메모리 증강 공간지능 기반 자율 로봇 내비게이션

김기섭, gsk@dgist.ac.kr
DGIST 로봇및기계전자공학과 조교수
2026.04.02

DGIST

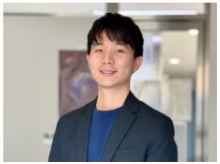
Giseop Kim

- PI of Autonomy and Perceptual Robotics Lab (APRL, 로봇인식 및 자율화 연구실)
- DGIST (2024–current)
- NAVER LABS (2022–2024)
- PhD (2022, KAIST)

APRL

- Autonomy and Perceptual Robotics Lab (APRL)

Faculty



Giseop Kim, Ph.D.

- Assistant professor of Robotics and Mechatronics Engineering, DGIST.
  - Joint Appointment, Physical AI Center, DGIST
  - Joint Appointment, Department of Artificial Intelligence, DGIST
  - Joint Appointment, Mechanical Engineering Track, School of Undergraduate Studies, DGIST
- Educations: Ph.D. (2022, KAIST) / M.S. (2019, KAIST) / B.S. (2017, KAIST)
- Past Career: Research Scientist (2021 — 2024, NAVER LABS)
- Google Scholar, CV, Personal Website

Current Lab Members

Full-time Researchers

Bokeon Suh
Integrated MS/PhD student (2025F-)

Jiseon Kim
MS student (2025F-)

Yumin Lee
MS student (2025F-)

Hyoseok Ju
MS student (2025F-)

Nayak Bibhutibhusan
Postdoc (2025F-)

Doyeon Kim
PhD student (2026S-)

Beomsu Kim
MS student (2026S-)

Hoyun Kim
MS student (2026S-)

Undergraduate Interns

- 2026 Winter: Hyeonwoo Jeong (DGIST), Yewon Kim (DGIST), Ayun Lee (DGIST) (Topics: DGIST 4D Mapping and Intelligent Robot Exploration)
- 2026 Spring: Yewon Kim (DGIST) (Topic: GS), Ayun Lee (DGIST) (Topic: VLN for exploration)

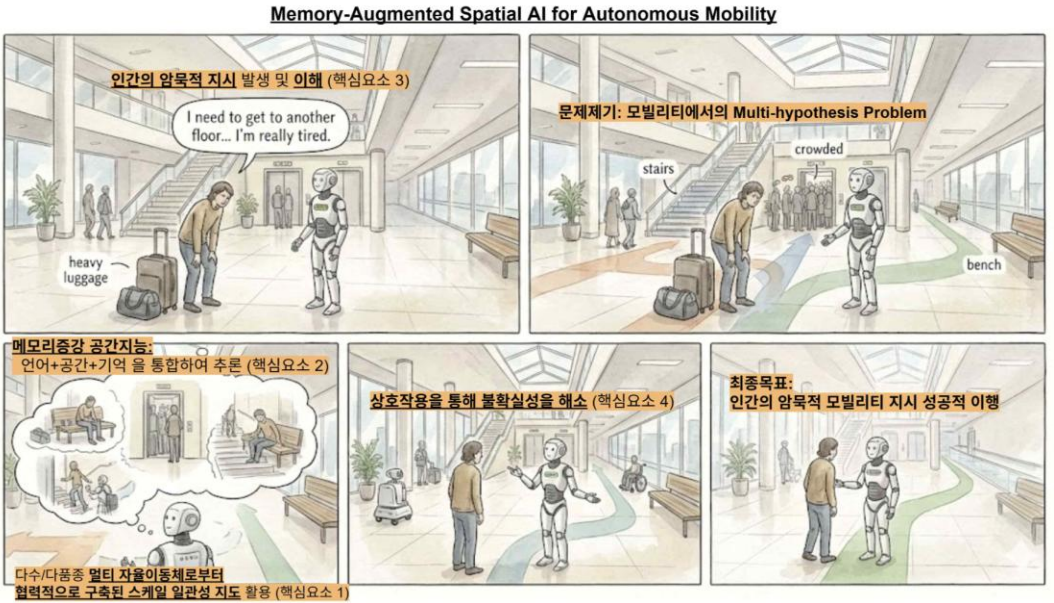
Final Goal of Next 5 years

3. 현재 APRL 에서 진행중인 프로젝트에 대해 이해하기

- 거시적으로는, Research 탭의 연구분야 설명을 먼저 참고해주세요.
- 구체적으로는, 향후 5년 동안 (2025 - 2029) 다음과 같은 질문들에 함께 답하고 문제를 풀어갈 학생들을 모집합니다:
  1. DGIST 의 컨실리언스홀은 연장 총 길이가 310m에 달하는 건물입니다. 이 건물 전체를 각기 다른 센서를 탑재한 이종로봇 5대가 자율적으로 돌아다니며, 하루 안에 건물 전체에 대한 공간적 이해를 하려면 어떻게 해야할까요? 공간정보는 어떤 방식 (의 조합) 으로 표현되어야 할까요? 이 정보는 다른 로봇이 어떻게 사용할 수 있을까요?
  2. 휴머노이드 로봇이 알아서 대중교통을 타고 강남에서 DGIST 까지 오게 하려면 어떻게 해야할까요? 예: 강남에서 서울역으로 이동하고 서울역에서 ktx를 타고 동대구역에 내려서 지하철을 타고 진천역에 내려서 급행8 버스를 타고 유가읍사무소에서 내려서 도보로 15분 정도 걸어오는 과정이다, 라고만 말해줘도 올 수 있을까요? 그렇게 하려면 어떤 기술을 만들어야 할까요? 그동안 어떤 어려움들이 존재할까요?
  3. 네비게이션에서의 플래닝 및 의사결정에 있어서 사람의 언어적 및 비언어적 표현은 어떻게 통합해야 할까요?
- 그리고 위 모든 목표에 기여하는 데 기반이 되는, SLAM 2.0 (Research 탭 참고) 을 정의하고 개별 기술들을 확보하는 일을 수행합니다.

