Eungchang Mason **Lee**

ROBOTICS RESEARCHER · UAVs EXPERT

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🐙 engcang | 🎓 Google Scholar | 🏠 engcang.github.io

About Me

I am a well-organized, fast-learning, and hard-working person. My research interests are laid on UAVs, Exploration, Path planning, Control, SLAM, and Quadruped Robots.

I recommend to look over my 🐙 Github and ▶ Youtube

Education

KAIST (Korea Advanced Institute of Science and Technology)   *Daejeon, Rep. of Korea*
PH. D. CANDIDATE IN ELECTRICAL ENGINEERING, URBAN ROBOTICS LAB   *Mar. 2021 - **Current***

KAIST (Korea Advanced Institute of Science and Technology)   *Daejeon, Rep. of Korea*
MASTER IN ELECTRICAL ENGINEERING, URBAN ROBOTICS LAB   *Mar. 2019 - Feb. 2021*
- GPA: 3.63/4.3

KyungPook National University   *Daegu, Rep. of Korea*
BACHELOR IN SCHOOL OF ELECTRONICS ENGINEERING   *Mar. 2012 - Feb. 2019*
- Graduation with top honors, **GPA: 4.23/4.3**, **rank: 2/354**
- Two-year leave for military service
- One-year leave for Working Holiday in Canada

Skills

Tools	MATLAB, Solidworks, Blender, Sketchup, Gazebo
Programming	ROS, C/C++, Python, MATLAB, Markdown, LaTeX, HTML
Languages	Korean, English

Honors & Awards

2022. 10	**Only one team that finished the course**: Autonomous Flight Competition in Battlefield Situations	*Rep. of Korea*
2019. 12	**3rd Prize/424**: AIRR AlphaPilot (LockheedMartin & The Drone Racing League)	*U.S.A*
2019. 02	**Grand Prize**: The right person of University (SmartKey-KyungPook National University)	*Rep. of Korea*
2019. 02	**2nd Prize/354**: Best Graduates of The Year (KyungPook National University)	*Rep. of Korea*
2018. 11	**MathWorks Korea Special Prize**: R-BIZ Challenge Turtlebot3 Autorace (ROBOTIS & MathWorks Korea)	*Rep. of Korea*

Experiences & Projects

Autonomous Flight Competition in Battlefield Situations   *Rep. of Korea*
HOSTED BY ADD   *May. 2022 - Oct. 2022*
CONDUCTED AT URBAN ROBOTICS LAB IN KAIST
- The competition aims to develop an autonomous drone to pass through complex and dangerous outdoor obstacles, infiltrate an unknown two-story building, detect hidden targets, create precise 3D maps including target types and coordinates, and return to the starting point safely.
- I developed main framework including local/global path planners, 3D map logger with the detected target positions and a decision-making system.
- Relative video - video

KHNP Virtual Robot Challenge 2022 (as a maintainer)

Rep. of Korea

HOSTED BY KHNP

Sep. 2022 - Dec. 2022

- The goals of the competition was to develop a autonomous navigation algorithm and a robust controller to complete diverse and challenging tasks including obstacle avoidance, exploration, and enduring the wind disturbances.
- I made Gazebo maps for the competition and coded scoring GUI. Additionally, I coded sample controllers for the the quadrotor UAV.
- Relative video - video

Palm Tree Field Exploration and Tree Identification with UAV / UGV

Rep. of Korea

CONDUCTED AT AKA-AI ROBOTICS

Nov. 2021 - May. 2022

- The final goal of this research project is to develop an exploration system for monitoring unknown palm tree orchard environments while avoiding collisions and figuring out appearances of trees.
- I developed the whole system including pointcloud data processing, path planning, and controller. A state-of-the-art open-sourced SLAM algorithm is utilized.
- Relative videos - video1, video2

IEEE UAV Competition

U.S.A

HOSTED BY LPCV

Jan. 2022 - Feb. 2022

CONDUCTED AT URBAN ROBOTICS LAB IN KAIST

- The goals of the competition was to track the non-uniform motion vehicle at constant distance away with a quadrotor UAV, while avoiding obstacles.
- We estimated the trajectory of the moving vehicle in the form of 5th order polynomial using the detected center point with YOLO network. Then, Adaptive weight Model Predictive Controller (AMPC) is designed to track the target effectively.
- I mainly developed state estimator and MPC controller.
- Relative video - video

KHNP Virtual Robot Challenge 2021 (as a maintainer)

