Kwanwoo Kim

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Summary

Researcher at the intersection of soft and collective robotics, seeking to uncover the governing principles of natural mechanics. Experience ranges from analyzing collective dynamics in steric-constrained granular robots ("link-bots") to designing nonlinear soft mechanisms utilizing snap-through instabilities and fluidic logic. Adept at integrating mechatronic design, control theory, and soft materials to develop programmable, physically intelligent systems. Committed to translating theoretical insights into functional prototypes that solve complex engineering challenges through morphological computation.

Education

M.S. in Mechanical Engineering, Seoul National University (SNU)
Sept 2024 – Present (Expected Aug 2026)

Seoul, Korea

B.S. in Mechanical Engineering, Seoul National University (SNU)
Sept 2018 – Aug 2024

Seoul, Korea

Publications

Kyungmin Son, Kimberly Bowal, **Kwanwoo Kim**, L. Mahadevan†, and Ho-Young Kim†, Emergent functional dynamics of link-bots, *Science Advances*, 11, eadu8326 (2025)

Kyuho Han, Sung-Gwang Lee, **Kwanwoo Kim**, Baren Jeong, Munyoung Paek, Whal Lee†, and Wontae Hwang†, Investigation of the effects of nasal surgery on nasal cavity flow using magnetic resonance velocimetry and computational fluid dynamics, *Physics of Fluids*, 35, 111908 (2023)

In Preparation:
Kwanwoo Kim and Ho-Young Kim†, Emergent clustering and interaction modalities in responsive link-bot collectives.

†:Corresponding Authors

Skills Summary

Electromechanical design: SolidWorks/Autodesk Fusion/Autodesk Inventor; rapid prototyping (3D print, laser cut); actuators & drivers (DC/servo/BLDC/solenoid); basic electronics (Arduino/Teensy); Adobe Illustrator/Premiere Pro.

Microfabrication & soft materials: Experience in spin coating, UV curing, micromolding (PDMS), injection molding, layer pour-coating, circuitry design & control of pneumatic actuators using pumps & valves, basic photolithography, Liquid Crystal Elastomer (LCE) & hydrogel synthesis and handling.

Controls & perception: PID tuning, system identification; vision-based multi-agent tracking (AprilTag/OpenCV); experiment automation.

Programming & simulation: MATLAB; Python; C/C++ (embedded); FEA (ABAQUS, COMSOL).

Languages: Korean (Native), English (Native-level fluency, TOEFL: 116/120), Mandarin Chinese (Upper-intermediate; HSK Level 6 – highest level).

Experiences (Reverse Chronological Order)

Full-time researcher, Microfluids and Soft Matter Lab, Seoul National University
Oct 2023 – Present
- *Advisor: Ho-Young Kim*
- Co-led research on 'link-bot' collectives, resulting in a publication in *Science Advances*.
- Currently leading a follow-up study on inter-collective interactions between multiple link-bots, involving stimuli-responsive materials.
- Developed physically responsive soft valves and characterized flow control performance under varying pressure/contact conditions.
- Won multiple prizes in academic idea competitions (refer to Projects & Awards section).

Seoul, Korea

Undergraduate research intern, Humanoid Generalization Laboratory, KAIST (Seoul Campus)
Dec 2022 – Aug 2023
- *Advisor: Beomjoon Kim*
- Designed and prototyped components for a highly back-drivable 6-DOF robotic arm optimized for delicate manipulation tasks.
- Implemented low-level motor control algorithms and executed hardware integration for BLDC and timing-belt actuation systems.

Seoul, Korea

Undergraduate research intern, Energy & Environmental Flow Laboratory, Seoul National University
Jun 2022 – Nov 2022
- *Advisor: Wontae Hwang*
- Analyzed 4D Velocimetry (MRV) data to characterize respiratory airflow before and after turbinoplasty, resulting in a co-authored publication in *Physics of Fluids*.
- Constructed an experimental setup mimicking human sinusoidal breathing patterns; visualized and interpreted 3D flow fields for manuscript preparation.

Seoul, Korea

Army interpreter, United States Forces Korea (ROK Army)
Aug 2019 – Mar 2021
- Completed mandatory service as a Korean-English interpreter for the Commander of the Eighth Army NCO Academy; collaborated with senior U.S. Army NCOs and ROK Army officers.