Final Goal of Next 5 years

- **Human-like Collaborative Navigation with Robot-Robot/Robot-Human Interactions**

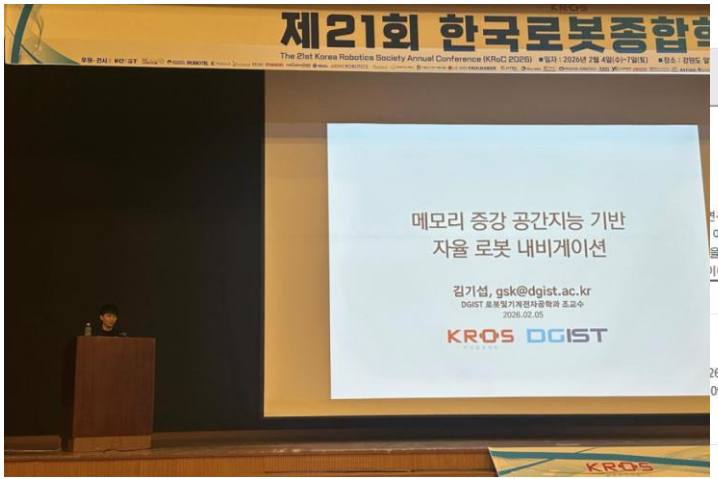


Related Awards

- Best poster award at Human-aware Embodied AI, IROS2025

Related Awards

- KRoC 2026



신진연구자

목록

연구자세션'을 통해 젊은 로봇 과학자들이 현재 진행 중인 연구 주제, 연구 성과, 향후 연구계획을 발표할 수 있는
이끌어갈 신진과학자들과 만남을 통해 최신 기술 트렌드를 공유하여 청중들께 독창적인 경험을 제공하길 기대하고
을 통해 연구 네트워크를 구축하고, 공동연구를 진행할 수 있도록 기회를 제공하고자 합니다.
내 또는 만 39세 이하의 연구자)

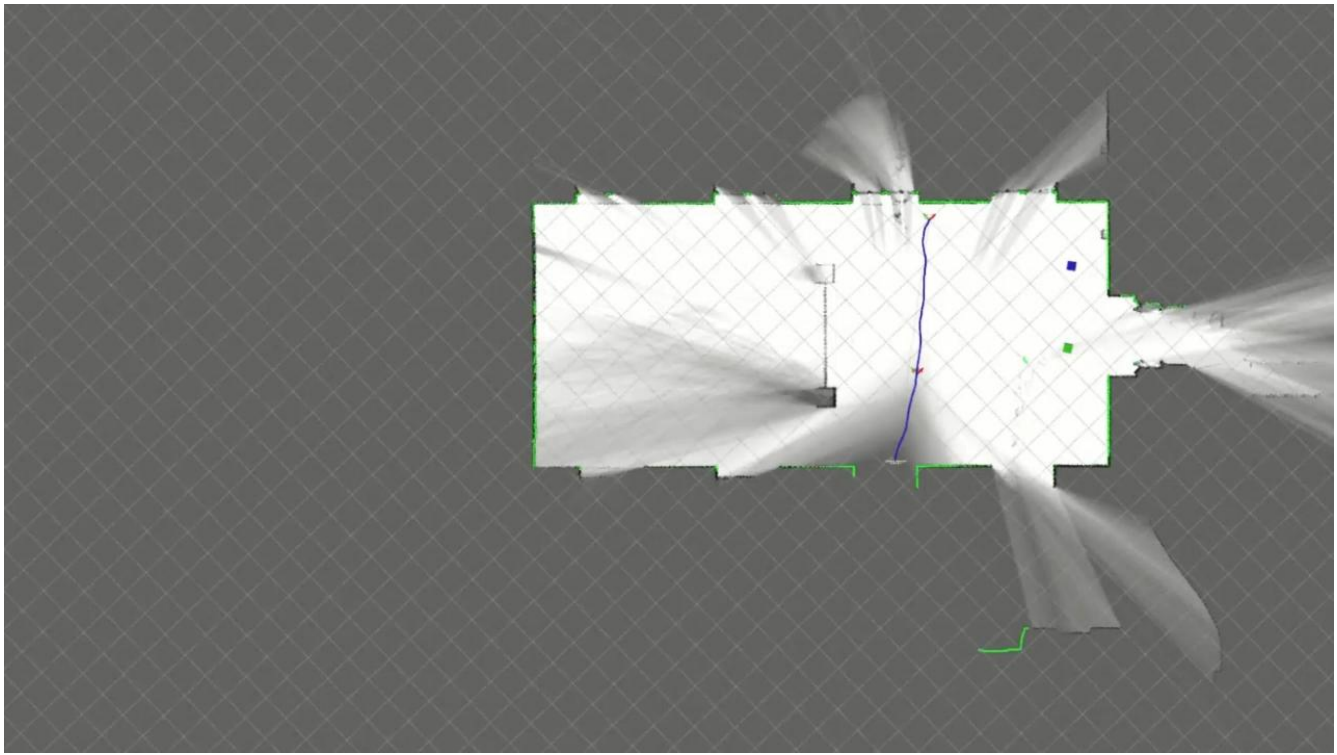
일시	장소	성명	소속
26년 2월 5일(목) 09:00~09:40	2층 그랜드볼룸 포레스트홀	한승용	전북대학교
		이진휘	한국공학대학교
		김진수	서울대학교
		김기섭	대구경북과학기술원
	2층 그랜드볼룸 포레스트홀	남세광	경북대학교
		김현규	한국항공대학교
		신희석	세종대학교

