

Hyungtae Lim

ROBOTICS RESEARCHER · FILED ROBOTICS ENGINEER

30, Mannyeon-ro 18beon-gil, Seo-gu, Daejeon, Republic of Korea

☎ (+82) 10-4494-5143 | ✉ shapelim@kaist.ac.kr | 🏠 limhyungtae.github.io/aboutme/ | 📧 limhyungtae | 🌐 hyungtae-lim

“Towards Pervasive Robotics and Artificial Intelligence”

Summary

Robotics researcher with a focused study on perception and state estimation of mobile robots. Particularly, study outlier-robust and dynamic object-robust algorithms to achieve generalization in real-world environments. An enthusiast of open source regarding researches to help others and contribute to the advancement of the robotics community. Currently, a highly prolific postdoc in the Urban Robotics Lab in KAIST, Republic of Korea to fulfill my country's military duty. Previously worked as a visiting student in StachnissLab and research intern in NAVER LABS.

Highlights

- 20 IROS, ICRA, RA-L, RSS, IJRR papers during grad school (12 first-author papers)
- 2022 IEEE RA-L Best Paper Award (among 1,100 papers, only 5 papers are selected)
- 1st prize in HILTI SLAM Challenge'23 in IEEE ICRA among 63 international teams
- CES'23 innovation award via tech. transfer regarding SLAM of mobile robots (collaborated with HILLS Robotics)
- Visiting scholar of Univ. Bonn, Germany (advisor: Prof. Cyrill Stachniss)
- From 2022, serve as a SLAM part outside expert, CTO division of LG Electronics, Republic of Korea
- 2nd cash prize in HILTI SLAM Challenge'22 in IEEE ICRA (in total, 4th place)
- Research intern of vision/deep learning team of NAVER LABS, Republic of Korea
- 1st prize in Hitachi-LG Data Storage LiDAR application competition, Republic of Korea

Field of Interest

MY RESEARCH INTEREST INCLUDES, BUT NOT CONFINED TO:

- SLAM using LiDAR, camera, or radar sensors
- Robust 3D point cloud registration
- Mobile robotics including autonomous vehicles and quadruped robots
- All kinds of perception that help perceiving the surroundings from the robot's perspective
- Localization including visual localization (i.e., visual place recognition)
- Static map building and moving object segmentation
- Robust visual(-inertial) and LiDAR(-inertial) odometry
- Analytical redundancy

Education

Korea Advanced Institute of Science and Technology (KAIST)

Daejeon, Republic of Korea

PH.D. IN ELECTRICAL ENGINEERING AND ROBOTICS PROGRAM

Mar. 2020 - Feb. 2023

- Dissertation: “Robust LiDAR SLAM for Autonomous Vehicles Leveraging Ground Segmentation” [pdf]
- Advised by Prof. Hyun Myung

Korea Advanced Institute of Science and Technology (KAIST)

Daejeon, Republic of Korea

M.S. IN ELECTRICAL ENGINEERING AND ROBOTICS PROGRAM

Mar. 2018 - Feb. 2020

- Dissertation: “Two-Stage Depth Prediction Using a 2D LiDAR and a Monocular Camera via Deep Learning”
- Advised by Prof. Hyun Myung

Korea Advanced Institute of Science and Technology (KAIST)

Daejeon, Republic of Korea

B.S. IN MECHANICAL ENGINEERING

Mar. 2013 - Aug. 2018

- Listed on Dean's list of ME, KAIST (GPA 4.23/4.3 at the semester) - Fall semester, 2015

Work Experience (Including Internship)

Outside Expert of CTO Division of LG Electronics Co. Ltd.

Republic of Korea

LG ELECTRONICS CO. LTD.

