Joonseo Kym

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Education

KAIST (Korea Advanced Institute of Science and Technology) Expected Feb 2029

Double Major in Mechanical Engineering and Electrical Engineering (Note: 3.77 / 4.30) *Daejeon, South Korea*

- **Relevant Coursework:** Introduction to Robotics Engineering, System Modeling and Control, Mechatronics System Design, Mechanical Vibrations, Data Structures, Solid Mechanics, Dynamics, Signals and Systems, Circuit Theory

IASA (Incheon Academy of Science and Arts) Mar 2019 - Feb 2022

National School for Gifted Students *Incheon, South Korea*

Patents

Elbow Rehabilitation Aiding Device Patent No. KR102635233B1, Registered Feb 2024

Co-inventor *South Korea*

- Invented a portable, wearable elbow rehabilitation device featuring a dual twisted-string actuation (TSA) mechanism to assist both internal and external forearm rotation.
- Engineered a gearless, lightweight ring-shaped housing integrated with a complex movable and fixed pulley system.
- Optimized the mechanical design to maximize string contraction length and operational torque within a strictly limited spatial footprint.
- Overcame the bulk and weight limitations of traditional Continuous Passive Motion (CPM) machines, enabling highly accessible, home-based rehabilitation for patients with reduced motor functions.

Experience

Undergraduate Research Assistant (Individual Research & URP) Dec 2023 – Jan 2025

Exoskeleton Lab (Advisor: Prof. Kyoungchul Kong) *Daejeon, South Korea*

- Conducted comprehensive research on proportional Mechanomyography (pMMG), encompassing theoretical principles, analog pneumatic sensor selection, and the end-to-end hardware manufacturing process.
- Fabricated custom pMMG sensors and developed a robust data acquisition (DAQ) system utilizing NI myRIO and FPGA architecture.
- Validated signal integrity and performance metrics through low-level LabVIEW programming, ensuring precise sensor calibration for robotic exoskeleton applications.
- Prepared a full manuscript as the 2nd author (Title: "[Insert Paper Title Here]"), detailing the design, fabrication, and validation methodologies of the customized pMMG sensor system.

Projects

Development of a Drone Landing Gear Mimicking Feline Skeletal Structure Mar 2019 – Dec 2019

IASA (Incheon Academy of Science & Arts) SA (Steam Activity) Research Project ***Role: Student Researcher***

- Designed and 3D-printed a biomimetic drone landing gear inspired by a cat's skeletal structure to ensure safe landings and minimize payload damage.
- Engineered a shock-absorbing joint mechanism utilizing the repulsive force of neodymium magnets and PVC foam, completing 7 iterative design revisions to optimize joint angles up to 152 degrees.
- Conducted drop experiments using PASCO ultrasonic sensors and Capstone software to analyze kinematics (position, velocity, acceleration), identifying that a radial leg arrangement yields superior buffer performance.
- Validated the prototype's shock-absorbing capabilities, successfully achieving stable landings for a 1.5kg payload from a 1m height and a 3kg payload from a 50cm height.

Optimization of Deep Reinforcement Learning for Control Problems Aug 2019 – Sep 2019

KAIST Gifted Program: Pre-Undergraduate Research Program (Pre-URP) ***Student Researcher***

- Implemented and trained a Double Deep Q-Network (DDQN) agent to solve the CartPole control problem using Keras and OpenAI Gym environments.
- Conducted extensive hyperparameter tuning across 11 variables (e.g., learning rate, epsilon decay, network depth, activation functions) to stabilize the learning process and maximize reward acquisition.
- Evaluated the model's performance over 1,000 episodes, establishing that the optimized DDQN model achieved the success threshold (average score ¿ 195) in just 151.8 episodes on average.

- Significantly improved learning efficiency, outperforming the default model's baseline of 549.6 episodes by approximately 72%.
- Completed intensive 2-week on-site research mentored by Professor Jeha Ryu at the Gwangju Institute of Science and Technology (GIST).

Development of a Circular Twisted String Continuous Passive Motion Actuator Mar 2020 – Apr 2021

IASA (Incheon Academy of Science & Arts) SA (Steam Activity) Research Project ***Role: First Author / Project Lead***

- Developed a wearable, circular twisted string continuous passive motion (CPM) actuator to significantly reduce the volume and weight of traditional elbow rehabilitation devices.
- Engineered a 2-stage pulley system within the circular mechanism, which quadrupled the range of motion and speed to achieve a 10.6 cm operational range sufficient for rehabilitation.
- Established and experimentally validated a mathematical model to predict string displacement and output force based on the number of twists.
- Demonstrated through load testing with linear potentiometers that the actuator generates over 60N of force, surpassing the 32.6N benchmark required to move an adult male forearm at a constant velocity.
- Achieved up to a 15-fold increase in output force relative to motor torque, confirming the system's mechanical stability and efficiency for high-load rehabilitation tasks.

