CHANKYO KIM

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Research Interests

Geometric modeling and Processing, Matrix Lie Group and System Analysis, Equivariant Feature Learning, Multi-modality in Manipulator and Mobile Robotics, Large-scale Optimization, Hybrid Systems, Graph NN, Sensorfusion Learning, Neural Representation

Education

University of Michigan - Ann Arbor *MI, USA* Sep. 2022 – Present
- M.S.c, Major: Control, Mechanical Engineering
- Supervisor : Prof. Maani Ghaffari (maanigj@umich.edu)
- Overall GPA - 4.0/4.0

Seoul National University (SNU) *Seoul, Republic of Korea* Mar. 2015 – Aug. 2022
- Bachelor of Science, Dept. of Mechanical and Aerospace Engineering
- Overall GPA - 4.06/4.3, Graduated as the 3rd in the Department
- 2 year work in military service, Seoul Metropolitan Police Agency

Hansung Science High School *Seoul, Republic of Korea* Mar. 2013 – Feb. 2015
- Early Graduation with Honors

Research Experiences

1. Univeristy of Michigan - Ann Arbor Jan. 2023 – Nov. 2023

Advisor : Prof. Maani Ghaffari

IMU Equivariant Learning : A general SO(3) equivariant framework for neural network
- Presented general framework of SO(3) equivariant learning that learns underlying geometries of temporal IMU signals without additional augment in data or modeling
- Our network design serves as general framework preserving SO(3) geometries of group action and sensory data. We showed that it can easily integrated into modern robotics application, extended kalman filter, with simple, lightweight, accurate design compared with existing network designs.
- Published project page and draft preparation for top-tier robotics journal publication[link]

Advisor : Prof. Gabor Orosz

Adaptive intelligent driver model in safe-efficient control for V2V Connected Automated Systems
- Propose advanced intelligent driver model with adaptive regularizer to enable stable trajectory optimization in connected mobile systems without extensive computation required in MPC-based approach
- Experiment showed the proposed algorithm reduces energy consumption satisfying safety boundary in complex connected vehicle system

Advisor : Prof. Ram Vasudevan

Development of Contact Solver and Simulation for Bipedal Robot
- Developing contact solver in the closed-loop constraint bipedal robot ("Digit").
- Developed new simulation environment and accurate closed-loop constrained robot model for accurate contact calculation (MuJoCo, Matlab to PyBullet)

2. Seoul National University

Biorobotics Laboratory, SNU Mar. 2020 – Sep. 2020

Advisor: Prof. Kyujin Cho, *Undergraduate Research Internship, UROP*
- Developed wearable master system with novel Tendon-clutching Mechanism and Model Predictive Control

- Studied and developed sensor fusion algorithm to use data stream of encoder, inertial sensor, and force sensor to control teleoperated wearable device

3. Company Research

Intellicon Metalab, *Summer Research Intern (former), AI Researcher (latter)* Summer.2021, May–Dec.2022
Advisor: Prof. Young-yik Rhim
- Researched Visually-Driven Text-Speech Synthesis Project, developing audio reconstruction autoencoder
- Integrated VR simulator with network for company product in market, published patent [link]

Bear Robotics Research Laboratory, *3D SLAM Research Intern* Feb. 2022 – April. 2022
Advisor : Dr. John Ha
- Developed backend graph optimization algorithm for 2D/3D SLAM algorithm with monocular camera and LiDAR to achieve accurate mapping quality in dynamic objects with less mapping effort.

Publications

Authored academic books from 2020 to 2022 as part of an Education Project, focusing on fundamental topics in perception, planning, and deep learning network design using Python. This initiative aimed to provide robotics education to students facing challenges associated with their regional location and economic circumstances.

