Woojong Kim

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Research Summary & Interests

Professional Summary* & *Highlights

- **Robotics Hardware Design Expert:** Specialized in developing novel sensors and actuators for service robots, with a strong focus on engineering designs that satisfy diverse operational requirements and multi-functionality. These innovations served as the core hardware foundation for a total of **6 journal publications**, including 4 in *IEEE RA-L*, as well as *IEEE T-RO* and *Nature Communications*.
  - *Pneumatic Artificial Muscles* (*PAM*): Developed *ffPAM* designed for compactness and rapid response, and *Double-SpringPAM* designed for bidirectional actuation and self-sensorization.
  - *Vision-Based Tactile Sensors:* Designed *UVtac*, leveraging UV markers for switchable functionalities, and *UVDtact*, achieving both a human fingertip form factor and multi-functional sensing capabilities.
- **Proven Design Capability:** Highly recognized for hardware innovation, winning the **Best Paper Award in Service Robotics at ICRA 2021** (awarded to 12 out of 4,005 papers) for designing a compact flat fabric pneumatic artificial muscle (*ffPAM*).
- **System Integration & Automation:** Extensive hands-on experience in constructing and configuring fully automated experimental setups utilizing industrial robot arms (e.g., UR5e) and motorized XYZ stages.

Core Research Areas

- **Vision-Based Tactile Sensors & Perception:** Hardware design and fabrication of optical tactile sensors, tactile image processing, shape reconstruction, and multi-axis force estimation.
- **Tactile Intelligence & Robotic Automation:** System configuration integrating tactile sensors with robotic arms, and the execution of automated manipulation tasks.
- **Pneumatic Artificial Muscles (PAM) for Robotic Devices:** Pneumatic actuator design, bidirectional actuation mechanism, sensorization, and standalone pneumatic control modules.

Education

Korea Advanced Institute of Science and Technology — Daejeon, South Korea
Ph.D. in Mechanical Engineering, GPA: 3.99/4.30, Advisor: Prof. Jung Kim — Mar. 2021 –Feb.2026
- Thesis: "A Vision-Based Tactile Sensor with a Fingertip Form Factor for Shape Reconstruction and Force Estimation"

Korea Advanced Institute of Science and Technology — Daejeon, South Korea
M.S. in Mechanical Engineering, GPA: 3.90/4.30, Advisor: Prof. Jung Kim — Mar. 2019 –Feb. 2021
- Thesis: "Design of a Compact Flat Fabric Pneumatic Artificial Muscle for Soft Wearable Robotic Devices"

Korea Advanced Institute of Science and Technology — Daejeon, South Korea
B.S. in Mechanical Engineering (Minor: Electrical Engineering), GPA: 3.74/4.30 — Mar. 2014 –Feb. 2019

Professional experience

Postdoctoral researcher Daejeon, South Korea
Korea Advanced Institute of Science and Technology Mar. 2026 –Current
InnoCORE PRISM-AI Center & Biorobotics Lab, Advisor: Prof. Jung Kim

– Topic: "Tactile Intelligence and Humanoid Tactile Robotic Fingertips for Dexterous Manipulation"

Publications

JOURNAL ARTICLES

[J6] Field-Programmable Robotic Folding Sheet
Hyunkyu Park, Yongrok Jeong, **Woojong Kim**, Jungrak Choi, Junseong Ahn, Jun-Ho Jeong, Inkyu Park, and Jung Kim
Nature Communications (*2025*)
(** Nature publisher highlights, Media highlights including CNN)

[J5] Graph-Structured Super-Resolution for Geometry-Generalized Tomographic Tactile Sensing: Application to Humanoid Faces
Hyunkyu Park, **Woojong Kim**, Sangha Jeon, Youngjin Na, and Jung Kim
IEEE Transactions on Robotics (*2024*)
(** T-RO editorial highlights) presented at *ICRA 2025*, Atlanta, USA

[J4] Bidirectional Double-Spring Pneumatic Artificial Muscle with Inductive Self-Sensing
Yeonha Cho †, **Woojong Kim** †, Hyunkyu Park, Jung Kim, and Youngjin Na
(† **Equally contributed**)
IEEE Robotics and Automation Letters, 8.12 (*2023*)

[J3] Marker-Embedded Tactile Image Generation via Generative Adversarial Networks
Won Dong Kim, Sanghoon Yang, **Woojong Kim**, Jeong-Jung Kim, and Jung Kim
IEEE Robotics and Automation Letters, 8.8 (*2023*)
presented at *ICRA 2024*, Yokohama, Japan