Optimal pMMG Sensor Placement for Knee Extensor Analysis Jun 2024 – Present

KAIST Undergraduate Research Program & Follow-up Research ***Project Lead & First Author***

- Independently conceptualized the research topic and spearheaded the entire project lifecycle—from initial hypothesis formulation to hardware design and experimental validation.
- Developed a synchronized data acquisition system using an STM32 microcontroller and MS5607 pressure sensors to capture muscle volume changes via pneumatic mechanomyography (pMMG), overcoming traditional sEMG/IMU limitations.
- Processed kinematic data using gait phase segmentation and Dynamic Time Warping (DTW) to map pMMG signals, establishing optimal sensor placement guidelines (e.g., 20% muscle length for vastus lateralis).
- Designed and executed advanced follow-up experiments at Angel Robotics using Motion Capture systems and Force Plates to simultaneously measure pMMG signals and actual knee joint torque via inverse dynamics.
- Currently drafting a first-author manuscript for journal submission detailing the quantitative assessment of knee extensor activation and joint torque estimation using pMMG sensors.

Awards & Honors

Research Project: "The Power of Twisted Strings: A Portable Elbow CPM Machine"

Regeneron ISEF & USAID May 2021

Fourth Award (Biomedical Engineering) & Science Champion Award *International*

- Recognized as one of the top research projects globally in the world's largest pre-college science competition.
- Awarded the Science Champion Award by the U.S. Agency for International Development (USAID).

Samsung Electronics Feb 2021

Samsung Humantech Paper Award - Gold Prize (Ranked 1st) *Corporate*

- Received the highest honor in the Physics/Earth Science category at South Korea's most prestigious corporate-led research competition.

Ministry of Science and ICT & KSEF Nov 2020 – Feb 2021

Grand Prize (Highest National Honor) & Gold Prize *Government*

- Awarded the **Grand Prize by the Ministry of Science and ICT** (YSC) for excellence in innovative biomedical research.
- Achieved the Gold Prize at the 18th Korea Science and Engineering Fair (KSEF).

Research Project: "Development of a Landing Device Inspired by Cat Skeletal Structure"

Korea Science Foundation Feb 2020

Research Excellence Award - Honorable Mention *National*

- Recognized for outstanding biomimetic research at the national level.

Extracurricular experience

KAIST Student Ambassador (KAINURI) Mar 2022 – May 2024
President (Official University Representative) *Daejeon, South Korea*

- Led the official student ambassador team, KAINURI, serving as a liaison between KAIST and the public to enhance the university's image.
- Organized and participated in events to promote KAIST's initiatives and achievements to external audiences.
- Developed and managed content for KAINURI's official social media platforms, increasing follower engagement by 25%.
- Collaborated with various university departments to coordinate promotional activities and campus tours for prospective students.

KAIST Creative Global Leader Camp Mar 2022 – May 2024
Head Teaching Assistant & Camp Coordinator *Daejeon, South Korea*

- Coordinated a camp designed to foster creativity and global leadership among high school students.
- Developed and facilitated interactive workshops and hands-on projects to enhance participants' scientific thinking and problem-solving skills.
- Supervised a team of teaching assistants, ensuring the smooth execution of camp activities and providing mentorship to participants.
- Managed logistics, scheduling, and communication with participants and their guardians, resulting in a 95% satisfaction rate among attendees.

Military Service & Work Experience

Gwacheon Family Center Feb 2025 – Nov 2026
Social Service Personnel (Mandatory Military Service) *Gwacheon, South Korea*

- Developed a Python-based automated transportation cost calculator with a custom GUI, integrating the Kakao Address API to streamline complex reimbursements and significantly reduce manual administrative workload.
- Completed mandatory military alternative service by providing educational mentorship to children from multicultural families and supporting community engagement initiatives.

Skills

Languages: Korean (Native), English (Fluent), German (Basic)
Programming & Software: Python, C, SolidWorks (CAD)
Robotics & Engineering: System Modeling & Control, Dynamics, Mechanical Vibrations, Circuit Theory
Hardware & Prototyping: Mechatronic System Integration, 3D Printing, Sensor Fabrication (pMMG), Actuator Interfacing
Research & Analytics: Real-time Data Acquisition, Signal Processing, Experimental Validation, Scientific Writing