Karlsruhe Institute of Technology

Master Thesis



Using a real world dataset (top left) to fine-tune a diffusion model and generate synthetic data (bottom right) from simulation data (top right).

Latent Scene Generation

Diffusion models have emerged as a powerful approach in generative modeling, capable of producing highly realistic synthetic images across diverse domains. However, generating images tailored to specific camera styles—such as color tone, noise patterns, resolution artifacts, and lens characteristics—presents a unique challenge. The goal of this thesis is to explore and implement techniques for adapting a diffusion model to a specific camera style. By leveraging large real-world datasets and simulated data, we aim to generate synthetic images that mimic the visual properties and characteristics of a chosen camera system. An examplary application is the generation of synthetic images – that match the required domain style – for training autonomous driving systems.

We provide access to GPU clusters for training deep learning models as part of your thesis. This topic also offers the opportunity for publication at international conferences.

The proposed thesis consists of the following parts:

+ Review of Diffusion Models: Understand the underlying principles of diffusion models and how they are applied in synthetic image generation.
+ Data Acquisition and Preprocessing
+ Camera Style Adaptation: Explore methods to adapt diffusion models to specific camera styles
+ Benchmarking and Validation: Evaluate the performance of the adapted diffusion model on real-world and simulated data

I am happy to answer any questions you might have. Feel free to ask for an appointment or directly ask at my office!

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

Advisors:
Marlon Steiner, M.Sc.
Marvin Klemp, M.Sc.
Kevin Rösch, M.Sc.

Programming language(s)[1]:
Python advanced

System, Framework(s):
Linux, PyTorch

Required skills:
- Prior knowledge of deep learning and its implementation in python
- Understanding complex deep learning-based model architectures
- Work on your own

Language(s):
German, English

For more information please contact:

Marlon Steiner

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

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[1] **skill levels:**

beginner	< 500 lines of code (LOC)
advanced	500 – 5000 LOC
proficient	> 5000 LOC