Minwoo Lee

Robotics Control Engineer

RT Linux · ROS2 · Force/Compliance Control · Prototype Integration

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Robotics engineer specializing in real-time control and contact-aware robotic system integration, with dual training in mechanical engineering and a robotics-focused software convergence curriculum. Over the past two years, I built and validated a 6-DoF force-controlled upper-limb exoskeleton and a closed-loop pneumatic glove, spanning actuator integration, ROS2 middleware, and real-time control.
I aim to apply this systems-level rigor to contact-rich manipulation and robotic automation.

Technical Skills

Programming C/C++, Python, MATLAB, Linux, ROS2, Git/VCS

Control Pinocchio, task-space force control, gravity/dynamics compensation, deterministic execution

Integration Actuators, sensors, and servo controllers; hardware abstraction layers, CAN/CANopen

Simulation & Validation Gazebo (ROS2 controller validation); Actuator frequency-response characterization; gravity-compensation bench testing; OpenSim-based biomechanical validation of HRI

Engineering 3D printing, CAD/CAE, mechatronics rapid prototyping, field maintenance of robotic systems

Selected Projects

Mar 2024 – Feb 2026 **6-DoF Force-Controlled Upper-Limb Exoskeleton**, Kyung Hee University ITEMLab

- Prototyped a 6-DoF, 2.85 kg upper-limb exoskeleton (4-DoF arm + 2 clavicle DoFs for shoulder-girdle coverage) with approx. 1 kgf Cartesian force-rendering capability, built around a custom actuator stack combining commercial QDD modules and in-house actuator designs.
- Built an 800 Hz RT Linux + ROS2 control SW stack with three parallel CAN/CANopen channels, ros2_control HAL implementations, and Pinocchio-based kinematics/dynamics on SE(3).
- Implemented task-space force control by combining RNEA-based gravity/dynamics compensation feedforward with wrench feedback and sensorless torque rendering. Supported both F/T-sensor-based feedback and motor-current-based torque estimation enabled by mechanically transparent joint actuation.

Sep 2024 – Dec 2025 **Closed-Loop Pneumatic Glove for Expert-Skill Capture**, Kyung Hee University ITEMLab

- Designed a bidirectionally actuated ($\pm$100 kPa) pneumatic glove as a physical frontend for expert-skill capture based on leader-follower pose synchronization.
- Implemented cascaded position-pressure feedback control, achieving 173 ms end-to-end stabilization to $\pm$5% with motion bandwidth exceeding prior pneumatic-glove works.
- Led an IRB-approved user study (N=16; $p < .001$ for perceived novelty); work resulted in an IEEE ISMAR 2025 demonstration and a Korean patent application.

Experience

Mar 2024 – Feb 2026 **Kyung Hee University ITEMLab**, Lab Chief & Research Assistant, Yongin, South Korea

- Supported lab operations and led prototyping across 3 government-funded robotics R&D efforts, delivering hardware prototypes, system integration, demos and publications.

Jun 2023 – Feb 2024 **Realimerse Inc.**, Co-founder & Chief Technology Officer, Suwon, South Korea

- Led commercialization-oriented development across mechanism, electronics, and control software; managed a 4-person R&D team on a 6-month timeline to CES 2024.
- Built and demonstrated a ROS2-based wearable prototype with custom BLDC + 3D-printed planetary actuators at CES 2024. Link

Selected Publications, Manuscripts, Conference Posters

Oct 2025 **A Pneumatic Glove with Closed-Loop Control and Bidirectional Actuation for Real-Time Pose Synchronization**, Lee *et al.* (1st author), *IEEE ISMAR 2025* Adjunct Proceedings, DOI | PDF

Sep 2025 **AI Speaks with Hands: A Bidirectionally Actuated Pneumatic Glove for Pose-Based Human–AI Communication**, Lee *et al.* (1st author), Manuscript under revision, PDF

Nov 2024 **A Pneumatic Haptic Glove System for Instructor-Learner Hand-Pose Motor Learning Scenarios**, Lee *et al.* (1st author), *2nd Korean Haptics Society Conference* (Korean, Poster & Demo)

Dec 2023 **A Hybrid Upper-Arm-Geared Exoskeleton with Anatomical Digital Twin for Tangible Metaverse Feedback and Communication**, Ha *et al.* (2nd author), *Advanced Materials Technologies*, DOI | PDF

Jun 2022 **Design of a Torque-Feedback Exoskeleton as a Metaverse Interface Device**, Lee *et al.* (1st author), *ICROS Domestic Conference* (Korean, Poster)

Patents

Jan 2026 **Pose-Based Human–AI Interaction System Using a Bidirectionally Actuated Glove**
Co-inventor, Korean Patent Application #10-2026-0011705

Sep 2025 **Metaverse Interface Device**
Co-inventor, Registered Korean Patent #10-2866095

Languages & Certifications

Korean Native

English OPIc IH; comfortable with technical documentation, papers, and written communication.

Licenses 3D Printer Operator; Driver's License (Class 1 Ordinary)

Awards

Nov 2022 **Korean Academy of Engineering President's Award**
2nd Place, National LINC3.0 Capstone Design Competition, Link

Sep 2022 **Center for Engineering Education Innovation Director's Award**
Excellence, Kyung Hee University — Creative Design Competition

Jul 2022 **LINC3.0 Director's Award**
1st Place, Kyung Hee University — Capstone Design Competition

Jun 2022 **Undergraduate Paper Award**
Institute of Control, Robotics and Systems (ICROS, Korea)

May 2020 **Academic Excellence Award**
Kyung Hee University

Education

Mar 2024 – Feb 2026 **Kyung Hee University**, M.S. in Software Convergence (GPA: 4.2/4.5)

- Advisor: Seungjae Oh
- Thesis title: Building Blocks for Full Upper-Limb Haptics

Mar 2016 – Feb 2024 **Kyung Hee University**, B.S. in Mechanical Engineering, Software Convergence (GPA: 3.8/4.5)

- Double major; Coursework and project work covered mechanics, control, software, sensing, robotics, computer vision, and machine learning fundamentals.