Simon (Hwanwoong) Kang

Robotics Engineer & Researcher

simon.kang@columbia.edu
simonhwk.github.io | /in/simonhwk
(929) 989-8042

Education

- **Columbia University** — New York, NY
  M.S. in Mechanical Engineering with concentration in Robotics & Control (GPA: 3.85/4.0) — *Sept 2022 – Current*
  - **Selected Coursework**: Digital Manufacturing(A+), Competitive Programming(A+), Artificial Intelligence, Evolutionary Computation, Robot Learning, Data Science for Mechanical Engineers
- **Chung-Ang University** — Seoul, Republic of Korea
  B.S. in Mechanical Engineering (GPA: 92.69/100) — *Feb 2022*

Technical Skills

- **Programming Languages**: Python, C++, MATLAB, Java, JavaScript
- **Robotics & AI**: Linux, ROS (Gazebo, RViz), OpenCV, TensorFlow, PyTorch, Simulink
- **Electronics & Hardware**: PCB Design and Assembly, Arduino, Raspberry Pi 4, Particle Photon, Intel Realsense D435i(IMU), Streolabs ZED Mini
- **CAD**: NX(NX Design Academic Certified), CATIA, Solidworks
- **Manufacturing**: Laser Cutting, CNC Mil/Lathing, Injection Molding, 3D Printing, Mechanical Systems Assembly
- **Version Control & Collaboration**: Git, GitHub, Slack

Research Experience

- **Creative Machines Lab** — Columbia University
  Graduate Research Assistant, Robot Metabolism Project — *May 2023 - Current*
  - **Fabrication**: Designed PCB enclosures using Solidworks and 3D printed them with Ultimaker and Prusa
  - **Mechatronics**: Maintained 20+ robot links with its parts: particle photon, battery, motor, wifi antenna, etc
  - **Localization**: Built world reconstruction and robot localization system with AprilTags and 4K RGB cameras
  - **Neuroevolution**: Evolved DNN parameters using Genetic Algorithms (Roulette Wheel Selection)
  - **Simulation**: Nvidia Isaac Gym Reinforcement Learning Simulation (CUDA for GPU acceleration)
  - **Controlller Design**: Closed Loop Controller Integration and Implementation with Particle Photon (In Process)
- **Columbia Makerspace** — Columbia University
  Member, Columbia Sustainability and Recycling Project — *Sept 2023 - Current*
  - **Materials**: Aided in managing the Bill of Materials and ordered listed items from McMaster-Carr
  - **Parts Preparation**: Printing customized parts needed for converting plastic to 3D printing filament (In Process)

Academic Projects

- **Digital Manufacturing** — Columbia University
  Delved into a variety of digital manufacturing methods, from 3D printing to laser cutting — *Jan 2023 - May 2023*
  - **Food Printing**: Developed a tailored G-code generator script for FDM based food printing
  - **Laser Cutting**: Wrote python script for automatically generating G-code when given a set of specifications
  - **Topology Optimization**: Leveraged nTopology for the design optimization of desks and chairs
  - **Lampshade Lattice**: Designed a script in OpenSCAD to produce STL files for geometric lattice structures
- **Robot Walking via Deep Deterministic Policy Gradient** — Chung-Ang University
  Implemented DDPG for RL agent training via MATLAB Simulink (Advisor: Dr. Seungtae Choi) — *Sept 2021 - Dec 2021*
  - **Algorithm Implementation**: Utilized DDPG on MATLAB's standard robot model for reinforcement learning to optimize walking postures.
  - **Reward Function Design**: Defined a multi-parameter reward function factoring in forward velocity, power consumption, and displacements (both vertical and lateral) for guiding the RL agent's actions
  - **Simulated Testing**: Set up a MATLAB simulated sidewalk environment, spanning 25 meters in length, where the robot learned to walk efficiently, showcasing trajectories without significant deviations

- **Data Analysis**: Observed and interpreted fluctuations in rewards and potential convergence to local maxima throughout training episodes.
- **Performance Outcome**: Successfully achieved robot walking with an episode reward of 846.6369, following real-world sidewalk constraints, and maintained an average of 554.65 steps per episode

- **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°, j2 = 87.6°, j3 = -85.5°)

- **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.

Professional Experience

- **Hyundai Motor Group** Seoul, Republic of Korea
  Engineer, North America Field Analytic Engineering Team, Global HQ *Mar 2022 - Sep 2022*
  - **Project Leadership**: Partnered with Hyundai Motor America, Kia US, and Deloitte US to guide the development of ML based Safety Data Analytics Infrastructure. The infrastructure explored and evaluated qualitative data to achieve early detection of emerging safety issues, and showcased our project in Washington, D.C. for NHTSA
  - **Root Cause Identification**: Collaborated with the R&D, Quality, Procurement, Manufacturing, and Factory Divisions to identify and scrutinize the root cause of potential safety issues for engines, powertrains, and electrification
  - **Engineering Documentation and Evaluation**: Reviewed GD&T and CAD drafts, conducted field verification, and organized component evaluation with R&D for possible ECOs and Safety Committee Review

- **NAVER LABS** Seongnam, Republic of Korea
  Data Asistant, 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*
  - **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