SHIGEMICHI MATSUZAKI

I am a researcher at **Frontier Research Center, Toyota Motor Corporation**. I am currently working on robot localization and mapping. My research interests include deep learning in robot perception, mobile robots in unstructured environments, mapping and localization of mobile robots, etc.

CONTACT

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https://shigemichimatsuzaki.github.io/

SKILLS

C++

Python

ROS (Robot Operating System)

PyTorch

PCL (Point Cloud Library)

LANGUAGES

Japanese (Native)

English (Business level fluency)

Chinese (Conversational level)

CERTIFICATIONS

TOEIC - 985 / 990

EDUCATION

Toyohashi University of Technology

Doctoral course in Engineering (2020-2023)

Toyohashi University of Technology

Master of Engineering: MEng, Computer Science (2018-2020)

Toyohashi University of Technology

Bachelor of Engineering: BE, Computer Science (2016-2018)

National Institute of Technology, Kumamoto College

Associate degree of Engineering (2010-2016)

EXPERIENCE

Intern

INTEL Microelectronics (M) Sdn. Bhd - Penang, Malaysia
January 2018 - February 2018

- Automating visualization of utilities of the devices in the factories
- Development of notification system
  - Requirements definition through communication with local employees in English

Research Assistant

Toyohashi University of Technology
October 2018 - March 2022

- Joint research with SINFONIA TECHNOLOGY Co., Ltd.
- In charge of the development of autonomous navigation of an agricultural mobile robot

Intern

National Institute of Advanced Industrial Science and Technology
March 2022 - April 2022

- Single-shot global localization based on graph-theoretic data association

Visiting researcher

University of Eastern Finland
July 2022 - September 2022

- Analysis of point cloud map generated by Terresterial Laser Scanner (TLS) and Aerial Laser Scanner (ALS) for UAV path planning

RESEARCH INTERESTS

Visual localization / mapping and navigation for mobile robots

- I am currently working on navigation of mobile robots that is robust to environmental changes in long term, such as the change of layout, appearances, and viewpoints.
- To this end, I am developing robust visual localization methods that can deal with viewpoint changes.
- I am specifically interested in multi-/cross-modal localization that allows the use of sensors with various modalities during mapping and localization phases.

Traversability estimation for navigation in plant-rich environments

- The main research topic in my doctoral study was **scene recognition considering traversable plant parts** for robot navigation in plant-rich environments such as greenhouses, forests, etc.
- Conventional mobile robots with range sensors do not take the presence of traversable objects covering the paths into account and thus **cannot traverse those paths, recognizing them as obstacles**.
- Our method **explicitly estimates the object classes and traversability** and enables navigation through the traversable plants.
- Our method can **broaden the applicable environments** of autonomous mobile robots to unstructured and complex environments with plants.

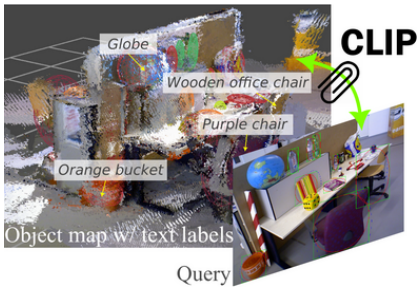
Deep learning

- In the traversability estimation, we adopt deep learning on images for the recognition of object classes and traversability.
- For practical situations with a few or no labeled training data available, I have studied and applied techniques such as **domain adaptation**, **un/semi-supervised learning**, **few-shot learning**, etc.

Home service robots

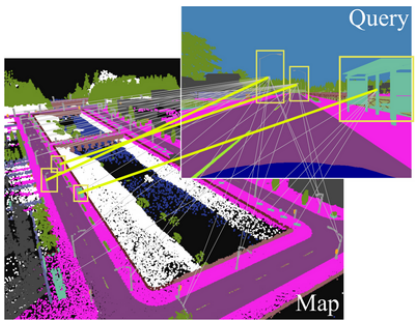
- Besides my main research, I also worked on software development for robot competitions such as **World Robot Summit (WRS)** and **RoboCup@Home**.
- As a team leader, I worked on the **project management** of the entire development, **system integration**, and **coding** of some functions, as well as some paperwork tasks.
- In WRS 2018, our team won **3rd place** out of 14 teams and was awarded the **Japanese Society for Artificial Intelligence Award**

RESEARCH THEMES



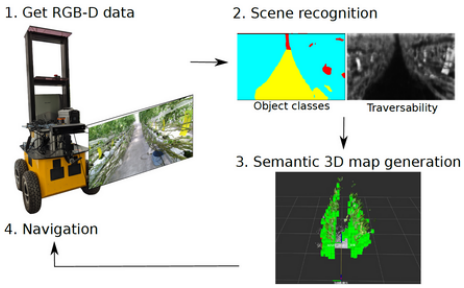
Object-based global localization using Vision Language Models

- Introducing Vision Language Models（VLMs) like CLIP (Radford+, 2021) to object-based pose estimation for better accuracy and efficiency of corresponding matching.
- Leveraging the multi-modal inference capabilities of VLMs, I am seeking localization methods that robustly estimates the pose using the fine-grained semantic information given through text and visual information.



