android and iOS using TFLite and CoreML; defined metrics, conducted error analysis, and enriched datasets across adverse weather, views, and lighting.
- **High-Resolution Image Stitching for Wind Turbines.** Developed a 48 MP image stitching algorithm fusing deep feature matching with GPS/INS/LiDAR for textureless wind turbine blade imagery; made offsite defect review by human inspectors 7× faster and provided precise 3D locations of defects. [Video]
- **ML-based Defect Detection.** Led product development for wind turbine defect detection, including data definition, annotation, and training of segmentation and object detection models.

Nearthlab Inc. Seoul, Korea
Aerospace Engineer *Feb 2021 – Jan 2022*

- **Flight Software and Simulation for Autonomous Drone Inspection.** Developed real-time onboard C++ flight software for drones to autonomously track and photograph wind turbine blades at a safe distance, validated in real flights; built a Simulation-In-The-Loop system with a 6DoF simulator (Gazebo, ROS) to accelerate testing.

Honors and Awards

- Gold Medal (494 teams), CVPR 2023 Image Matching Challenge, Google Research 2023
- 7th of 642 teams (Top 1%), CVPR 2022 Image Matching Challenge, Google Research [writeup] 2022
- Minister's Prize (1st), 2019 CubeSat Development Competition, Ministry of Science and ICT, Korea 2022
- KAIST-Boeing Scholarship (merit-based), KAIST Department of Aerospace Engineering 2017 – 2018
- Encouragement Award, KAIST Undergraduate Research Participation Program 2017
- National Scholarship (merit-based, full tuition), Korea Student Aid Foundation 2013 – 2015, 2017 – 2020

Teaching and Mentoring

- **Buddy/Mentor**, KAIST Buddy Program: mentored 6 international exchange students 2019
- **Teaching Assistant**, KAIST URP: mentored 3 undergraduates building a high-altitude balloon 2019
- **General Physics Tutor**, KAIST: weekly General Physics I tutorials for freshmen 2018
- **Mentor/Teacher**, LG Global School: science lessons for 50+ underrepresented students 2015

Patents

- D. Shin, S. Baek, **H. Kwon** (2026). "A method and an apparatus for merging image based on contour of object." KR1029469660000.
- **H. Kwon**, S. Baek, D. Shin, Y. Choi (2025). "A method and an apparatus for displaying defects of an object in an image." KR1027941550000.
- **H. Kwon**, S. Baek, D. Shin (2025). "A method and an apparatus for merging images." KR1027575010000.
- J. Moon, S. Baek, **H. Kwon** (2022). "AI apparatus and method for image stitching for inspecting a wind turbine." KR102467590B9, EP4328850A3, US20240070850A1.