Minsung Kim

Current Affiliation

Ph.D. candidate (2021.08), Dynamic Robotic System Lab (DYROS Lab, http://dyros.snu.ac.kr/), Dept of Trandisciplinary Studies, Seoul National University

Contact Information

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For source codes: https://github.com/WestsideMS

Education

Seoul National University, Seoul, Korea **2011.3 - 2021.8**
Ph.D. of Dept of Trandisciplinary Studies (Robotics)
- Lab: Dynamic Robotic System Lab (DYROS Lab, http://dyros.snu.ac.kr/)
- Advisor: Professor Jaeheung Park (park73@snu.ac.kr)

Chung-Ang University, Seoul, Korea **2003.3 - 2010.2**
B.A., Electrical and Electronics Engineering, Feb., 2010

Research Experience

Advanced Institute of Convergence Technology (AICT), Suwon, Korea **2010.7 - 2011.02**
Internship
- Lab: Dynamic Robotic System Lab (DYROS Lab, http://dyros.snu.ac.kr/)
- Advisor: Professor Jaeheung Park (park73@snu.ac.kr), Junghoon Kwon (Ph.D., AICT)

Research Interests

Path planning and Path following control of an Autonomous Vehicle using Optimal Control method

Sampling and Search Method based Motion Planning of a Nonholonomic Mobile Robot

Decision Making using Model Predictive Control scheme

Deep Learning method for Parking Lot Detection (YOLO v3, etc.) and Drivable Area Detection (VGG net)

Machine Learning for Human Gait Recognition

Manipulation of Industrial Robot (6-DoF)

Research Experience

During Ph.D. student

Autonomous Driving Cars In Unstructured Environment **2016 - Presence**
- Path planning, Decision making, and Integration researches [DC5],[DC7],[DC8],[J8]
  - ✓ Autonomous parking algorithm using automatic selection of forward and backward switching points via model predictive control (MPC)
  - ✓ [DC7] Presentation : https://youtu.be/OQXkArMRLTw
- Path following and Collision Avoidance researches [DC3],[DC4],[DC6],[J6],[J9]
  - ✓ Model Predictive Control Method for Autonomous Vehicles using Time-Varying and Non-uniformly Spaced Horizon

✓ [J9] Presentation : https://youtu.be/eo7fYDLGQcg

- Recognition researches [J4],[J5]
  - ✓ Parking Line Based SLAM approach using AVM/LiDAR Sensor Fusion for Rapid and Accurate Loop Closing and Parking Space Detection
  - ✓ [J5] Presentation : https://youtu.be/DCaltpi9X0s

[Ongoing paper] Autonomous Parking Method Using Model Predictive Control:a feasibility and stability study

✓ Presentation : https://youtu.be/KJVo_7RSWbk

[Ongoing paper] [Carsim] Variable Interval Prediction Model Predictive Control (VIP-MPC) for the local planning and following of an autonomous vehicle

✓ Presentation : https://youtu.be/zjRWDb2kr3o

[Ongoing project] Automatic integrated parking system

- Localization: LeGO-LOAM (SLAM)
- Recognition: YOLO (v3)
- Path planning: Informed RRT star (OMPL)
- Path-following: Model predictive controller using a dynamic bicycle model

✓ Presentation : https://youtu.be/lnz1ppNMHq0

Valet Parking PROJECT, Phantom AI,USA **2020 - Presence**

- Path following algorithm development

✓ site: https://phantom.ai/

SMART CAMPUS PROJECT, SAMSUNG (SAIT) **2016 - 2020**

- From 2017 to 2019, project leader
- Development Autonomous Valet Parking System

✓ Presentation: http://dyros.snu.ac.kr/project/%EC%9E%90%EC%9C%A8-%EB%B0%9C%EB%A0%9B-%ED%8C%8C%ED%82%B9/

Study on Vehicle Lateral Control for Backward Driving **2015 - 2016**

- Design and development of backward driving algorithm for autonomous vehicle [C3]

DARPA ROBOTICS CHALLENGE FINAL 2015, USA **2014 - 2015**

- United States Department of Defense
- Complete the first mission (Drive the vehicle using Humanoid)
- Development of a guided user interface (UI) using a camera via Inverse Perspective Mapping (IPM) scheme [J2]
  - ✓ Video: https://youtu.be/KrjQxV53e0g
- No falling down during the competitions and 12th in DRC Finals 2015 [J3]
  - ✓ Video: https://youtu.be/YJlkYRONB9k