Rep. of Korea

HOSTED BY KHNP

Sep. 2021 - Dec. 2021

- The goals of the competition was to develop a autonomous navigation algorithm and a robust controller to complete diverse and challenging tasks including obstacle avoidance, manipulation for grasping a cube, climbing stairs, and enduring the disturbances.
- I made Gazebo maps for the competition and coded scoring GUI. Additionally, I coded sample controllers for the manipulator and the quadruped robot.
- Relative video - video

Unmanned Swarm CPS Research Lab

Rep. of Korea

SUPPORTED BY ADD

Jan. 2021 - Dec. 2021

CONDUCTED AT URBAN ROBOTICS LAB IN KAIST

- In this project, we developed adaptive multi robot localization method. With the high fidelity networking, artificial intelligent cooperative control, and mobile ground control station, unmanned swarm system has been researched to operate cyber-physical systems.
- As my lab was in charge of managing all 10 labs and developing multi robot localization, I mainly managed all members in the project, validated whole system for the demonstration, and developed localization algorithm.
- Relative video - video
- Relative paper - DOI: 10.23919/ICCAS52745.2021.9649888

Autonomous Drone Navigation for Power Line Inspection in Underground

Rep. of Korea

SUPPORTED BY KEPCO AND KEPRI

Aug. 2020 - Dec. 2022

CONDUCTED AT URBAN ROBOTICS LAB IN KAIST

- In this project, we developed indoor SLAM, navigation, and exploration method to operate an UAV exploring the underground power line tunnel safely.
- In consideration with the limited payload and computational resource of the UAV, the precomputed and lightweight local exploration planner was developed.
- I mainly developed path planner and navigation system.
- Relative videos - video1, video2, video3
- Relative publications - DOI: 10.1007/978-981-16-4803-8_16, DOI: 10.1109/IROS51168.2021.9636611

A Study on the Visual-Inertial Navigation System of Artificial Intelligent Unmanned Aerial Vehicle for Reconnaissance and Exploration

Rep. of Korea

HOSTED BY ROND

May. 2020 - Nov. 2020

CONDUCTED AT URBAN ROBOTICS LAB IN KAIST

- The main goal of this project is to develop an UAV system with Visual-Inertial Navigation System for 3D mapping of unknown environments adopting single RGB-D camera.
- I mainly implemented whole system including VIO, YOLO object detection, mapping system, and controller.
- Relative video - video

AIRR AlphaPilot (Artificial Intelligence Robotic Racing)   *U.S.A*

Hosted by Lockheed Martin and The Drone Racing League   *Mar. 2019 - Dec. 2019*

Conducted at Unmanned Systems Research Group in KAIST

- AlphaPilot is the first large-scale open innovation challenge of its kind focused on advancing artificial intelligence (AI) and autonomy. The main goal of this competition is to finish the drone racing track as soon as possible autonomously.
- I mainly implemented a VIO (Visual-Inertial Odometry) and Kalman filter-based state estimator and basic controller.
- Our team won the 3rd prize among 424 teams over 81 countries.
- Relative videos - Youtube playlist

R-BIZ Challenge Turtlebot3 Autorace   *Rep. of Korea*

Hosted by ROBOTIS, MathWorks Korea, KIRIA, and MOTIE   *Jun. 2018 - Nov. 2018*

Conducted at Physical Intelligence Lab in KyungPook Natl. Univ.

- ROS based autonomous driving system for a mobile robot (Turtlebot3) is developed for completing the racing track with diverse missions.
- I mainly developed Lyapunov functional to control the robot, HOG-based object detector, and decision-making mission planner.
- Our team won the MathWorks Korea Special Prize.

Research on Multi-Rate Sensor Fusion based Mobile Robot Model Predictive Control System   *Rep. of Korea*

Supported by The Electronics and Telecommunications Research Institute (ETRI)   *Apr. 2018 - Dec. 2018*

Conducted at Physical Intelligence Lab in KyungPook Natl. Univ.

