

Simon (Hwanwoong) Kang

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EDUCATION

- **Columbia University** New York, NY
M.S. in Mechanical Engineering with concentration in Robotics & Control (GPA: 3.85/4.0) Sept 2022 – Current
- **Chung-Ang University** Seoul, Republic of Korea
B.S. in Mechanical Engineering Feb 2022

RESEARCH EXPERIENCE

- **Creative Machines Lab** Columbia University
Graduate Research Assistant, Robot Metabolism Project May 2023 - Current
 - **AprilTag Detection:** Developed a real-time AprilTag detection system using the AprilTags 3 library
 - **Camera Calibration:** Computed the calibration matrix for the camera to enhance detection accuracy
 - **Pose Estimation:** Employed OpenCV to compute the 3D pose of each detected tag relative to the camera
 - **Coordinate Transformation:** Transformed detected tag poses into a predefined global coordinate system
 - **Visualization:** Designed a visualization interface that displays the video feed with detected tags highlighted, indicating tag ID, global pose, and reprojection error
 - **Error Calculation:** Implemented a system to calculate and visualize reprojection errors for all detected tags, ensuring optimal system performance

RESEARCH PROJECTS

- **Reinforcement Learning for Robot Walking** Chung-Ang University
Implemented DDPG for RL agent training via Simulink (Advisor: Dr. Seungtae Choi) Sept 2021 - Dec 2021
 - **Environment Design:** Established stopping criteria and episode termination using MATLAB's RL toolbox
 - **Optimization:** Crafted a reward function to maximize returns based on the agent's current state actions
 - **Training Insights:** Analyzed an episode reward graph post a 10-hour training session; noted episodes with high deviation due to exploratory actions in unfamiliar environments
 - **Performance Metrics:** Achieved an average reward of 590.704 after 2227 episodes, with an overall trend of increasing rewards over time and a total of 727,529 steps
- **Optimization of 3-DOF Humanoid Robot Leg Posture** Chung-Ang University
Determined optimal joint angles to minimize torque (Advisor: Dr. Dongjun Shin) Mar 2021 - June 2021
 - **Kinematic Modeling:** Employed forward kinematics, Jacobian matrices, and dynamic equations for modeling
 - **Design & Assembly:** Designed and assembled robot components using CATIA, exporting the design as a URDF
 - **Control System:** Developed block diagrams in MATLAB Simulink, integrating PD controllers
 - **Performance Outcome:** Achieved a torque reduction of 1.5% on average and 11.3% at the knee joint by optimizing joint angles to ($j1 = -32.3^\circ$, $j2 = 87.6^\circ$, $j3 = -85.5^\circ$)
- **Drowsiness Detection via Eye Movement Tracking** Chung-Ang University
Leveraged flex sensors and OpenCV for drowsiness detection (Advisor: Dr. Giuk Lee) Mar 2021 - June 2021
 - **Sensor Integration:** Assembled a system using flex sensors, breadboard, electrical wiring, and Arduino Uno to quantify neck bending as an indicator of drowsiness.
 - **Visual Processing:** Implemented facial recognition using Raspberry Pi 4, Python, and OpenCV. Deployed Dlib library for face and eye detection and applied Histogram of Oriented Gradients for brightness-based object identification. Developed a blink ratio system using OpenCV's bilateral filter and thresholding for binary data conversion.
 - **System Fusion:** Synchronized mechanical and computer vision systems, introducing a time-based parameter. Triggered an LED warning if neck bending and eyelid closure persisted for over 2.5 seconds.
 - **Practical Application:** Potential to enhance safety for long-haul truckers, mitigating risks from unintended microsleep episodes.
- **UAV Wing Structural Analysis** Chung-Ang University
Determined optimal carbon thickness in a sandwich beam structure (Advisor : Dr. Youngsik Choi) Sept 2020 - Dec 2020

- **Material Selection:** Constructed a sandwich beam wing structure using Expanded Polypropylene (EPP) and carbon, denoted as C-EPP-C
- **Analytical Modeling:** Employed the sandwich beam equation to forecast stress, shear force, and deformation dynamics of the wing
- **CAD Analysis:** Integrated EPP and carbon material properties into a CAD model for structural analysis, utilizing CATIA's GSA function. Incorporated XFLR5 for evaluating wing and airfoil performance under low Reynolds numbers
- **Optimization Outcome:** Identified optimal carbon thickness at 1.5mm, achieving a maximum principal strength of 3.6MPa for carbon and 0.25MPa for EPP. Given allowable stresses of 1470MPa (Carbon) and 2.4MPa (EPP), the design proved to be stable with a considerable safety margin

PROFESSIONAL EXPERIENCE

- **Kia Motors** Seoul, Republic of Korea
Engineer, North America Safety Engineering Team, Global HQ *July 2022 - Sep 2022*
 - **Safety Oversight:** Led diagnostics and management of safety quality issues within powertrains, engines, and electric motors; collaborated extensively with KUS NASO and NHTSA.
- **Hyundai Motor Group** Seoul, Republic of Korea
Engineer, North America Field Analytic Engineering Team, Global HQ *Mar 2022 - July 2022*
 - **Project Leadership:** Directed the development of a safety data system for HMG's automotive brands (Kia, Hyundai, and Genesis) in collaboration with HMA, KUS, HAE, HAEA, and Deloitte. The final system was prominently showcased in partnership with Deloitte at a NHTSA event in Washington DC.
- **NAVER LABS** Seongnam, Republic of Korea
Data Assistant, AI Translation Team *Dec 2016 - Mar 2017*
 - **Deep Learning:** Engaged in a DNN initiative using TensorFlow aimed at enhancing the capabilities of the PAPAGO AI translator.
 - **Data Management:** Curated and annotated a specialized speech dataset to advance ML models for translation.

LEADERSHIP AND SERVICES

- **Literary Society Leader** Chung-Ang University
Directed reading groups, curated reading lists, and facilitated literary discussions *Oct 2018 - Feb 2022*
 - **Literary Exploration:** Guided discussions on seminal works by authors including Orwell, Hemingway, Emerson, Whitman, and Faulkner.
 - **Publication:** Spearheaded the compilation and publication of a book featuring select literary contributions from society members.
- **Military Interpreter** Korea Military Academy
Served in the Office of International Affairs *Jan 2015 - Oct 2016*
 - **Military Service:** Completed mandatory military service as a Korean citizen, serving in a pivotal role at KMA.
 - **International Relations:** Managed communications with renowned military academies globally, including the U.S. Military Academy at West Point.
 - **Collaborative Efforts:** Orchestrated Memorandum of Understanding (MOU) processes with diverse entities, notably the National Medical Center..

TECHNICAL PROFICIENCY

- **Programming Languages:** Python, C++, MATLAB, Java, JavaScript (Node.js)
- **Robotics & AI:** ROS (Gazebo, RViz), OpenCV, TensorFlow, PyTorch, Simulink
- **CAD & Hardware:** NX, Solidworks, Arduino, Raspberry Pi
- **Databases & Cloud:** MySQL, MongoDB, AWS (EC2, S3, Lambda)
- **Version & Collaboration:** Git, GitHub, Slack