Path Planning research **2013 - 2014**

- Modified A star, Search algorithm
- Robust path planning for autonomous vehicle in position uncertainty [C1]

KOREA AUTONOMOUS VEHICLE CONTEST **2012 - 2013**

- Line recognition using 2D lidar data and autonomous vehicle testing (Hyundai, Grandeur 240)
- Full course complete, 5th in overall, 1st among the teams that participated in the self-driving competition for the first time
  - ✓ Video: https://youtu.be/EyjRJQamkrg
  - ✓ Presentation: http://dyros.snu.ac.kr/project/korea-autonomous-vehicle-contest-2013/

Torque-based control on industrial robot for human-robot cooperation **2011 - 2012**
- NT Robot. http://www.ntrobot.net/main
- Implementation of Torque-based Control on Industrial Robot for Human-Robot Cooperation
- Inverse Kinematics for 6-DoF manipulator
  - ✓ Video: https://youtu.be/vshUS2uSchQ

Human recognition by gait analysis using motion capture system **2011.3 - 2013.2**
- Research and Development on Human recognition algorithm by using 3D Motion Capture System
- Machine Learning based approach to identify individual humans.
- Feasibility study of gait recognition using points in three-dimensional space [J1]
- The Research of 2D GEI using Motion Capture Data [DC1]

During internship in AICT, Suwon *Research on the 3D motion capture system* 2010.7 - 2011.2
- Survey and Research on the Motion Capture System
- Pilot project

Technical skills

Hardware Experience

Intelligent Vehicle, Mobile Platform
- Hyundai Grandeur HG 240, *DYROS-Spirit1*
- Wheeled Mobile Robot, *TETRA-DS*

Manipulator
- 6-DoF arm, *Roman-3D*
- 6-DoF arm, *Hyundai HA020*

Software Experience

Programming Skills
- Intermediate C++, Python, and Matlab programming for robotics (Windows, Ubuntu 16.04)
- Carsim: Comparison of Path-following algorithms, Autonomous Parking (Perpendicular, Parallel and Angle Parking, Highway navigation, Collision avoidance)
- ROS (Robot Operating System), V-Rep, CARLA, Gazebo
- OpenCV

Libraries
- Math - Eigen, Lapack, MKL
- Optimization - CVXGEN, Gurobi, qpOASES, IFOPT and IPOPT

Awards

Scholarship Half Scholarship for academic excellence at Seoul National University, 2013.

KOREA AUTONOMOUS VEHICLE CONTEST 5th in overall (1st among the teams that participated in the self-driving competition for the first time) 2013.

- ✓ Video: https://youtu.be/EyjRJQamkrg

DARPA ROBOTICS CHALLENGE FINAL, USA 12th in overall (World No.1 team using platform THORMANG) 2015.

✓ Video: https://youtu.be/YJlkYRONB9k

Journal Articles

[J9] **M. Kim**, D. Lee, J. Ahn, M. Kim, and J. Park. Model Predictive Control Method for Autonomous Vehicles using Time-Varying and Non-uniformly Spaced Horizon. IEEE ACCESS (Accepted, 2021.5.16), 2021.

[J8] M. Kim, J. Ahn, **M. Kim**, and J. Park. A Comparative Analysis of Path Planning and Tracking Performance According to the Consideration of Vehicle's Constraints in Automated Parking Situations. Minor Revisions Required (2021,04,27), The Journal of Korea Robotics Society, 2021.

[J7] J. Ahn, S. Shin, **M. Kim**, and J. Park. ACCURATE PATH TRACKING BY ADJUSTING LOOK-AHEAD POINT IN PURE PURSUIT METHOD. International journal of automotive technology 22 (1), 119-129, 2021.

[J6] **M. Kim**, G. Im, and J. Park. A Comparative Study of Parking Path Following Methods for Autonomous Parking System, The Journal of Korea Robotics Society 15 (2), 147-159, 2020.

[J5] G Im, **M. Kim**, and J. Park. Parking line based SLAM approach using AVM/LiDAR sensor fusion for rapid and accurate loop closing and parking space detection. Sensors 19 (21), 4811, 2019.