[J2] UVtac: Switchable UV Marker-Based Tactile Sensing Finger for Effective Force Estimation and Object Localization
Woojong Kim †, Won Dong Kim †, Jeong-Jung Kim, Chang-Hyun Kim, and Jung Kim
(† **Equally contributed**)
IEEE Robotics and Automation Letters, 7.3 (*2022*)
presented at *ICRA 2023*, London, UK

[J1] Compact Flat Fabric Pneumatic Artificial Muscle (ffPAM) for Soft Wearable Robotic Devices
Woojong Kim, Hyunkyu Park, and Jung Kim
IEEE Robotics and Automation Letters, 6.2 (*2021*)
(** Best Paper Award in service robotics at IEEE ICRA 2021) presented at *ICRA 2021*, Xi'an, China

CONFERENCE PAPERS

[C3] Robotic Skin with Sparsely Embedded Transducers for Contact Localization on Non-planar Surfaces
Minju Kim, Junhwi Cho, Sangha Jeon, Hyunki Park, **Woojong Kim**, and Jung Kim
2026 23rd International Conference on Ubiquitous Robots (*UR*), **Accept**

[C2] UVDtact: UV Marker-Embedded Fingertip-Like Vision-Based Tactile Sensor for Shape Reconstruction and Force Estimation
Woojong Kim, Won Dong Kim, Hyunkyu Park, Joonho Lee, Jeong-Jung Kim, and Jung Kim
2026 IEEE International Conference on Robotics and Automation (*ICRA*), **Accept**

[C1] Vision-Based Aided-Grasping in Teleoperation with Multiple Unknown Objects
Yunjoo Kim, **Woojong Kim**, Seongwoong Hong, Seulki Kyeong, Jirou Feng, and Jung Kim
Companion of the 2020 ACM/IEEE International Conference on Human-Robot Interaction (*HRI*) (*2020*)

IN PREPARATION

[I2] Tactile-Augmented Vision-Language-Action Framework for Precision Robotic Drawing

Juhee Park, **Woojong Kim**, Gunhee Park, and Jung Kim
IEEE Robotics and Automation Letters

[I1] Full-Anterior-Mechanoreceptive Anthropomorphic Hand with Super-Resolution Tomographic Tactile Skin

Sangha Jeon, **Woojong Kim**, and Jung Kim
Nature Communications

Awards, honors, and fellowships

- **PRISM-AI InnoCORE Fellowship** Mar. 2026 - Current
  from Korean Government
- **Invited Speaker at Korea Institute of Industrial Technology (KITECH)** 2026
  Talk entitled: "Human Fingertip-Like Vision-Based Tactile Sensor for Dexterous Manipulation"
- **Invited Speaker at the KRoC Flagship Conferences** 2022
  The 17th Korea Robotics Society Annual Conference (KRoC 2022)
  For the contents of the awarded paper at ICRA 2021
- **Best Paper Award in Service Robotics (Winner, 12/4005) (ICRA 2021)** 2021
  2021 IEEE International Conference on Robotics and Automation (ICRA 2021)
  For the paper entitled "Compact Flat Fabric Pneumatic Artificial Muscle (ffPAM) for Soft Wearable Robotic Devices"
- **KAIST Support Scholarship** Mar. 2019 - Feb. 2025
  from KAIST
- **National Science and Engineering Undergraduate Scholarship** Mar. 2016 - Feb. 2019
  from Korean Government
- **Dean's List** Fall 2017
  from KAIST College of Engineering
- **Outstanding Achievement Award** 2016, 2015
  from Department of Mechanical Engineering, KAIST

Projects

Enhancing dexterous robotic tool use via tactile-integrated VLA models
Project mentor Mar. 2026 –Current

- **Project objective** : R&D on integrating tactile sensing into Vision-Language-Action (VLA) models to enhance precision in robotic manipulation tasks, specifically focusing on drawing tasks using a gripped pen.
- **Role & Contribution** : Project mentor. Serving as a post-doc mentor to supervise junior researchers and direct the overall research direction of the project. Involved in designing the hardware setup, including a robot arm and a gripper equipped with GelSight sensors, and overseeing the integration of the visuo-tactile framework.

Development of drone perching mechanism
Person in charge Jan. 2023 –Dec. 2025

- **Project objective** : R&D on the implementation of perching mechanism based on compliant actuators to perform long-term operation of military drones.
- **Funding** : Defense Acquisition Program Administration.

– **Role & Contribution** : Person in charge. Involvement in designing a bistable pneumatic actuator for perching drones, developing a lightweight standalone pneumatic pressure generation & control module, and demonstrating autonomous landing and perching.