Global Localization via Graph-Theoretic Correspondence Matching

- Single-shot global localization based on **graph-theoretic matching** of instances between a query and the prior map.
- Does not rely on computationally demanding feature learning etc.
- Potentially applicable to **cross-modal** global localization problems.



Scene recognition for mobile robots in plant-rich environments

- Scene recognition for robot navigation considering traversable plants covering the paths, which may otherwise be recognized as obstacles.
- A novel architecture for estimating both object classes and traversability, and a manual annotation-free training method for the model.

PUBLICATIONS

Journals

1. S. Matsuzaki, K. Tanaka, K. Shintani, “**CLIP-Clique: Graph-Based Correspondence Matching Augmented by Vision Language Models for Object-Based Global Localization**”, IEEE Robotics and Automation Letters, vol. 9, Issue 11, pp. 10399-10406, 2024
2. S. Matsuzaki, K. Koide, S. Oishi, M. Yokozuka, A. Banno, “**Single-Shot Global Localization via Graph-Theoretic Correspondence Matching**”, Advanced Robotics, vol. 38, Issue 3, pp. 168-181, 2024
3. T. Yrttimaa, S. Matsuzaki, V. Kankare, S. Junttila, N. Saarinen, A. Kukko, J. Hyyppä, J. Miura, M. Vastaranta, "**Assessing forest traversability for autonomous mobile systems using close-range airborne laser scanning**", Croatian Journal of Forest Engineering, vol. 45, Issue 1, p. 13, 2024
4. S. Matsuzaki, J. Miura, H. Masuzawa, “**Multi-source Pseudo-label Learning of Semantic Segmentation for the Scene Recognition of Agricultural Mobile Robots**”, Advanced Robotics, vol. 36, Issue 19, pp. 1011-1029, 2022, doi: 10.1080/01691864.2022.2109427.
5. S. Matsuzaki, H. Masuzawa, J. Miura, “**Image-based scene recognition for robot navigation considering traversable plants and its manual annotation-free training**”, IEEE Access, vol. 10, pp. 5115-5128, 2022, doi: 10.1109/ACCESS.2022.3141594.

International conferences

1. S. Matsuzaki, T. Sugino, K. Tanaka, Z. Sha, S. Nakaoka, S. Yoshizawa, K. Shintani, “**CLIP-Loc: Multi-modal Landmark Association for Global Localization in Object-based Maps**”, IEEE Int. Conf. on Robotics and Automation (ICRA), 2024
2. S. Matsuzaki, H. Masuzawa, J. Miura, “**Multi-Source Soft Pseudo-Label Learning with Domain Similarity-based Weighting for Semantic Segmentation**”, IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS), 2023
3. Y. Uzawa, S. Matsuzaki, H. Masuzawa, J. Miura, “Dataset Generation for Deep Visual Navigation in Unstructured Environments", The 11th European Conference on Mobile Robots (ECMR), 2023
4. S. Matsuzaki, H. Masuzawa, J. Miura, “**Online refinement of a scene recognition model for mobile robots by observing human's interaction with environments**”, IEEE Int. Conf. on Systems, Man, and Cybernetics (SMC), 2022
5. Y. Uzawa, S. Matsuzaki, H. Masuzawa, J. Miura, "**End-to-end path estimation and automatic dataset generation for robot navigation in plant-rich environments**", International Conference on Autonomous Systems, 2022
6. S. Matsuzaki, J. Miura, H. Masuzawa, "**Semantic-aware plant traversability estimation in plant-rich environments for agricultural mobile robots**", European Conference on Mobile Robots (ECMR) Workshop on Agricultural Robotics and Automation, 2021
7. S. Matsuzaki, H. Masuzawa, J. Miura, S. Oishi, “**3D Semantic Mapping in Greenhouses for Agricultural Mobile Robots with Robust Object Recognition Using Robots' Trajectory**”, IEEE Int. Conf. on Systems, Man, and Cybernetics (SMC), pp.357-362, 2018

MEMBERSHIPS/AFFILIATIONS

- IEEE, Robotics and Automation Society (RAS)
- The Robotics Society of Japan (RSJ)

PEER REVIEW

- IEEE RA-L
- IEEE ICRA
- IEEE IROS
- IEEE ROBIO