[J4] K. Park, G. Im, **M. Kim**, and J. Park. Parking space detection based on camera and LIDAR sensor fusion. The Journal of Korea Robotics Society 14 (3), 170-178, 2019.

[J3] S. Kim, M. Kim, J. Lee, S. Hwang, J. Chae, B. Park, H. Cho, J. Sim, J. Jung, H. Lee, S. Shin, **M. Kim**, W. Choi, Y. Lee, S. Park, J. Oh, Y. Lee, S. Lee, M. Lee, S. Yi, K. Chang, N. Kwak, and J. Park. Team SNU's Control Strategies to Enhancing Robot's Capability: Lessons from the DARPA Robotics Challenge Finals 2015, The DARPA Robotics Challenge Finals: Humanoid Robots to the Rescue, Springer, pp. 347-379, 2018.04

[J2] S. Shin, **M. Kim**, and J. Park. Development of Tele-operation Interface and Stable Navigation Strategy for Humanoid Robot Driving. Journal of Institute of Control, Robotics and Systems 22 (11), 904-911, 2016.

[J1] **M. Kim**, M. Kim, S. Park, J. Kwon, and J. Park. Feasibility study of gait recognition using points in three-dimensional space. International Journal of Fuzzy Logic and Intelligent Systems 13 (2), 124-132, 2013.

International Conference Articles

[C4] J. Ahn, **M. Kim**, S. Kim, S. Lee, and J. Park. Formation-based tracking method for human following robot. 15th International Conference on Ubiquitous Robots (UR), 2018.

[C3] **M. Kim**, S. Shin, and J. Park. Study on vehicle lateral control for backward driving. 13th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), 2016.

[C2] S. Kim, M. Kim, J. Lee, S. Hwang, J. Chae, B. Park, H. Cho, J. Sim, J. Jung, H. Lee, S. Shin, **M. Kim**, N. Kwak, Y. Lee, S. Lee, M. Lee, S. Yi, K. K.C. Chang, and J. Park. Approach of Team SNU to the DARPA Robotics Challenge Finals. 2015 IEEE-RAS International Conference on Humanoid Robots, Seoul, Korea, 3-5 Nov 2015.

[C1] J. Im, **M. Kim**, S. Shin, and J. Park. Robust path planning for autonomous vehicle in position uncertainty. 11th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), 2014.

Domestic Conference Articles

[DC8] M. Kim, J. Ahn, **M. Kim**, and J. Park. Intersection Detection and Navigation at Un-

structured Environment using Candidate Trajectory. The Korean Society of Automotive Engineers Annual Autumn Conference, 2020.

[DC7] **M. Kim**, G. Im, J. Ahn, M. Kim, and J. Park. Autonomous parking algorithm using automatic selection of forward and backward switching points via model predictive control. The Korean Society of Automotive Engineers Annual Autumn Conference, 2018.

[DC6] J. Ahn, M. Kim, G. Im, **M. Kim**, and J. Park. Development of Autonomous Valet Parking System and Simulation Result. The Korean Society of Automotive Engineers Annual Conference, Korea, 2018.

[DC5] G. Im, **M. Kim**, J. Ahn, M. Kim, and J. Park. V-Rep Simulator for Autonomous Vehicle Research in Parking lot Environment. The Korean Society of Automotive Engineers Annual Conference, Korea, 2018.

[DC4] **M. Kim**, and J. Park. Autonomous Parking using Sampling-Based Path Planning and Model Predictive Control, The Korean Society of Automotive Engineers Annual Conference, Korea, 2018.

[DC3] **M. Kim**, J. Ahn, and J. Park. A comparative study on the steering controller for autonomous parking, The 13th Korea Robotics Society Annual Conference, Korea, 2018.

[DC2] S. Kim, **M. Kim**, and J. Park. Collision-free motion planning based on elastic band theory for autonomous driving, The Korean Society of Automotive Engineers Annual Conference, Korea, 2014.

[DC1] **M. Kim**, J. Park, and J. Kwon. The Research of 2D GEI using Motion Capture Data, Human Computer Interaction Conference, pyeongchang, Korea, 13.01.2012.

Academic Services

Reviewer for IEEE Intelligent Vehicles Symposium (IV), 2020.
Reviewer for IEEE Conference on Decision and Control (CDC), 2020.
Reviewer for IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2018.
Reviewer for IEEE International Conference on Ubiquitous Robots (UR), 2018.