Mar. 2022 - Present

- Was in charge of introducing state-of-the-art SLAM technologies and suggesting the direction of future technologies for mobile robots.
- Gave a lecture entitled “Introduction of the latest SLAM technology trends and Semantic SLAM”

Visiting Scholar

STACHNISSLAB

Bonn, Germany

Nov. 2022 - Feb. 2023

- After the defense of my dissertation, I visited Prof. Cyrill Stachniss' lab
- Was in charge of an improved version of static map building
- Submitted and accepted a paper to RSS 2023 titled *ERASOR2*.
- Relevant code: <https://github.com/url-kaist/ERASOR2>

Research Intern

NAVER LABS

Gyeonggi-Do, Republic of Korea

Apr. 2022 - Sep. 2023

- Was a Ph.D. research intern
- Was in charge of robust global registration using a 3D point cloud captured by a LiDAR sensor called *Quatro*.
- Submitted and accepted a paper to IEEE ICRA 2022.
- Relevant code: <https://github.com/url-kaist/Quatro>

Research Project Experience

Development of Artificial Intelligence Robot Autonomous Navigation Technology for Agile Movement in Crowded Space

Urban Robotics Lab.

SUPPORTED BY THE MINISTRY OF TRADE, INDUSTRY & ENERGY (MOTIE), REPUBLIC OF KOREA

Mar. 2020 - June 2023

- Was in charge of dynamic object detection in order to generate static maps and perform moving-object-robust SLAM in dynamic environments
- Keywords: SLAM, 3D LiDAR, Static Map Building, OpenCV, C++, ROS

Study of Semantic SLAM Towards Spatial AI Technologies

Urban Robotics Lab.

SUPPORTED BY LG ELECTRONICS

Mar. 2022 - Dec. 2022

- Studied various deep learning-aided SLAM methods, such as Kimera and Hydra
- Run semantic SLAM in our real-world data to check the feasibility
- Keywords: 3D semantic mapping, Semantic SLAM

Deep Learning-Based Depth Prediction Using a Mono Camera and 2D LiDAR Sensor

Urban Robotics Lab.

SUPPORTED BY HYUNDAI KEFICO

Mar. 2022 - Nov. 2022

- Was in charge of the development of deep learning-based depth prediction
- Studied various calibration methods (2D LiDAR-to-camera, 3D LiDAR-to-IMU, camera-to-IMU)
- Run deep learning models on NVIDIA Xavier
- Keywords: Real-time deep learning, Depth prediction, Calibration, PyTorch, OpenCV, C++, ROS

A Study on the Visual Place Recognition in Multiple Photos

Urban Robotics Lab.

SUPPORTED BY KAIST INSTITUTE FOR SECURITY CONVERGENCE RESEARCH

Mar. 2020 - Dec. 2020

- Studied visual place recognition application. Struggled to improve the performance of the SOTA deep learning-based VPR approaches
- Keywords: Visual place recognition, Deep learning, Semantic segmentation, Inpainting, Python, PyTorch

Development of Robot Intelligence Technology for Mobility with Learning Capability Toward Robust and Seamless Indoor and Outdoor Autonomous Navigation

Urban Robotics Lab.

SUPPORTED BY THE MINISTRY OF TRADE, INDUSTRY & ENERGY (MOTIE)

Mar. 2020 - Sep. 2020

- Developed SLAM algorithm applied to mobile robots
- Was in charge of SLAM, static map building in low-dynamic environments, and movable area prediction
- Keywords: SLAM, 3D LiDAR, Registration, Static map building, Mobile robots, C++, ROS

Indoor Navigation of Mobile Robots using Deep Learning-based Object Recognition

Urban Robotics Lab.

SUPPORTED BY SAMSUNG ELECTRONICS CO., LTD.

Jan. 2019 - Sep. 2019

- Developed SLAM and perception algorithms applied to robot cleaners for achieving robust navigation in indoor environments
- Was in charge of depth prediction using a 2D LiDAR sensor and a monocular camera for collision avoidance of mobile robots via deep learning
- Keywords: 2D LiDAR, Sensor Fusion, Deep Learning, Mobile Robots, PyTorch, ROS

IITP Artificial Intelligence R&D Grand Challenge: Track 4, Intelligent Control

Urban Robotics Lab.

SUPPORTED BY IITP, WHICH IS A GOVERNMENT-AFFILIATED ORGANIZATION

Jan. 2019 - Jun. 2019

- Was in charge of the task of a drone passing through windows
- Implemented RGB-D camera-based path planning&following. Participated in applying VIO to estimate the odometry of UAV
- Keywords: VIO, Path planning and following, Projective geometry, OpenCV, ROS

Machine Learning-Based Classification of Small Object Captured by Unmanned Aerial Vehicle

Urban Robotics Lab.