신진연구자 II

SLAM

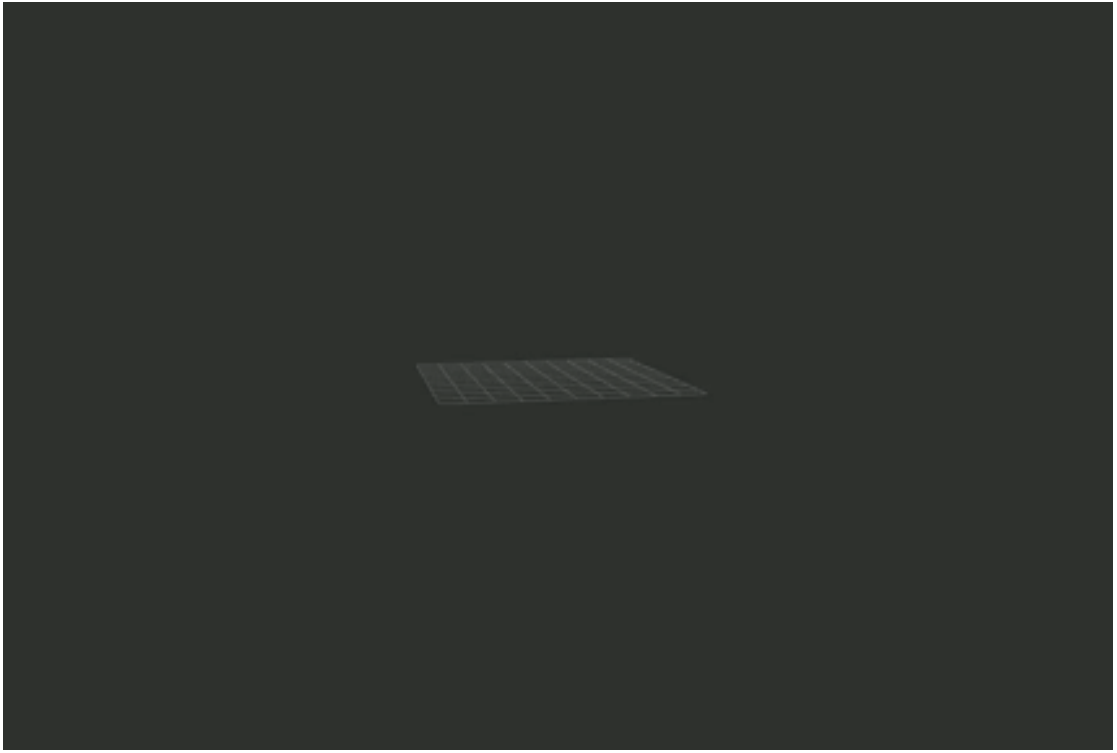
COLMAP (CVPR 2016, Structure-from-Motion Revisited)

SLAM



Google Cartographer, 2016

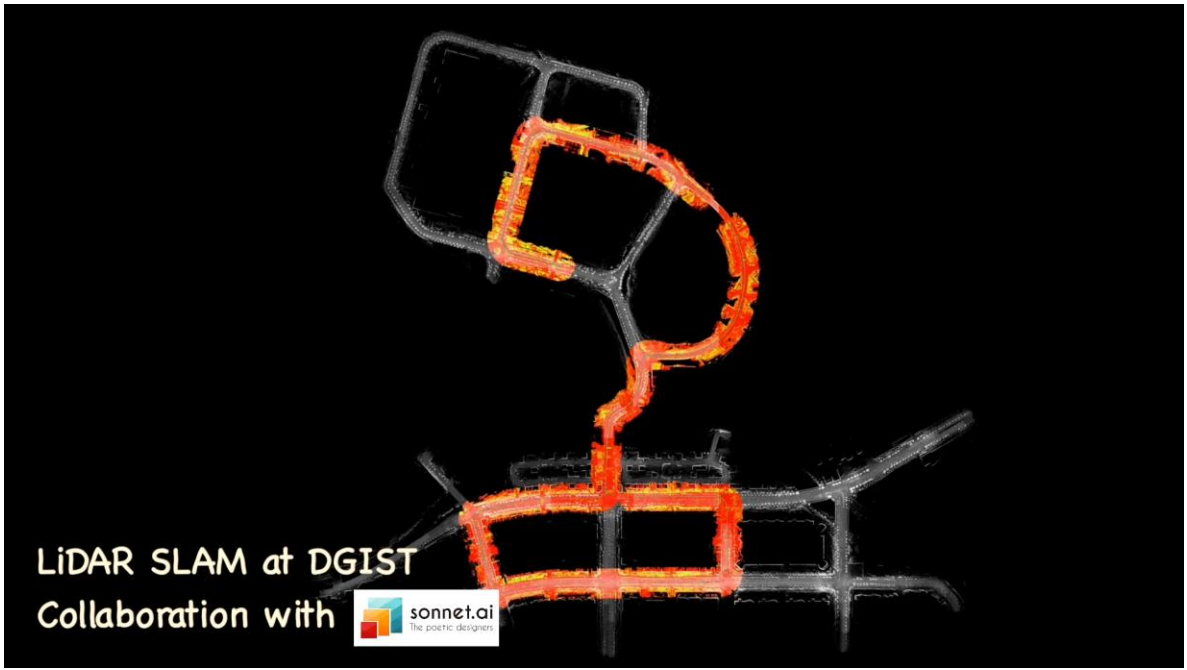
SLAM



DGIST E5 (RME Building)

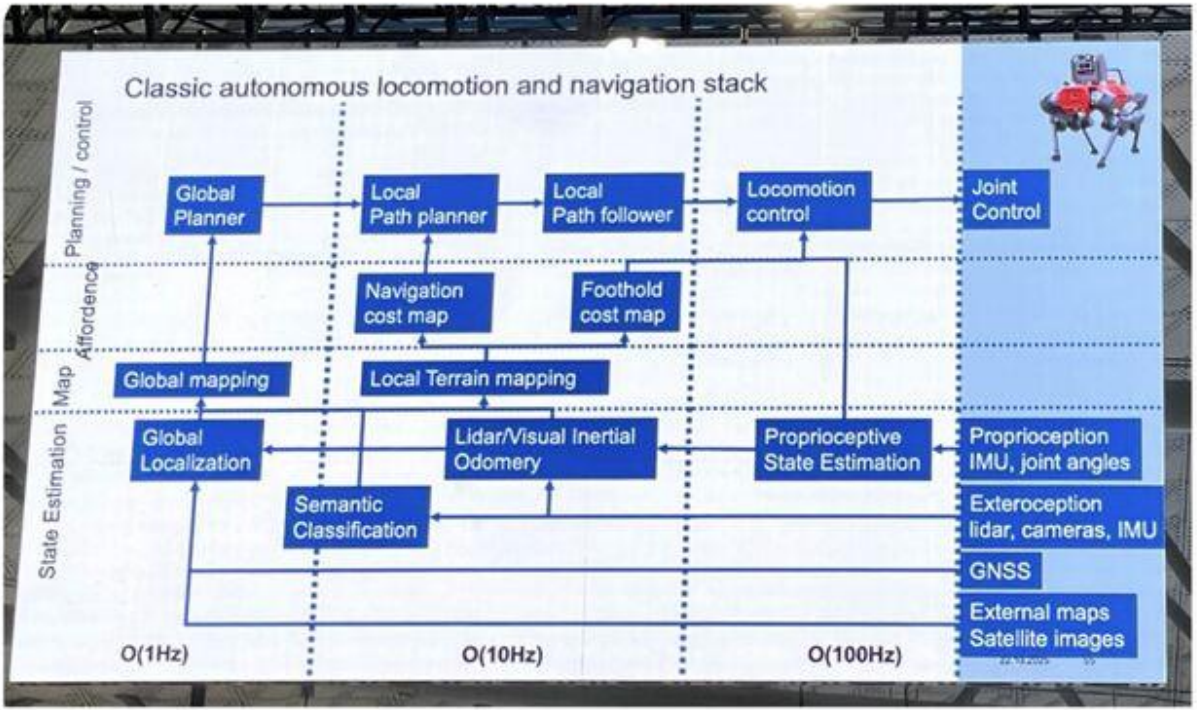
Autonomous Robot Navigation

- Collaboration with sonnet.ai



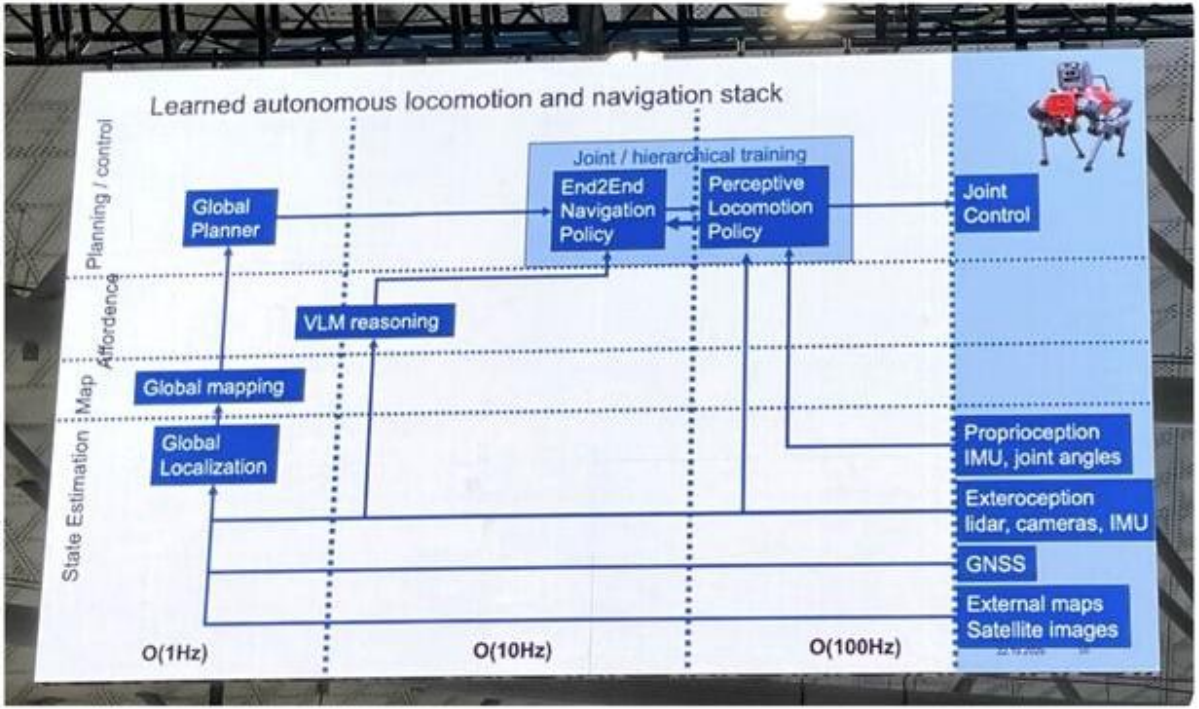
DGIST campus

Autonomous Robot Navigation



Source: Prof. Marco Hutter, from IROS2025

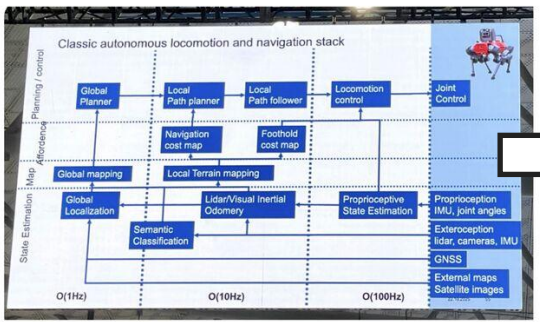
Autonomous Robot Navigation

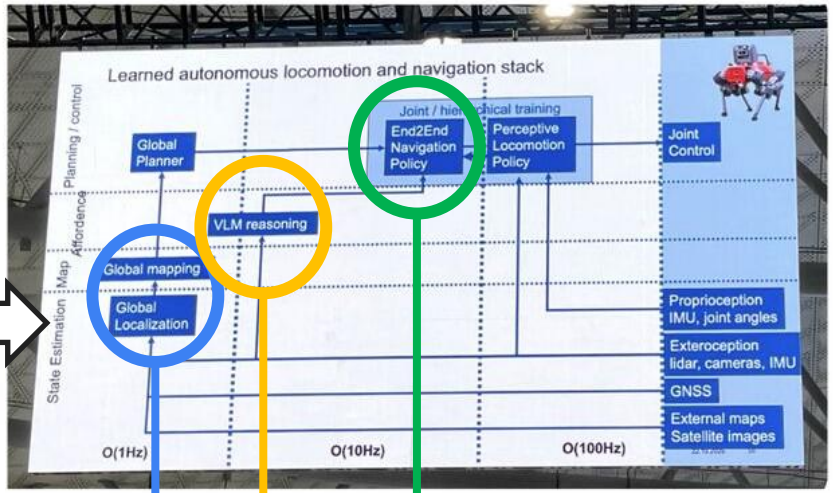


Source: Prof. Marco Hutter, from IROS2025

Autonomous Robot Navigation

Source: Prof. Marco Hutter,
from IROS2025



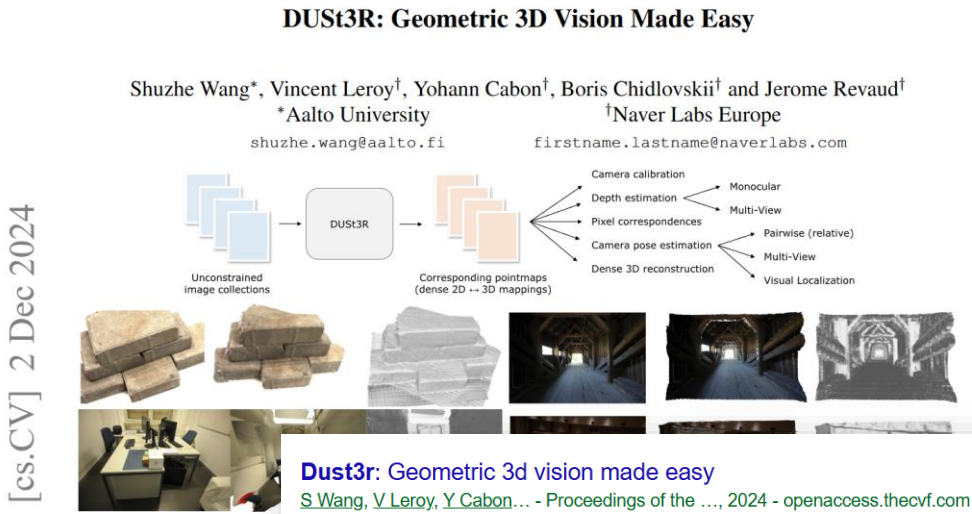


Visual-Language Nav

Memory

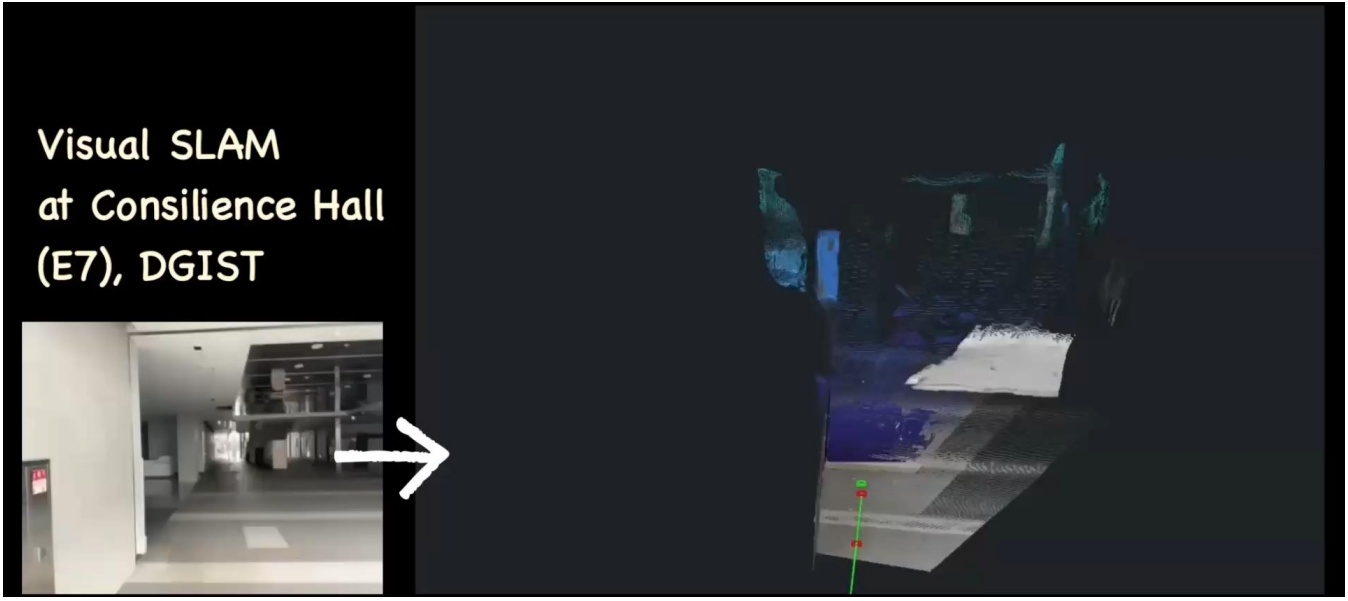
3D Foundation Models

3D Foundation Model



Wang, Shuzhe, et al. "Dust3r: Geometric 3d vision made easy." Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition. 2024.

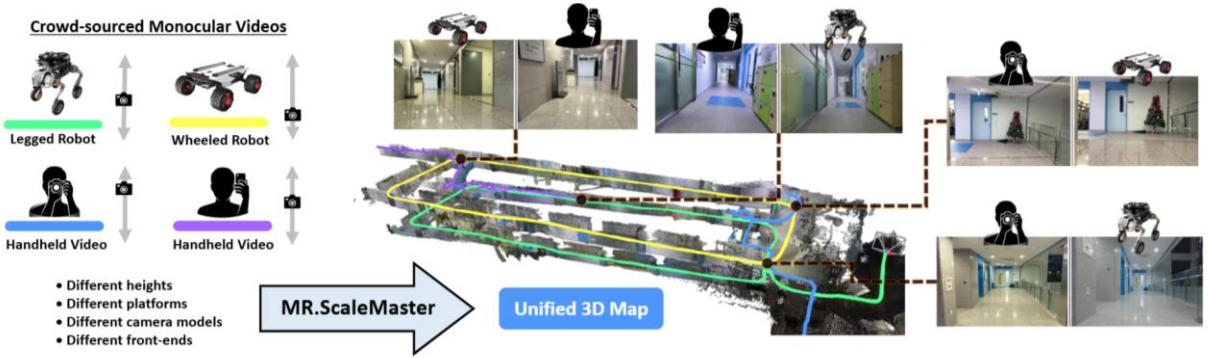
3D Foundation Model



Hyoseok Ju, Bokeon Suh, Giseop Kim,
ICRA 2026 (accepted, to appear),
Have We Mastered Scale in Deep Monocular Visual SLAM? The ScaleMaster Dataset and Benchmark

Multi-robot Collaborative SLAM

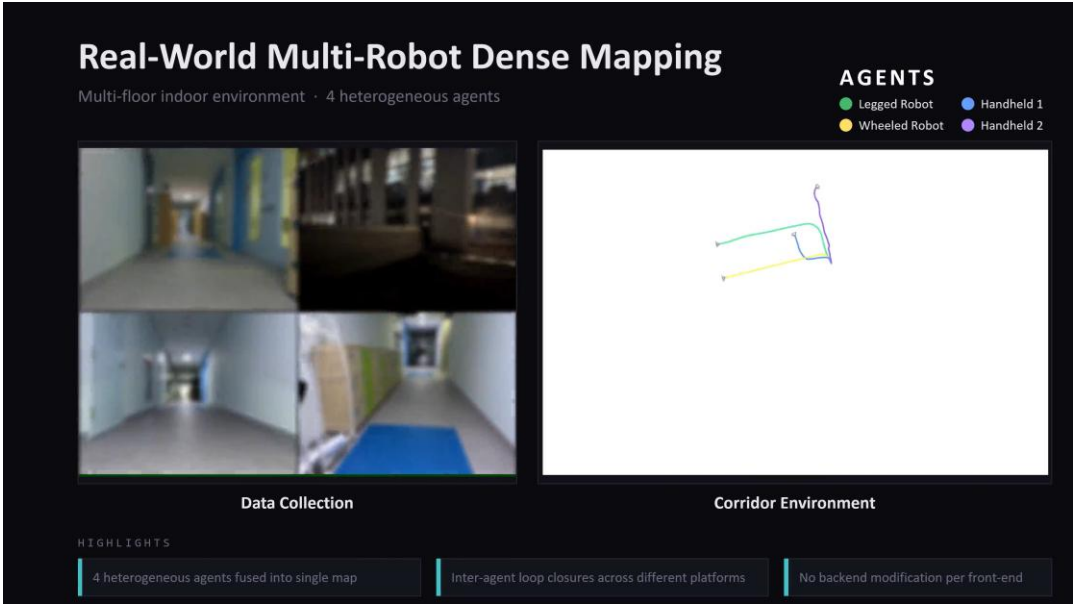
- In 3D Foundation era.



Submitted, under review

Multi-robot Collaborative SLAM

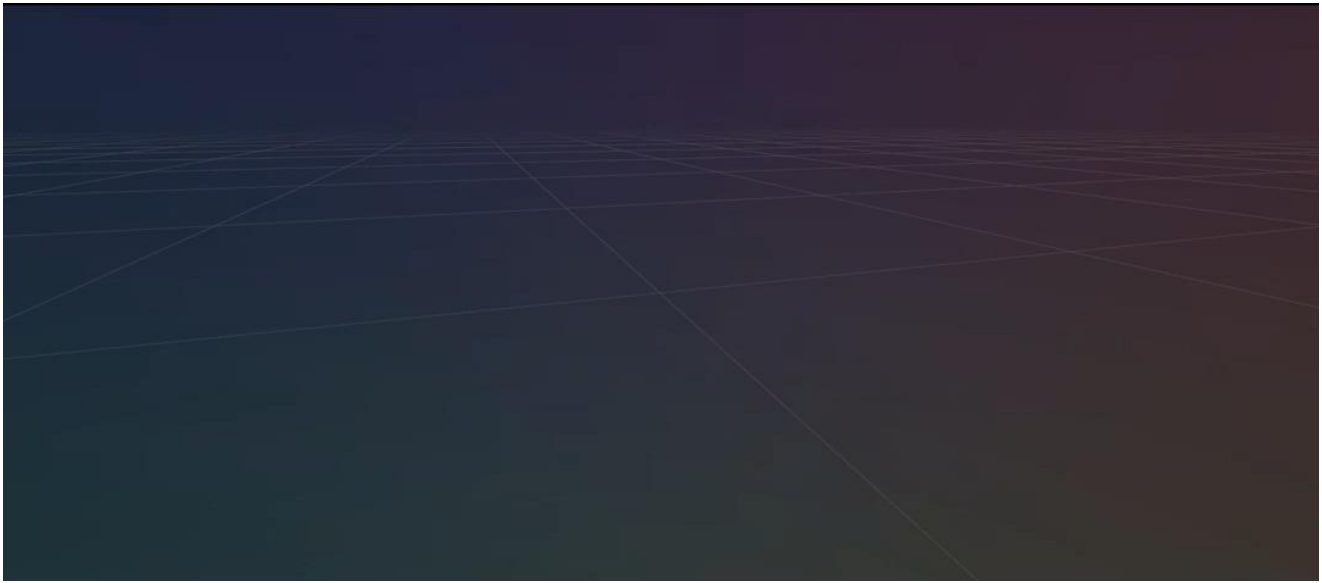
- In 3D Foundation era.



