KI DELTA LEARNING
Scalable AI for Automated Driving

SceneNeRF: 3D Reconstruction of Real-World Scenes

Thies de Graaff

Goal

The generation of synthetic data samples for AI training and testing, as well as scenario-based testing of entire automated driving functions requires a great variety of realistic virtual worlds. This work investigates the automated reconstruction of real-world scenes based on images and sparse point clouds, gathered from sensors attached to a vehicle.

Related Work

Our approach is based on Neural Radiance Fields (NeRF) [1], a technique to learn an implicit 3D representation of a scene, encoded in the weights of a feed-forward network. The network is queried with sets of points in 3D space, which are sampled from rays that correspond to pixels from the training set. The network predicts densities and colors for each input sample and by leveraging classical volume rendering to accumulate a color for a ray, the network can be trained with the pixel color as a target.

Technical approach

By design, Neural Radiance Fields are only suited for static scenes, which imposes problems in high-dynamic traffic scenes. Plus, they may lack in details for large scenes.
We overcome these challenges by leveraging different ideas from the literature and integrating them into a greater architecture. A notable feature of this architecture is the differentiation of foreground and background which enables the usage of different encoding techniques. The foreground makes use of a Multi Resolution Hash Table [2] that stores trainable feature vectors in a voxel grid. We train independent MLPs for the foreground and background, while their results are aggregated to a single color prediction of a ray. To tackle the problem of moving objects, per-image trainable feature vectors are used. This enables to differentiate between static objects that are shared between all images and moving objects, that are specific for each individual image.

Evaluation

To evaluate the robustness of SceneNeRF against the different mentioned challenges, we designed a synthetic benchmark that contains the same scenes with the phenomena turned on and off.

References

[1] Mildenhall et al. NeRF: Representing Scenes as Neural Radiance Fields for View Synthesis, arXiv, 2020
[2] Müller et al. Instant Neural Graphics Primitives with a Multiresolution Hash Encoding, ACM Trans. Graph, 2022

Environment

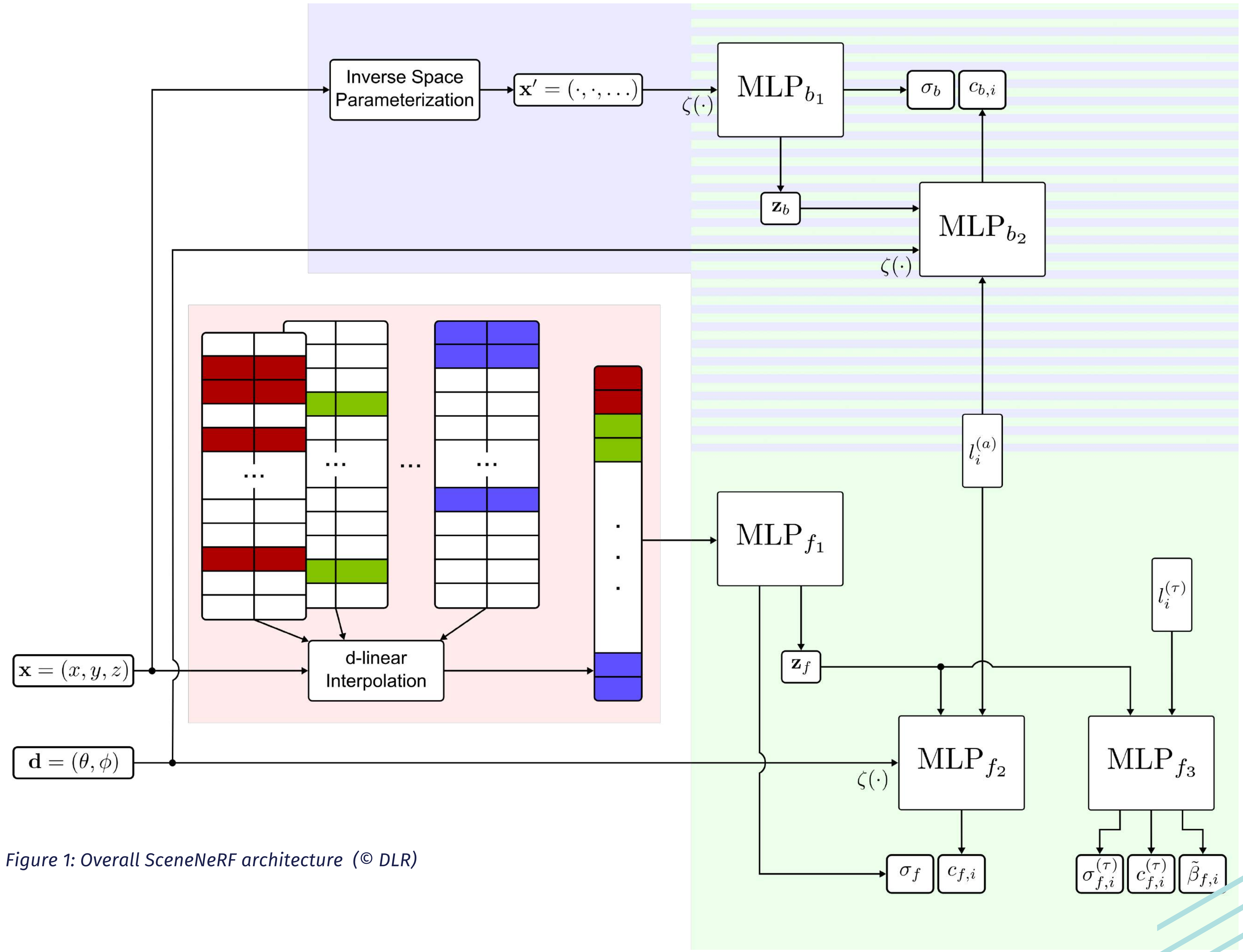

Figure 1: Overall SceneNeRF architecture (© DLR)

Partners

External partners

For more information contact:

thies.degraaff@dlr.de

KI Delta Learning is a project of the KI Familie. It was initiated and developed by the VDA Leitinitiative autonomous and connected driving and is funded by the Federal Ministry for Economic Affairs and Climate Action.

www.ki-deltalearning.de @KI_Familie KI Familie

Supported by: Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag