Karlsruher Institut für Technologie

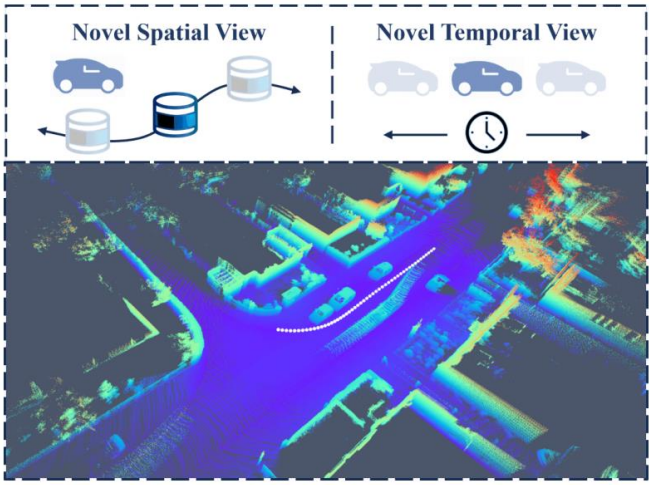
Applied Informatics and Formal Description Methods
Cooperative Autonomous Systems
Kaiserstraße 89
76133 Karlsruhe

https://cas.aifb.kit.edu/

Master Thesis

Learning Realistic 4D LiDAR Point Cloud Generation via Gaussian Splatting for Connected Autonomous Driving

Background:



Connected and automated driving (CAD) systems require accurate, efficient, and realistic 3D perception of dynamic environments. However, collecting large-scale, diverse LiDAR datasets remains costly and time-consuming. Recent research has shown the potential of LiDAR-based novel view synthesis (NVS) to generate realistic point clouds by learning continuous spatio-temporal scene representations. Notably, GS-LiDAR introduces panoramic Gaussian splatting with 2D Gaussian primitives and periodic vibration modeling to simulate dynamic LiDAR signals, while LiDAR4D leverages a hybrid 4D neural representation with motion priors for time-consistent reconstruction of large-scale scenes. Despite these advances, a unified framework that combines the physical realism of LiDAR-specific attributes (e.g., intensity, ray-drop) with the flexibility and efficiency of 4D Gaussian splatting remains underexplored. This thesis aims to address this gap by learning realistic and temporally coherent LiDAR point cloud generation tailored for dynamic scenes in connected autonomous driving scenarios.

Your Tasks:

- Literature review on Gaussian Splatting, and dynamic scene reconstruction.
- Reproduction and benchmarking of baseline models on datasets like KITTI, nuScenes, and Open MARS
- Design and implementation of a novel 4D LiDAR Gaussian Splatting pipeline.
- Benchmark the system's performance against existing SOTA methods.

Your Profile:

- Strong background in machine learning and computer vision
- Experience with LiDAR data processing.
- Knowledge of deep learning frameworks (e.g., PyTorch or Tensorflow) and practical experience of NeRF/Gaussian Splatting
- Ability to work independently and tackle complex, open-ended research problems.

Start date: Immediately **Duration:** As per the applicable examination regulations.

If you are interested or have any questions regarding this thesis position, feel free to contact:
M.Sc. **Lei Wan** Tel: +49 016 270-91287 E-Mail: lei.wan@partner.kit.edu

[1] Zheng, Zehan, et al. "Lidar4d: Dynamic neural fields for novel space-time view lidar synthesis." *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*. 2024.
[2] Jiang, Junzhe, et al. "GS-LiDAR: Generating Realistic LiDAR Point Clouds with Panoramic Gaussian Splatting." *arXiv preprint arXiv:2501.13971* (2025).