Submitted, under review

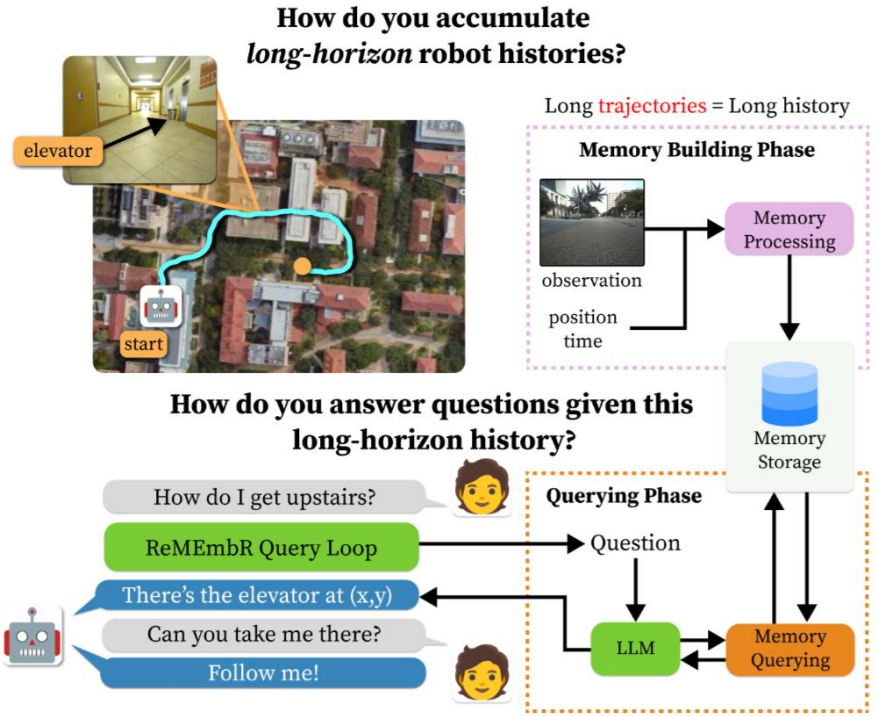
Multi-robot Collaborative SLAM

- **In 3D Foundation era.**



On KITTI dataset

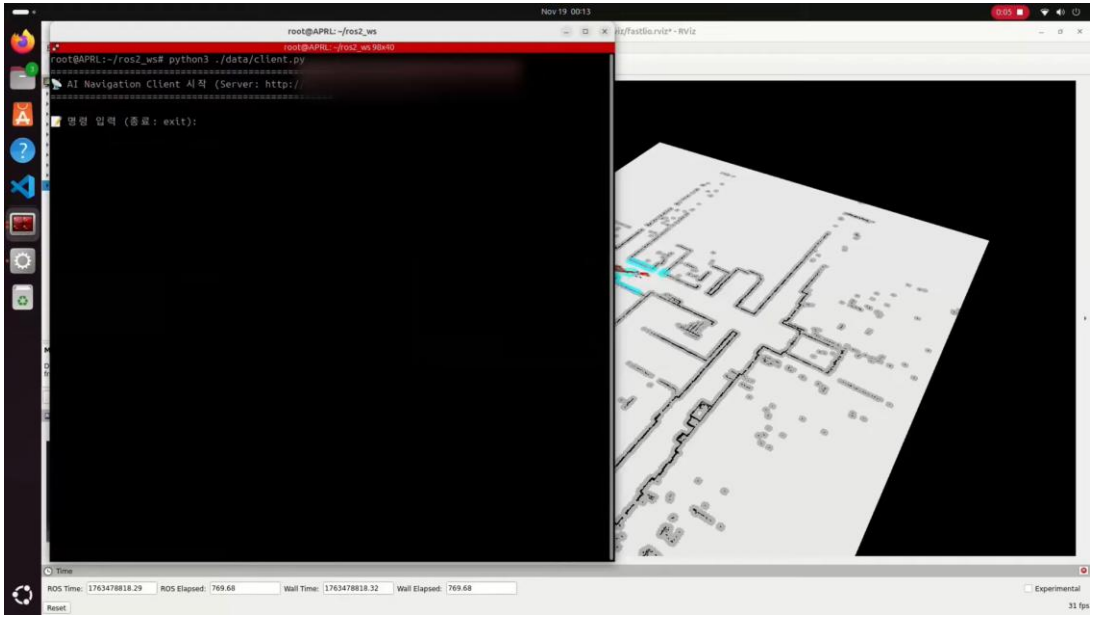
Memory



Anwar, Abrar, et al. "Remembr: Building and reasoning over long-horizon spatio-temporal memory for robot navigation." 2025 IEEE International Conference on Robotics and Automation (ICRA). IEEE, 2025.

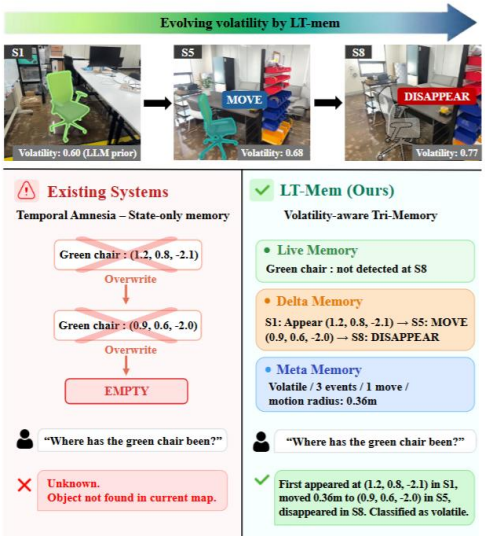
Memory

- **VLN demo - "where is the elevator?"**
  https://www.youtube.com/watch?v=so3B1NDoCO0



Memory

- Long-term Navigation Memory



Event	Description	Example Query	Required Memory
APPEAR	Object first observed in session S_t	"When did the scissor first appear?"	Delta
DISAPPEAR	Object no longer detected after S_t	"Was the vacuum in the room at Session 9?"	Delta
MOVE	Centroid displacement beyond threshold	"Did the brown basket move at Session 6?"	Delta
NONE	No state change detected in session S_t	"Did the fridge stay in place at Session 4?"	Delta
RE-APPEAR	Object returns after prior disappearance	"Did the green chair come back at Session 9?"	Delta
Compound (multi-session reasoning)			
Trajectory	Sequence of transitions across all sessions	"Where has the blue totebag been across all sessions?"	Delta, Meta, Live
Volatility	Frequency and magnitude of changes	"Which object moved most frequently?"	Meta
Temporal localization	Identifying *when* a change occurred	"When was the last time the white board moved?"	Delta
Counterfactual	Comparing states at two specific sessions	"Was the robot dog in the same location in S_1 and S_{10}?"	Delta, Live