- **C.K.Kim**, et al., $Kang.H^*$, Introduction of Python and Autonomous Robot System with MIT Race Car, *Hongreung Publishing Company*, 2022. [link]
- **C.K.Kim**, et al., $Kang.H^*$, Introduction of Calculus and Artificial Intelligence wth Advanced Python, *Hongreung Publishing Company*, 2022. [link]
- J.H. Im, **C.K.Kim**, et al., $Kang.H^*$, Introduction of Natural Language Processing and Data Analysis, *Hongreung Publishing Company*, 2022. [link]

C.K.Kim, M.Zhu, $M.Ghaffari^*$, IMU Equivariant Learning : A general SO(3) equivariant framework for neural network, *Paper In Preparation*, 2023 [git]

Projects

Noise Adaptive I-EKF Real-Time Semantic Bird's Eye View Mapping Dec. 2022 – March. 2023
- Train Noise Parameter Adapter in Invariant Extended Kalman Filter (I-EKF) for State Estimation / Use learned I-EKF state estimation with semantic bird's eye view mapping algorithm (MotionNet) to generate Global Bird's Eye View Map
- Advisor : Prof. Maani Ghaffari

Investigation of Policy Optimization for Multi-agent system Dec. 2022 – March. 2023
- Designed 4 multi-agent game simulation and analyzed the impact of hyper parameter in PPO, TRPO and compared with Double DQN and Montle Carlo Tree Search model
- Advisor : Prof. Honglak Lee

Fewshot learning in Body Keypoint Extract and Human Pose Estimation Aug. 2021 – March. 2022
- Generated human pose dataset for domain generalization in various viewpoints, resolution, and luminous intensity.
- Developed modified few-shot learning algorithm of human pose estimation from collected human key point data.
- Advisor : Prof. Joonseok Lee

Writing

Full-donation mentoring project for young highschool students in South Korea (21 authors).

- **C.K.Kim**, et al., Why Engineering, *MegaStudy Books*, Jan. 2022. [link]

Teaching Experiences

Theory and Lab of IoT, AI, and Big Data, *Department of Computer Science*, SNU, Fall. 2021

Advanced Physics, *Department of Physics & Astronomy*, SNU, ***Best Teach Award*** Fall. 2021

Physics, *Department of Physics & Astronomy*, SNU Fall. 2019

Graduate Courses

Mobile Robotics	(grade : A)
Connected Vehicles	(grade : A)
Machine Learning CSE	(grade : A)
Mechanical System Modeling and Control	(grade : A+)
Convex Optimization	(grade : A)

Extra Curricular

OUTTA | *Non-Profit Organization for AI education* Mar. 2020 – June. 2022

- Organized Organization for democratization of AI Education in young students in Korea, United States
- Developed AI/Robotics Education Bootcamp
  - Summer 2021, "Autonomous Driving Coding Bootcamp : Perception and Planning"
  - Summer 2022, "Image Processing Bootcamp : Facial Emotion Recognition"
  - Summer 2023, "Generative Model Bootcamp : Facial Image/Video Generation"

STEM | *Honor Society of Seoul National University, College of Engineering* Mar. 2020 – June. 2021

- Serve as 10th Vice Chairman
- Launch seminar: Optimization in Autonomous Vehicle Driving / AI algorithm inspired by how human learns: Introduction of Reinforcement Learning

Awards and Scholarships

International Graduate Research Fellowship, Daeshin Songchon Fundation, Korea 2023 –

- Full Tuition for Graduate Study, 2 years
- Awarded to one M.S. student at South Korea

Summa Cum Laude (Graduation Honors), Seoul National University 2022

Sinyang Eminence Scholarship, Sinyang Foundation, Korea 2020 – 2022

- Full Tuition for Academic Excellence during Bachelor Study

Certificate of Appreciation, Dean of the College of Engineering, SNU July. 2021

- Acknowledgement of genuine efforts at the forefront of Robotics Education in Korea

Research Fellowship, Practical Problem Research Group, Korea July. 2021

- $7,000/year research fellowship for practical problems in dynamic systems

2020 Human-Robot Interaction Robot Design Competition, Seoul National University July. 2020

- The Grand Prize

Samsung Humantech Paper Award, Samsung Feb. 2014

- The Bronze Prize

Korea Mathematical Olympiad, Korean Mathematical Society 2011

- Silver Medal

Korea Physics Olympiad, The Korean Physical Society 2011

- Silver Medal

Technical Skills

Languages : Python (Advanced) , Matlab (Advanced) , C++ , Solidworks
Library and Platform (Advanced) : PyTorch , Physic Engines (PyBullet , MuJoCo) , ROS