OUTSOURCED BY PIXONEER GEOMATICS AND AGENCY FOR DEFENSE DEVELOPMENT

Jan. 2018 - Dec. 2019

- Developed both SVM-based and Deep Learning-based classification algorithms
- Implemented HOG-LBP for input to SVM and engaged in designing novel Deep Learning architecture.
- Keywords: Deep Learning, SVM, HOG-LBP, Classification, Python, PyTorch

- Implemented Monte Carlo localization (MCL) using range measurements by ultra-wideband (UWB) sensors for UAV from scratch single-handed
- Struggled to cover None-line-of-sight (NLOS) issues.
- Keywords: MCL, Beacon-based localization, UWB sensors, NLOS, ROS

Publications

* denotes the authors are co-first authors, and [†] denotes the authors are co-corresponding authors

INTERNATIONAL JOURNAL

1. Hyungtae Lim, Minh Oh, Seungjae Lee, Seunguk Ahn, and Hyun Myung, "Similar but Different: A Survey of Ground Segmentation and Traversability Estimation for Terrestrial Robots," *Int. J. Control, Automat. Syst. (IJ-CAS)*, vol. 22, pp. 347–359, 1 Feb. 2024
2. Hyungtae Lim, Beomsoo Kim, Daebeom Kim, Eungchang Mason Lee, and Hyun Myung, "Quatro++: Robust Global Registration Exploiting Ground Segmentation for Loop Closing in LiDAR SLAM," *Int. J. Robot. Res. (IJRR)*, p.02783649231207654, 2 Nov. 2023
3. Alex Junho Lee, Seungwon Song, Hyungtae Lim, Wooju Lee, and Hyun Myung, " $(LC)^2$: LiDAR-Camera Loop Constraints For Cross-Modal Place Recognition," *IEEE Robot. Automat. Lett. (RA-L)*, vol. 8, no. 6, pp. 3589–3596, 20 Apr. 2023
4. DongKi Noh, Changki Sung, Teayoung Uhm, WooJu Lee, Hyungtae Lim, Jaeseok Choi, Kyuewang Lee, Dasol Hong, Daeho Um, Inseop Chung, Hochul Shin, MinJung Kim, Hyoung-Rock Kim, SeungMin Baek, and Hyun Myung, "X-MAS: Extremely Large-Scale Multi-Modal Sensor Dataset for Outdoor Surveillance in Real Environments," *IEEE Robot. Automat. Lett. (RA-L)*, vol. 8, no. 2, pp. 1093–1100, 12 Jan. 2023
5. Seungwon Song, Hyungtae Lim, Alex Junho Lee, and Hyun Myung, "DynaVINS: A Visual-Inertial SLAM for Dynamic Environments," *IEEE Robot. Automat. Lett. (RA-L)*, vol. 7, no. 4, pp. 11523–11530, 31 Oct. 2022
6. Minh Oh*, Euigon Jung*, Hyungtae Lim, Wonho Song, Sumin Hu, Eungchang Mason Lee, Junghee Park, Jaekyung Kim, Jangwoo Lee, and Hyun Myung, "TRAVEL: Traversable Ground and Above-Ground Object Segmentation Using Graph Representation of 3D LiDAR Scans," *IEEE Robot. Automat. Lett. (RA-L)*, vol. 7, no. 3, pp. 11523–11530, 13 Jun. 2022 **Won 2022 IEEE RA-L Best Paper Award**
7. Seungwon Song, Hyungtae Lim, and Hyun Myung, "G2P-SLAM: Generalized RGB-D SLAM Framework for Mobile Robots in Low-Dynamic Environments," *IEEE Access*, vol. 10, pp. 21370–21383, 11 Feb. 2022
8. Changki Sung, Seulgi Jeon, Hyungtae Lim, and Hyun Myung, "What If There Was No Revisit? Large-Scale Graph-based SLAM with Traffic Sign Detection in an HD Map Using LiDAR Inertial Odometry," *J. Intell. Serv. Robot.*, pp. 1–10, 25 Nov. 2021
9. Hyungtae Lim, Hanseok Ryu, Matthew Rhudy, Dongjin Lee, Dongjin Jang, Changho Lee, Young-min Park, Wonkeun Youn[†], and Hyun Myung[†], "Deep Learning-Aided Synthetic Airspeed Estimation of UAVs for Analytical Redundancy with a Temporal Convolutional Network," *IEEE Robot. Automat. Lett. (RA-L)*, vol. 7, no. 1, pp. 17–24, 1 Oct. 2021
10. Hyungtae Lim, Minh Oh, and Hyun Myung, "Patchwork: Concentric Zone-Based Region-Wise Ground Segmentation With Ground Likelihood Estimation Using a 3D LiDAR Sensor," *IEEE Robot. Automat. Lett. (RA-L) with IROS*, vol. 6, no. 4, pp. 6458–6465, 28 Jun. 2021
11. Wonkeun Youn*, Hyungtae Lim*, Hyoung Sik Choi, Matthew B. Rhudy, Hyeok Ryu, Sungyug Kim, and Hyun Myung, "State Estimation of HALE UAV With Deep Learning-Aided Virtual AOA/SSA Sensor for Analytical Redundancy," *IEEE Robot. Automat. Lett. (RA-L)*, vol. 6, no. 3, pp. 5276–5283, 19 Apr. 2021
12. Hyungtae Lim, Sungwon Hwang, and Hyun Myung, "ERASOR: Egocentric Ratio of Pseudo Occupancy-Based Dynamic Object Removal for Static 3D Point Cloud Map Building," *IEEE Robot. Automat. Lett. (RA-L) with ICRA*, vol. 6, no. 2, pp. 2272–2279, 23 Feb. 2021

INTERNATIONAL CONFERENCE

1. Wooju Lee, Dasol Hong, Hyungtae Lim[†], and Hyun Myung[†], "Object-Aware Domain Generalization for Object Detection," in *Annual AAAI Conf. Artif. Intell. (AAAI)*, 20–27 Feb. 2024. Accepted. To appear.

2. Seoyeon Jang, Minho Oh, Byeongho Yu, I Made Aswin Nahrendra, Seungjae Lee, Hyungtae Lim, and Hyun Myung, "TOSS: Real-time Tracking and Moving Object Segmentation for Static Scene Mapping," in *Proc. Int. Conf. Robot. Syst. (IROS)*, Xian, China, 6–8 Dec. 2023. Accepted. To appear. **Received Best Paper Award**.
3. Dong-Uk Seo, Hyungtae Lim, Eungchang Mason Lee, Hyunjun Lim, and Hyun Myung, "Enhancing Robustness of Line Tracking Through Semi-Dense Epipolar Search in Line-based SLAM," in *Proc. IEEE/RSJ Int. Conf. Intell. Robot. Syst. (IROS)*, Detroit, U.S., 1–5 Oct. 2023. Accepted. To appear.
4. Hyungtae Lim, Lucas Nunes, Benedikt Mersch, Xieyuanli Chen, Jens Behley, Hyun Myung, and Cyrill Stachniss, "ERASOR2: Instance-Aware Robust 3D Mapping of the Static World in Dynamic Scenes," in *Robotics: Science and Systems (RSS)*, Daegu, South Korea, 15–19 Jul. 2023.
5. Hyungtae Lim, Daebeom Kim, Beomsoo Kim, and Hyun Myung, "AdaLIO: Robust Adaptive LiDAR-Inertial Odometry in Degenerate Indoor Environments," in *Proc. Int. Conf. Ubiquiti. Robot. (UR)*, Hawaii, U.S., 25–28 Jun. 2023.
6. Hyungtae Lim, Kawon Han, Gunhee Shin, Giseop Kim, Songcheol Hong, and Hyun Myung, "ORORA: Outlier-Robust Radar Odometry," in *Proc. IEEE Int. Conf. Robot. Automat. (ICRA)*, London, UK, 29 May–2 Jun. 2023.
7. Alex Junho Lee, Hyungtae Lim, Minho Oh, Wonho Song, and Hyun Myung, "Volumetric Vegetation Monitoring From LiDAR Scans With Ground Estimation," in *Proc. Int. Conf. Control, Automat. Syst. (ICCAS)*, Busan, Republic of Korea, 27 Nov.–1 Dec. 2022, pp. 1378–1379
8. Seungjae Lee*, Hyungtae Lim*, and Hyun Myung, "Patchwork++: Fast and Robust Ground Segmentation Solving Partial Under-Segmentation Using 3D point cloud," in *Proc. IEEE/RSJ Int. Conf. Intell. Robot. Syst. (IROS)*, Kyoto, Japan, 22–27 Oct. 2022, pp. 13276–13283
9. Sumin Hu, Yeeun Kim, Hyungtae Lim, Alex Junho Lee, and Hyun Myung, "eCDT: Event Clustering for Simultaneous Feature Detection and Tracking," in *Proc. IEEE/RSJ Int. Conf. Intell. Robot. Syst. (IROS)*, Kyoto, Japan, 22–27 Oct. 2022, pp. 3808–3815
10. Dong-Uk Seo*, Hyungtae Lim*, Seungjae Lee, and Hyun Myung, "PaGO-LOAM: Robust ground- optimized LiDAR odometry," in *Proc. Int. Conf. Ubiquiti. Robot. (UR)*, Jeju, Republic of Korea, 4–6 Jul. 2022, pp. 1–7
11. Hyungtae Lim, Suyong Yeon, Soohyun Ryu, Yonghan Lee, Youngji Kim, Jaeseong Yun, Euigon Jung, Donghwan Lee, and Hyun Myung, "A Single Correspondence Is Enough: Robust Global Registration to Avoid Degeneracy in Urban Environments," in *Proc. IEEE Int. Conf. Robot. Automat. (ICRA)*, Philadelphia, USA, 23–27 May 2022, pp. 8010–8017
12. Sungwon Hwang, Hyungtae Lim, and Hyun Myung, "Equivariance-Bridged SO(2)-Invariant Representation Learning Using Graph Convolutional Network," in *Proc. British Machine Vis. Conf. (BMVC)*, Virtual, 22–25 Oct. 2021
13. Hyungyu Lee, Myeongwoo Jeong, Chanyoung Kim, Hyungtae Lim, Changgwe Park, Sungwon Hwang, and Hyun Myung, "Low-level Pose Control of Tilting Multirotor for Wall Perching Tasks Using Reinforcement Learning," in *Proc. IEEE/RSJ Int. Conf. Intell. Robot. Syst. (IROS)*, Prague, Czech (Virtual), 27 Sep.–1 Oct. 2021, pp. 9669–9676
14. Eungchang Mason Lee, Junho Choi, Hyungtae Lim, and Hyun Myung, "REAL: Rapid Exploration With Active Loop-Closing Toward Large-Scale 3D Mapping Using UAVs," in *Proc. IEEE/RSJ Int. Conf. Intell. Robot. Syst. (IROS)*, Prague, Czech (Virtual), 27 Sep.–1 Oct. 2021, pp. 4194–4198
15. Hyungtae Lim, Hyeonjae Gil, and Hyun Myung, "MSDPN: Monocular Depth Prediction With Partial Laser Observation Using Multi-stage Neural Networks," in *Proc. IEEE/RSJ Int. Conf. Intell. Robot. Syst. (IROS)*, Las Vegas, USA (Virtual), 24 Oct.–24 Dec. 2020, pp. 10750–10757
16. Hyungtae Lim, Sungwon Hwang, Sungjae Shin, and Hyun Myung, "Normal Distributions Transform is Enough: Real-Time 3D Scan Matching for Pose Correction of Mobile Robot Under Large Odometry Uncertainties," in *Proc. Int. Conf. Control, Automat. Syst. (ICCAS)*, Busan, Republic of Korea, 13–16 Oct. 2020, pp. 1155–1161, **Received Student Best Paper Award**
17. Hyungtae Lim, Changgwe Park, and Hyun Myung, "RONet: Real-Time Range-Only Indoor Localization via Stacked Bidirectional LSTM with Residual Attention," in *Proc. IEEE/RSJ Int. Conf. Intell. Robot. Syst. (IROS)*, Macau, China, 4–8 Nov. 2019, pp. 3241–3247
18. Jungmo Koo, Changgwe Park, Hyungtae Lim, and Hyun Myung, "Light-Weight Deep Neural Networks for Multi-Target Classification," in *Proc. Int. Conf. Control, Automat. Syst. (ICCAS)*, Jeju, Republic of Korea, Oct.

