# KIT
Karlsruhe Institute of Technology

# mrt

**Bachelor Thesis / Master Thesis**



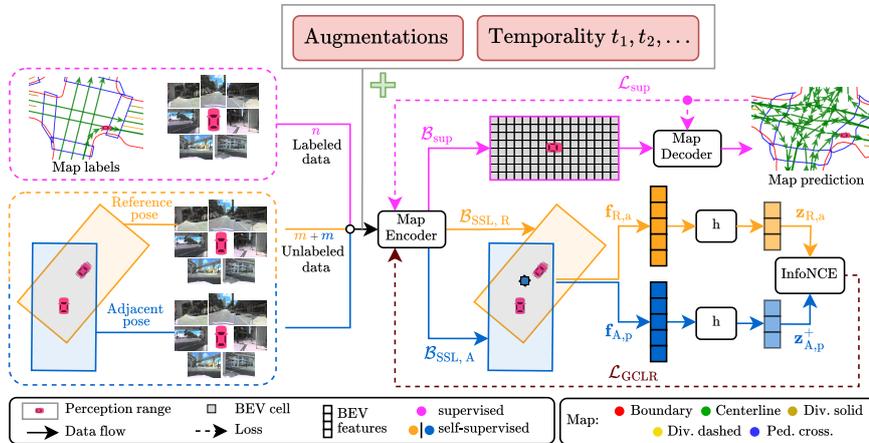| Perception range | BEV cell | BEV features | supervised | Map: | Boundary | Centerline | Div. solid |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Data flow | Loss | | self-supervised | | Div. dashed | Ped. cross. | |

## Deep Learning: Extension of Semi-Supervised Online HD Map Construction Method MapGCLR

Current state-of-the-art map construction methods leverage sensor data (e.g., 360° surround-view cameras) and encoder-decoder architectures to generate high-definition (HD) maps. However, these fully supervised approaches rely heavily on large-scale labeled datasets, which are costly and time-consuming to annotate for map elements. To address this limitation, Semi-Supervised Learning (SSL) frameworks like MapGCLR exploit unlabeled data by combining supervised learning with self-supervised contrastive objectives.

While MapGCLR effectively utilizes spatial relationships (e.g., adjacent vehicle poses), it does not yet fully exploit the available unlabeled data. In particular, temporal context and advanced data augmentations remain underutilized. Incorporating temporal sequences enables learning temporally consistent and geometrically stable Bird's Eye View (BEV) representations. Additionally, strong image- and feature-level augmentations are key to improving robustness and invariance in contrastive learning.

The goal of this thesis is to extend the MapGCLR framework by integrating temporal sequences and advanced augmentation strategies into its self-supervised pipeline. The impact of these extensions will be evaluated in terms of representation quality and map prediction performance on partially labeled datasets. Experiments will be conducted on the Argoverse 2 dataset.

The thesis includes the following tasks:

+ Literature review on Semi-Supervised Learning, temporal representation learning, and BEV/HD map perception
+ Implementation and Evaluation of temporal modeling and advanced data augmentation strategies

### Literature

1. Merkert et al., MapGCLR: Geospatial Contrastive Learning of Representations for Online Vectorized HD Map Construction, `https://arxiv.org/abs/2603.10688`

2. Lilja et al., Exploring Semi-Supervised Learning for Online Mapping, `https://arxiv.org/abs/2410.10279`

**Institute of Measurement and Control Systems (MRT)**
Prof. Dr.-Ing. Christoph Stiller

**Advisor:**
Jonas Merkert, M.Sc.

**Programming language(s)[1]:**
Python    advanced

**System, Framework(s):**
Linux, PyTorch

**Required skills:**
- Experience with Neural Networks in Deep Learning context
- Experience with PyTorch, NumPy and Matplotlib
- Motivation and independent work style with the interest learning new things

**What we offer:**
- Work with state-of-the-art methods and cutting-edge research
- Access to large GPU servers and HPC clusters
- Supervision by experienced researchers in Deep Learning

**Language(s):**
German, English

A (partially) successful thesis may lead to a joint **international conference publication** of the scientific work

For more information please contact:

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Or directly send in your application including your current grades as well as our questionnaire!