KI DELTA LEARNING
Scalable AI for Automated Driving

LiDAR Simulation in Carla

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WP 1.3

Use-Case in Delta Learning

There is an increasing need for synthetic data in the autonomous driving research community. With synthetic data there is no need to manually label data and corner case data can be generated easily. However there is a gap between the synthetic and the real data. In Delta Learning the goal is to close this gap so that a deep neural network that is trained on synthetic data can be applied to real data. On the one hand one can improve the sensor model used to generate the synthetic data, on the other hand one can work on the machine learning algorithm side. In this WP Valeo works on the side of the sensor model.

Technical Problem

Valeo works with the simulation environment Carla to generate synthetic LiDAR data. There is a synthetic LiDAR available within this simulation environment, however this model is rather simplified. Valeo aims at creating an improved sensor model and integrating it into Carla. Here the example is a pulsed rotating LiDAR with distance and echo pulse width output. The model shall support multiple echoes per channel and simulate sensor effects like sensitivity profiles and blooming. At first Valeo aimed at simulating reflections through the usage of raytracing instead of raycasting, yet this seems difficult to realize within Carla. Therefore the model needed to be adapted to use the rendering and raycasting output from Unreal Engine on which Carla is based. It is planned to further look into raytracing at a later point in the project.

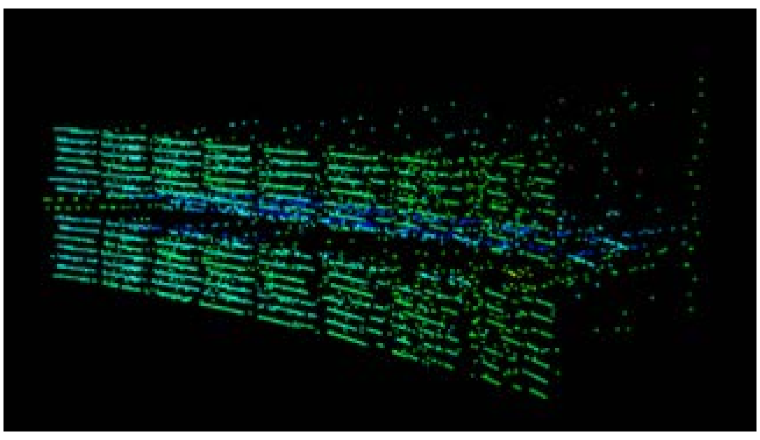

Figure 1: example of a pointcloud with multiple echoes per channel

Technical Solution

In a first step the sensor field of view is upsampled. That way it will later be possible to simulate multiple echoes. For each pixel the echo is collected, where the intensity information comes from the renderer and the distance information from a raycasting process.

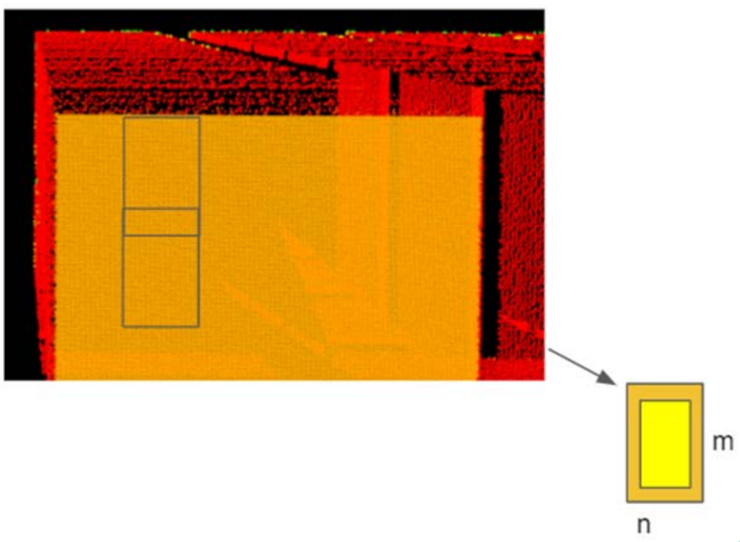

Figure 2: downsampling process at construction of optical signal

Here the intensity data is masked by a sensitivity and a blooming profile. Each cell now contains m x n distance - intensity pairs. These are pictured as a distance intensity graph. Finally a convolution of this graph and a supergaussian function is calculated to generate the synthetic optical signal. The electrical signal is described by applying noise and simulating the ringdown behaviour of an APD.

In the last step the echo is calculated in a way similar to the way this is done for a real signal: an echo is detected through a threshold and walk error compensation is applied. The result is a pointcloud with a value for the echo pulse width for each point. One channel can have multiple echos. The development of the model has been completed. At this point Valeo is working on the integration with Carla.

Evaluation

The quality of the generated synthetic LiDAR data is going to be evaluated in the sense of how far it is from real LiDAR data. It will be evaluated whether certain sensor effects that are present in the real data are also present in the synthetic data. Furthermore KPIs are going to be evaluated on real and synthetic data and the results are going to be compared.

Sensors

Valeo

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Partners

External partners

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KI FAMILIE

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