2019

19. Jieum Hyun, Taekjun Oh, Hyungtae Lim, and Hyung Myung, "UWB-Based Indoor Localization Using Ray-Tracing Algorithm," in *Proc. Int. Conf. Ubiquiti. Robot. (UR)*, Hawaii, USA, 24-27 Jun. 2019, pp. 98–101
20. Hyungtae Lim, Jungmo Koo, Jieum Hyun, and Hyung Myung, "Effective Indoor Robot Localization by Stacked Bidirectional LSTM Using Beacon-Based Range Measurements," in *Proc. Int. Conf. Robot Intell. Tech. Applications (RiTA)*, Putrajaya, Malaysia, 16-18 Dec. 2018, pp. 144–151
21. Hyungtae Lim, Jungmo Koo, Jieum Hyun, and Hyun Myung, "Recurrent Neural Networks for Range-Based Indoor Robot Localization," in *Proc. IEEE/RSJ Int. Conf. Intell. Robot. Syst. (IROS)*, Madrid, Spain, 1–5 Oct. 2018

Teaching Experience

[CTP445] Augmented Reality (Lecturer: Prof. Woontack Woo)

GUEST LECTURER FOR SIX WEEKS TO TEACH BASIC KNOWLEDGE OF VISUAL SLAM

Minor Program in Culture
Technology, KAIST

Spring, 2023

[EE581] Linear Systems (Lecturer: Prof. Donghwan Lee)

TEACHING ASSISTANT

Electrical Engineering, KAIST

Spring, 2022

[EE585] Mobile Robotics and Autonomous Navigation (Lecturer: Prof. Hyun Myung)

TEACHING ASSISTANT

Electrical Engineering, KAIST

Fall, 2021

[EE581] Linear System (Lecturer: Prof. Donghwan Lee)

TEACHING ASSISTANT

Electrical Engineering, KAIST

Spring, 2021

[EE688] Optimal Control Theory (Lecturer: Prof. Donghwan Lee)

TEACHING ASSISTANT

Electrical Engineering, KAIST

Fall, 2020

[EE305] Introduction to Electronics Design Lab (Lecturer: Prof. Dongho Cho)

TEACHING ASSISTANT

Electrical Engineering, KAIST

Spring, 2020

[CE208] IT in Construction Engineering (Lecturer: Prof. Hyun Myung)

TEACHING ASSISTANT

Civil Engineering, KAIST

Fall, 2018

[CE558] Introduction to Civil Robotics (Lecturer: Prof. Hyun Myung)

TEACHING ASSISTANT

Civil Engineering, KAIST

Spring, 2018

Honors & Awards

INTERNATIONAL AWARDS

2023	Best Paper Award , RiTA'23	Xian, China
2023	Best Paper Award (among 1,100 papers, 5 papers are received) , IEEE RA-L	London, UK
2023	1st Prize (among 63 teams) , HILTI SLAM Challenge in <i>IEEE ICRA'23</i>	London, UK
2023	CES Innovation Award , Consumer Technology Association (CES)	San Francisco, USA
2022	2nd Cash Prize, 4th in Total , HILTI SLAM Challenge in <i>IEEE ICRA'22</i>	Philadelphia, USA
2020	Student Best Paper Award , ICCAS	Busan, Republic of Korea

DOMESTIC AWARDS

2020	Kim Sung-Bue Creative Activity Award , KAIST	Daejeon
2019	Han Cheolhui Augustine Scholarship , EE, KAIST	Daejeon
2019	1st Prize , Hitachi-LG LiDAR Application Competition	Seoul
2018	Excellence Prize , Smart City Service and Start-Up Competition	Seoul
2015	Dean's List , ME, KAIST	Daejeon