- The final goal of this research project is to design multi-rate State Estimator that can assume exact state using asynchronized data from a vehicle's multi sensor system.
- I mainly developed ROS based data processing system, LiDAR based path planning for the mobile robot.
- Relative publication - DOI: 10.1109/ICCE.2019.8661985

Military service   *Rep. of Korea*

Republic of Korea Army   *Mar. 2013 - Dec. 2014*

- Served as a Signaller in Combat Support Company
- Discharged as Sergeant

Activities

1. **2022 UVS Symposium:** Invited talk - "How we won Autonomous Flight Competition in Battlefield Situations", 2022. 12., *Daejeon, Rep. of Korea*

2. **KBS JungGyeon-ManLi Season 3** - "Ep 6. Coexistence with Robots", Co-operation with Meere Company, 2021. 11., *Video*

Featured Publications

(†: Co-first author)

1. **E. M. Lee**, A. Nahrendra, J. Choi, S. Lee, and H. Myung, "Autonomous Flying Drone for Unmanned Reconnaissance in Battlefield Situations", *Korea Robotics Society Annual Conference (KRoC) RED Show*, **Best work Awarded**, 2023, *Pyeongchang, Rep. of Korea*

2. **E. M. Lee**, J. Choi, H. Lim, and H. Myung, "REAL: Rapid Exploration with Active Loop-Closing toward Large-Scale 3D Mapping using UAVs", *IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems **(IROS)***, 2021, *Prague, Czech Rep.*

3. **E. M. Lee**, D. Choi, and H. Myung, "Peacock Exploration: A Lightweight Exploration for UAV using Control-Efficient Trajectory", *Intl. Conf. on Robot Intelligence Technology and Applications (RiTA)*, **Best paper Awarded**, 2020, *Rep. of Korea*

4. **E. M. Lee** *et al.*, "Development of a 3D Mapping System including Object Position for UAV with a RGB-D camerain an Unknown and GNSS-denied Environment", *Institute of Embedded Engineering of Korea 2020 Fall Conference (IEMEK)*, **Best paper Awarded**, 2020, *Rep. of Korea*

Other Publications

(†: Co-first author)

International Journal Papers

1. I. M. A. Nahrendra, C. Tirtawardhana, B. Yu, **E. M. Lee**, and H. Myung, "Retro-RL: Reinforcing Nominal Controller with Deep Reinforcement Learning for Tilting-Rotor Drones", *IEEE Robotics and Automation Letters **(RA-L)***, 2022

2. M. Oh, E. Jung, H. Lim, W. Song, S. Hu, **E. M. Lee**, J. Park, J. Kim, J. Lee, and H. Myung, "TRAVEL: Traversable Ground and Above-Ground Object Segmentation Using Graph Representation of 3D LiDAR Scans", *IEEE Robotics and Automation Letters **(RA-L)***, 2022

3. Y. Kim, B. Yu, **E. M. Lee**, J. Kim, H. Park, and H. Myung, "STEP: State estimator for legged robots using a preintegrated foot velocity factor", *IEEE Robotics and Automation Letters **(RA-L)***, 2022

4. J. Jeon, S. Jung, **E. M. Lee**, D. Choi, and H. Myung, "Run Your Visual-Inertial Odometry on NVIDIA Jetson: Benchmark Tests on a Micro Aerial Vehicle", *IEEE Robotics and Automation Letters **(RA-L)***, 2021

