Karlsruher Institut für Technologie

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

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

Bachelor/Master Thesis

A Review of Feed-Forward 4D Reconstruction for Connected Autonomous Driving

Background:

Autonomous driving systems require a consistent understanding of dynamic environments, including both 3D geometry and temporal motion. This has motivated increasing research interest in 4D reconstruction, which models full spatio-temporal scenes (3D + time). Traditional 4D reconstruction pipelines typically rely on multi-stage optimization, explicit pose estimation, and iterative neural rendering, making them computationally expensive and difficult to scale to real-world driving scenarios. Recently, feed-forward 4D reconstruction has emerged as a new paradigm. Transformer-based methods such as Any4D and DGGT can reconstruct dynamic driving scenes directly in a single forward pass, without per-scene optimization. These approaches achieve real-time inference, strong generalization, and explicit scene representations, making them highly promising for autonomous driving perception. The main objective of this thesis is to systematically study and benchmark feed-forward 4D reconstruction methods in autonomous driving scenarios.

Your Tasks:

- Conduct a structured literature review of recent feed-forward 4D reconstruction methods
- Reproduce and evaluate selected methods on public autonomous driving datasets
- Perform benchmark comparisons in terms of reconstruction quality, motion consistency, generalization ability, and inference efficiency.

Your Profile:

- Solid background in deep learning and computer vision.
- Experience with PyTorch and Python.
- Basic knowledge of 3D geometry or multi-view vision.
- Independent, research-oriented mindset and the ability to explore open-ended 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] Karhade, Jay, et al. "Any4D: Unified Feed-Forward Metric 4D Reconstruction." arXiv preprint arXiv:2512.10935 (2025).
[2] Chen, Xiaoxue, et al. "DGGT: Feedforward 4D Reconstruction of Dynamic Driving Scenes using Unposed Images." arXiv preprint arXiv:2512.03004 (2025).