Submitted, under review

Memory

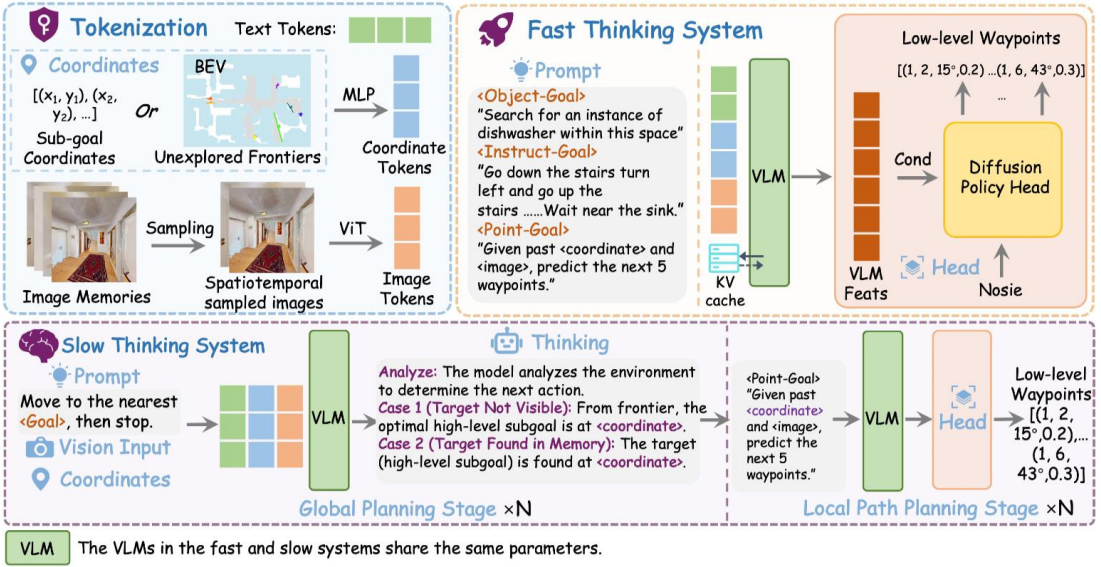
- **Long-term Navigation Memory**

Q: When should I go if I want to find a parking spot?
A: Come around 8:00AM to find a parking spot (Session3, 0 cars at that time).

Q: When is it hardest to find a place to park?
A: It's hardest to find a spot around 1:03PM (Session8, 34 cars).
Avoid that time if you want an empty spot.

Visual-Language Nav

- **VLN: VLA for Navigation**



Xue, Xinda, et al. "Omninav: A unified framework for prospective exploration and visual-language navigation." arXiv preprint arXiv:2509.25687 (2025).

Visual-Language Nav

Instruction:
Walk forward along the white wall .Once you are close to the passage on your right, make a right turn and enter the passage. Continue walking straight, following the black striped tiles on the floor. After passing the fire hydrant, turn slightly to the right and move forward until you see a black sofa. Walk towards the black sofa and stop in front of it to finalize the trajectory.

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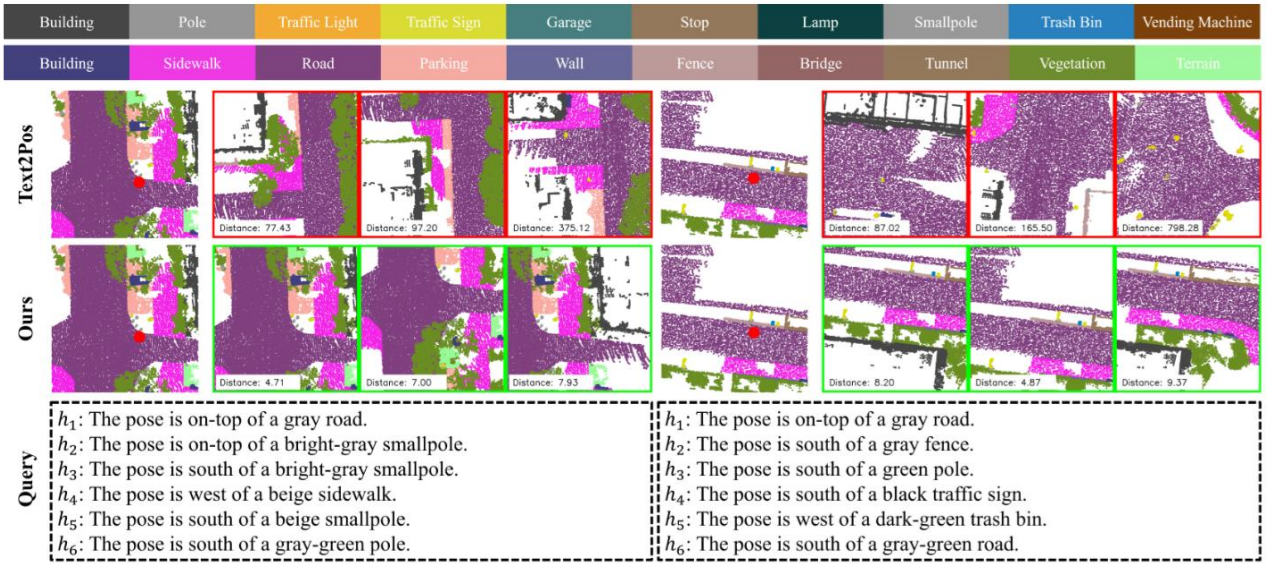
Visual-Language Nav

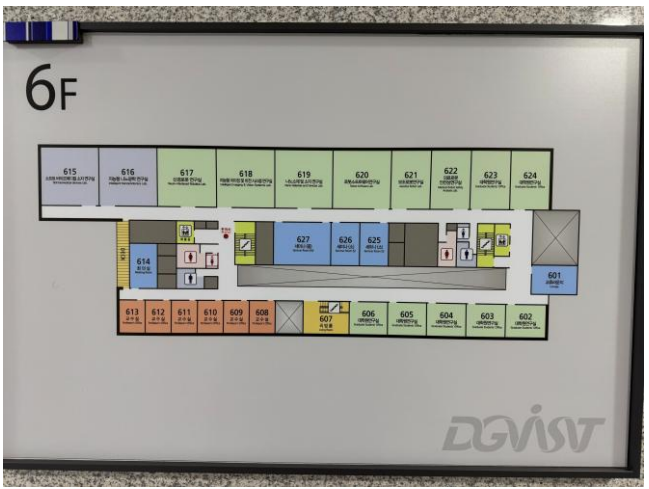
- Language meets robot sensing modality



Goal of 2026-2027

- 암묵적 인간 지시를 이해하고 상호작용하는
  다중 자율 모빌리티를 위한 메모리 증강 공간지능 개발 (2026-2029)

- 다양한 형태의 map interface에서의
  point-to-language grounded navigation



Thank you!