

# Seonwoo Kim

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## Research Interests

My research focuses on **robotic manipulation**, with particular emphasis on **classical control theory** and **learning based control** for robotic manipulators. During my Master's studies, I developed a strong foundation in disturbance observer design and force estimation algorithms. More recently, I have expanded my focus to AI-driven robot learning, exploring how imitation and reinforcement learning can enable complex manipulation behaviors. I am particularly interested in **contact-rich manipulation** and **whole-body manipulation**, where I aim to bridge model-based control with learning-based approaches to achieve robust and dexterous robot manipulation in unstructured environments.

## Education

**Korea University**, MS in Mechanical Engineering

Sept 2023 – Aug 2025

- Advisor: Prof. Daehie Hong
- GPA: 4.5/4.5
- **Thesis:** Adaptive Contact Force Estimation for Robotic Manipulators Using an Interacting Multiple Model-Based Disturbance Kalman Filter and Bayesian Neural Network
- **Coursework:** Linear system, Vehicle dynamics, Robust control, Intelligent control, Digital control, Optimal control, Kinematics Analysis

**Korea University**, BS in Mechanical Engineering

Mar 2017 – Aug 2023

- GPA: 3.55/4.5
- **Coursework:** Robotics, Mechatronics , Kinematics

## Research Experience

**Korea Institute of Science and Technology (KIST)**, Intern Researcher

Jul 2025 – Dec 2025

- **Autonomous bi-manual manipulation for humanoid robots:** Developed humanoid bi-manual manipulation policies by training robot foundation model based AI model (Nvidia Gr00t) with combined real-world and synthetic datasets, enabling robust dual-arm coordination
- **XR-based humanoid teleoperation system:** Developed an integrated teleoperation system combining Meta Quest hand tracking, camera/sensor modules, and Jetson Orin-based control architecture to enable real-time humanoid robot manipulation through inverse kinematics
- **Reinforcement learning for dexterous manipulation:** Trained humanoid dexterous manipulation policies using reinforcement learning in NVIDIA Isaac Sim/Lab simulation environment for complex object manipulation tasks

**Korea University**, Student Researcher

Sep 2023 – Aug 2025

- **AI-based autonomous excavator control:** Imitation learning based trajectory generation policy design using LSTM networks to learn from expert operators, enabling autonomous execution of diverse excavation tasks (radial digging, trenching, slope work, and stockpile excavation)
- **6-DOF motor grader blade control system:** Designed control system for motor grader blade (hybrid 3-DOF serial + 3-DOF parallel manipulator), implementing forward/inverse kinematics solvers and pose control algorithms for autonomous blade positioning
- **External force estimation for construction equipment:** Developed disturbance observer and Kalman filter-based contact force estimator to estimate soil-bucket interaction forces without additional force/torque sensors (published in IEEE RA-L and TIM)

## Teaching Experience

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### Korea University, Seoul Korea

- Teaching Assistant, MECH226 Dynamics, Prof. Daehie Hong

Mar 2024 – Dec 2024

### Korea University, Seoul Korea

- Teaching Assistant, MOBI208 Dynamics, Prof. Seongho Yun

Mar 2025 – Jun 2025

## Award

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### MATLAB Korea AI Competition for University Students

2023

#### Bronze Award

- Led a team to develop an **autonomous excavator trajectory generation system** using Deep Learning.
- Implemented a **GRU-based network in MATLAB** to clone expert excavation skills from human demonstration data.
- Integrated Intel RealSense D455 for real-time terrain perception and achieved smooth digging motion control on a 1/14 scale excavator.
- **Demo Video**

## Publications

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### Journal Articles

#### Task Space End-Effector Contact Force Estimation for Robotic Manipulators Using a Bayesian Augmented Interacting Multiple Model-Based Disturbance Kalman Filter (Accepted)

2026

*IEEE Transactions on Instrumentation and Measurement (IEEE TIM)* (SCIE)

Seonwoo Kim, Myeongin Jin, Jihun Kim, Chanwoo Kim, Daehie Hong (First author)

#### Acceleration Measurement-Free Dissipative Disturbance Observer for Robotic Manipulators (Published)

2025

*IEEE Robotics and Automation Letters (IEEE RA-L)* (SCIE)

Seonwoo Kim, Chanwoo Kim, Yeonho Ko, Daehie Hong (First author)

DOI: 10.1109/LRA.2025.3564205

### Conference Proceedings

#### [Poster Session] Soil Interaction Force Estimation via Identified Excavator Dynamics with Particle Filter

2024

International Conference on Precision Engineering and Sustainable Manufacturing (PRESM 2024)

Seonwoo Kim, Jihun Kim, Chanwoo Kim, Daehie Hong

#### [Poster Session] Estimating the Interaction Force Between Excavator Bucket and Ground Using a Simplified Dynamical Model and Hydraulic Sensors

2024

Proceedings of the KSPE 2024 Spring Conference

Seonwoo Kim, Jangho Bae, Chanwoo Kim, Jihun Kim, Daehie Hong

#### [Poster Session] Optimal Excavator Bucket Trajectory Generation with Soil Mechanics Model Design

2023

Proceedings of the KSPE 2023 Autumn Conference

Seonwoo Kim, Jangho Bae, Jaemyung Huh, Chanyoung Moon, Cheolhwan Im, Jinwoo Park, Daehie Hong

## Technologies

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**Programming Languages:** C, C++, Python, Matlab/Simulink, Labview, Julia

**Developer Tools:** Pytorch, Isaac Sim/Lab, ROS2, Git, Docker

**CAD:** Solid works