International Conference Papers

1. J. Choi, **E. M. Lee**, M. Jeong, D. Choi, and H. Myung, "Range-only Relative Position Estimation for Multi-UAV", *IEEE International Conference on Control, Automation and Systems (ICCAS)*, 2022, *Busan, Rep. of Korea*
2. **E. M. Lee**, *et al.*, "CEO-MLCPP: Control-Efficient and Obstacle-Aware Multi-Layer Coverage Path Planner for 3D Reconstruction with UAVs", *International Conference on Robot Intelligence Technology and Applications (RiTA)*, 2022, *Gold Coast, Australia*
3. D. Lee, **E. M. Lee**, H. Lim, S. Song, and H. Myung, "FARO-Tracker: Fast and Robust Target Tracking System for UAVs in Urban Environment", *International Conference on Robot Intelligence Technology and Applications (RiTA)*, 2022, *Gold Coast, Australia*
4. D. Lee, **E. M. Lee**, D. Choi, J. Choi, C. Tirtawardhana, and H. Myung, "M-BRIC: Design of Mass-driven Bi-Rotor with RL-based Intelligent Controller", *International Conference on Ubiquitous Robots (UR)*, 2022, *Jeju, Rep. of Korea*
5. **E. M. Lee**, J. Jeon, and H. Myung, "TROT-Q: Traversability and Obstacle Aware Target Tracking System for Quadruped Robots", *Asian Control Conference (ASCC)*, 2022, *Jeju, Rep. of Korea*
6. S. Shin, **E. M. Lee**, J. Choi, and H. Myung, "MIR-VIO: Mutual Information Residual-based Visual Inertial Odometry with UWB Fusion for Robust Localization", *IEEE International Conference on Control, Automation and Systems (ICCAS)*, **Best paper Awarded**, 2021, *Jeju, Rep. of Korea*
7. S. Lee, S. Chang, **E. M. Lee**, J. Choi, J. Jeon, S. Kim, and H. Myung, "TPL: Trajectory Planner for Target Tracking in Low-Light Environments", *International Conference on Robot Intelligence Technology and Applications (RiTA)*, 2021, *Daejeon, Rep. of Korea*
8. C. Kim[†], **E. M. Lee**[†], J. Choi, J. Jeon, S. Kim, and H. Myung, "ROLAND: Robust Landing of UAV on Moving Platform using Object Detection and UWB based Extended Kalman Filter", *IEEE International Conference on Control, Automation and Systems (ICCAS)*, 2021, *Jeju, Rep. of Korea*
9. **E. M. Lee**, D. Seo, J. Jeon, and H. Myung, "QR-SCAN: Traversable Region Scan for Quadruped Robot Exploration using Lightweight Pre-computed Trajectory", *IEEE International Conference on Control, Automation and Systems (ICCAS)*, 2021, *Jeju, Rep. of Korea*
10. J. Choi, **E. M. Lee**, S. Shin, and H. Myung, "Solving Geometric Constraints for Relative Position Estimation using UWB Sensors in Multi-Robot System", *World Congress on Advances in Nano, Bio, Robotics and Energy (ANBRE21)*, 2021, *Seoul, Rep. of Korea*
11. D. Choi, **E. M. Lee**, and H. Myung, "Online 3D Coverage Path Planning Using Surface Vector", *IEEE International Conference on Ubiquitous Robots (UR)*, 2021, *Gangneung, Rep. of Korea*
12. **E. M. Lee**, and H. Myung, "Analysis on the performance of VIO according to Trajectory Planning of UAV", *IEEE International Conference on Control, Automation and Systems (ICCAS)*, 2020, *Jeju, Rep. of Korea*
13. **E. M. Lee**, I. Wee, T. Kim, and D. H. Shim, "Comparison of Visual Inertial Odometry using FlightGoggles Simulator for UAV", *IEEE International Conference on Control, Automation and Systems (ICCAS)*, 2019, *Jeju, Rep. of Korea*
14. Y. Jin, S. Han, **E. M. Lee**, S. Lee, C. Shin, and J. Yun, "Development of Autonomous Driving Systems Using State Estimator with Multi-rate Sampled-data", *IEEE International Conference on Consumer Electronics (ICCE)*, 2019, *Las Vegas, U.S.A*

Domestic Papers

1. **E. M. Lee** and H. Myung, "Two-Stage Optimization-Based Energy-Efficient Coverage Path Planner for 3D Reconstruction", *Korea Robotics Society Annual Conference (KRoC)*, 2023, *Pyeongchang, Rep. of Korea*
2. **E. M. Lee**, D. Lee, H. Lim, S. Song, and H. Myung, "Non-uniform motion target tracking system for UAVs", *Korea Robotics Society Annual Conference (KRoC)*, 2022, *Pyeongchang, Rep. of Korea*
3. S. Jung, J. Choi, **E. M. Lee**, D. Choi, and H. Myung, "Multi-sensor based 3D Mapping for Autonomous Bridge Inspection Using Unmanned Aerial Vehicle", *Korea Institute of Structural Maintenance and Inspection 2020 Fall Conference (KSMI)*, 2020, *Seoul, Rep. of Korea*
4. **E. M. Lee**, I. Wee, T. Kim, S. Moon, and D. H. Shim, "Analysis on Visual-Inertial State Estimation(VINS-Mono) for Drone using FlightGoggles Simulator", *The Korean Society for Aeronautical and Space Sciences 2019 Spring Conference (KSAS)*, 2019, *Byeonsan, Rep. of Korea*
5. I. Wee, **E. M. Lee**, T. Kim, and D. H. Shim, "Dynamic Model Analysis of Flight Goggles Simulator and Autonomous Flight using Moving Virtual Target", *The Korean Society for Aeronautical and Space Sciences 2019 Spring Conference (KSAS)*, 2019, *Byeonsan, Rep. of Korea*
6. T. Kim, I. Wee, **E. M. Lee**, and D. H. Shim, "Vision based Gate Detection Algorithm for Autonomous Drone Racing", *The Korean Society for Aeronautical and Space Sciences 2019 Spring Conference (KSAS)*, 2019, *Byeonsan, Rep. of Korea*