Development of vision-based tactile sensors and tactile image generation
Project participant Jan. 2021 –Dec. 2023

– **Collaboration** : Korea Institute of Machinery & Materials (KIMM).
– **Project objective** : Collaborative research on the hardware development of vision-based tactile sensors and the data generation of tactile images.
– **Role & Contribution** : Project participant. Involvement in developing a vision-based tactile sensor capable of obtaining independent, switchable tactile images using UV markers, designing tactile signal processing algorithms, and demonstrating robotic tasks including contact force-tracking and object alignment. Contributed to conceptual discussions on tactile image generation strategies. Research paper publication ([J2], [J3]).

Wearable soft robotic suit for elders
Project participant Mar. 2019 –Jun. 2021

– **Collaboration** : Korea Institute of Robotics & Technology Convergence (KIRO).
– **Project objective** : National R&D on the soft wearable robotic suit capable of monitoring and assisting the walking of elders.
– **Funding** : Institute for Information & communication Technology Planning & evaluation.
– **Role & Contribution** : Project participant. Involvement in development of wearable sensing suit and participating in discussions on enhancing capacitive strain sensor design.

Wearable foot drop assistance suit for drop foot patients
Project participant Mar. 2019 –Dec. 2019

– **Collaboration** : Seoul National University Hospital (Prof. Dong Yeon Lee), Korea Institute of Industrial Technology (KITECH).
– **Project objective** : National R&D on the pneumatic wearable robotic suit for assisting drop foot disorder.
– **Funding** : Ministry of Science and ICT.
– **Role & Contribution** : Project participant. Involvement in developing a pneumatic control module, participating in discussions on thermal management for the battery pack, and performing human subject experiments.

Technical skills

Deep learning and computer language: Pytorch, Python, MATLAB, LaTeX

3D modeling and simulation: SolidWorks, ABAQUS

Hardware prototyping: Pneumatic actuator design, Soft material manufacturing, 3D printing, Laser cutting, Circuit design

Robot operation: LabVIEW, ROS

Biosignal processing: Surface electromyography

Domestic publications

[8] Development of Underactuated Finger Mechanism for Vision-Based Tactile Sensor

Hyunjo Chung, **Woojong Kim**, Junhwi Cho, and Jung Kim
The 20th Korea Robotics Society Annual Conference (*KRoC 2025*), *Korea Robotics Society, 2025*

[7] Development of a Fabric-Based Pneumatic Bistable Gripper for Drone Perching

Woojong Kim, Ung Heo, Sangha Jeon, and Jung Kim
The 39th Institute of Control, Robotics and Systems Annual Conference (*ICROS 2024*), *2024*

[6] Development of Compact Variable-Stiffness Actuator using Magnet Repulsion

Gunhee Park, Hyunkyu Park, **Woojong Kim**, and Jung Kim
The 39th Institute of Control, Robotics and Systems Annual Conference (*ICROS 2024*), *2024*

[5] Comparison of Normal Force Estimation Performance of the UV Marker-based Tactile Sensor According to Voronoi Area Data Utilization of Marker Images

Woojong Kim, Won Dong Kim and Jung Kim
The 38th Institute of Control, Robotics and Systems Annual Conference (*ICROS 2023*), *2023*

[4] Position Control of the Sensorized Flat Fabric Pneumatic Artificial Muscle (ffPAM)

Woojong Kim, and Jung Kim
The 16th Korea Robotics Society Annual Conference (*KRoC 2021*), *Korea Robotics Society, 2021*

[3] Force Characterization and Dynamic Analysis of the Flat Fabric Pneumatic Artificial Muscle

Woojong Kim, and Jung Kim
2021 Korea Society of Biomechanics Annual Conference, 2021

[2] Development of Backpack Loading Estimation Model under Different Locomotion Conditions (Level, Stair, Inclined) using Surface Electromyography (sEMG) and Ground Reaction Force

Seulki Kyeong, Junghoon Park, **Woojong Kim**, and Jung Kim
2017 Korea Institute of Military Science and Technology Annual Conference, 2017

[1] Development of Backpack Loading Estimation Model using Surface Electromyography (sEMG) of Gastrocnemius During Walking and Running

Junghoon Park, **Woojong Kim**, Younghha Shin, and Jung Kim
Korea Society for Precision Engineering 2017 Spring Conference, 2017

Teaching experience

Korea Advanced Institute of Science and Technology — Daejeon, South Korea
Teaching Assistant — Mar. 2021 –Feb. 2025

- [ME488] Introduction to Biomedical Machine Technology, Spring 2021
- [ME203] Mechatronics System Design, Fall 2021, 2022, 2023
- [ME303] Mechanical Engineering Laboratory, Fall 2021 - Spring 2023
- [ME459] Introduction to Visual Intelligence, Spring 2022
- [ME400] Capstone Design, Spring 2024
- [ME106] Human and Machine, Fall 2024

Referees

Jung Kim Department head and professor in Dept. of Mechanical Engineering, KAIST

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