Camp Humphreys, Korea

Projects & Awards (Reverse Chronological Order)

Sequential soft bellows for wafer flattening *(KSME–SEMES Open Innovation Challenge, 2025)*

- Engineered a sequentially actuated soft-bellows array to optimize pressure distribution and mitigate stress concentrations during wafer flattening.
- Led the experimental validation using pneumatic control systems and conducted Finite Element Analysis (FEA) using ABAQUS to predict deformation behaviors.
- Awarded Honorable Mention (Finalist) in the competition.

Buckle-driven, ultra-fast compliant tourniquet *(Capstone, 2025)*

- Led a 5-person team in the end-to-end development of a rapid hemostasis device.
- Designed and prototyped a snap-through buckling mechanism; validated efficacy via pressure/leakage tests and early usability feedback.
- Integrated a superabsorbent hydrogel layer to enhance blood uptake and accelerate hemostasis.

Retinol oxidation-resistant packaging *(COSMAX–Academia Joint Research, 2024)*

- Developed a custom evaluation apparatus to quantify oxygen permeation and identify failure modes in conventional cosmetic containers.
- Conducted parametric studies using FEA to optimize soft valve geometry for minimized air ingress.
- Engineered a snap-through check valve demonstrating superior sealing performance over existing commercial solutions; delivered final technical report to the sponsor.

Frost suppression on heat exchangers using macro-scale surface textures *(KSME-LG Home Technology Competition, 2024)*

- Constructed experimental test rigs to demonstrate how macro-scale surface textures delay frost formation and improve defrosting efficiency.
- Selected for poster presentation at the KSME Autumn Conference 2024.
- Awarded the Silver Prize (2nd Place) in the competition.

Customized Protein Vending Machine Startup *(Co-Founder & Lead Engineer, 2023)*

- Built an end-to-end dispensing system (mechanics, controls, sensors) for customizable protein servings, implementing safety interlocks and reliability protocols.
- Pitched business models and working prototypes to venture capital firms.
- Secured approximately $20,000 USD in cumulative funding from government and university sources (SNU Entrepreneurship Center, Seoul Business Agency, Advanced Institute of Convergence Technology).
- Awarded the 3rd Place Prize in K-Startup Makerstar Competition (hosted by Korea Institute of Startup & Entrepreneurship Development).

Biodegradable, water-soluble toilet-seat cover dispenser *(Capstone, 2022)*

- Conceptualized and led hardware development for a sanitary dispenser utilizing water-soluble, biodegradable film to reduce plastic waste.
- Awarded 2nd Place Prize in SNU Creative Engineering Design Fair.
- Selected for departmental sponsorship to attend CES as a student representative.

IDC RoboCON using Unity (2022)
- Collaborated in a multi-university virtual robotics competition hosted by Tsinghua University.
- Programmed a virtual robot agent in Unity capable of autonomous obstacle avoidance and debris collection across complex terrains.
- Awarded Honorable Mention (Finalist) in the competition.

*Refer to kwanwoo-kim.com for more details on past and ongoing research projects

Outreach

Graduate Mentor, Undergraduate Research Opportunities Program (SNU)
Jul 2025 – Present
Seoul, Korea

IB Course Tutor, IB Physics, English Language & Literature, Mathematics (Zoom)
Sep 2018 – Aug 2019
Seoul, Korea

Student Mentor, South Africa Vastfontein Program
Nov 2017
Pretoria, South Africa

References (Alphabetic order)

Amy Kyungwon Han, PhD
- Assistant Professor, Department of Mechanical Engineering, Seoul National University, Seoul, Korea
- Research fields: Soft robotics, Medical robotic devices
- Relationship: **Research advisor**
- E-mail: amyhan@snu.ac.kr

Ho-Young Kim, PhD
- Professor, Department of Mechanical Engineering, Seoul National University, Seoul, Korea
- Research fields: Soft matter, Microfluidics, Collective behavior and bio-inspired systems
- Relationship: **Master's advisor / Research advisor**
- E-mail: hyk@snu.ac.kr

Jeong-Yun Sun, PhD
- Professor, Department of Materials Engineering, Seoul National University, Seoul, Korea
- Research fields: Soft matter, hydrogels
- Relationship: **Research advisor**
- E-mail: jysun@snu.ac.kr

Wontae Hwang, PhD
- Professor, Department of Mechanical Engineering, Seoul National University, Seoul, Korea
- Research fields: Respiratory flow (biofluids), Gas turbine
- Relationship: **Undergraduate advisor / Research advisor**
- E-mail: wthwang@snu.ac.kr