KI DELTA LEARNING
Scalable AI for Automated Driving

# Rare-Event-Simulation-based Failure Identification and (Re-)Training

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WP 2.2
WP 2.4

Environment

## Technical Problem

A major problem in machine learning is the strong dependence of the performance of the neural network (the AI) on the training data set. This can lead to weak performance of the network under specific circumstances like certain weather conditions if the given circumstance is not present or only seen rarely in the training data set. It would be desired to adapt the already available model to those circumstances based on a small synthetic dataset instead of having to collect a large dataset in the new domain and start training from scratch, since the real-world data elicitation and the model training are costly concerning time and money.
This leads to our central research question: How can we systematically and efficiently generate data samples for the new domain that will help to adapt the model in the desired way? For this research question, we are exploring a new approach that we call "Rare-Event-Simulation-based Failure Identification".

## Technical Solution

Rare Event Simulation consists of simulation guiding algorithms that aim to steer the simulation towards misclassifications. These techniques will allow us to systematically find samples in the target domain that are not correctly classified by the model. The samples found this way can then be used to further train and enhance the model, so that it will increase its performance in the new domain. The main procedure is shown schematically in Figure 1. and works as follows: We start with a parametrized scenario that is simulated in a traffic simulator (e.g. CARLA). The outputs of the simulator are given to the perception AI, the system-under-test, which performs a semantic segmentation of the simulation data. In the next step the criticality monitor will compare the output with the ground truth. The resulting output called criticality is a performance indicator for the network and reflects the number of found misclassifications. Based on the measured criticality, the rare event simulation algorithms will then suggest new parameters for the next simulation run. With every run of this loop, these algorithms can collect more information over the system, leading to an increased chance of detecting a critical simulation run.

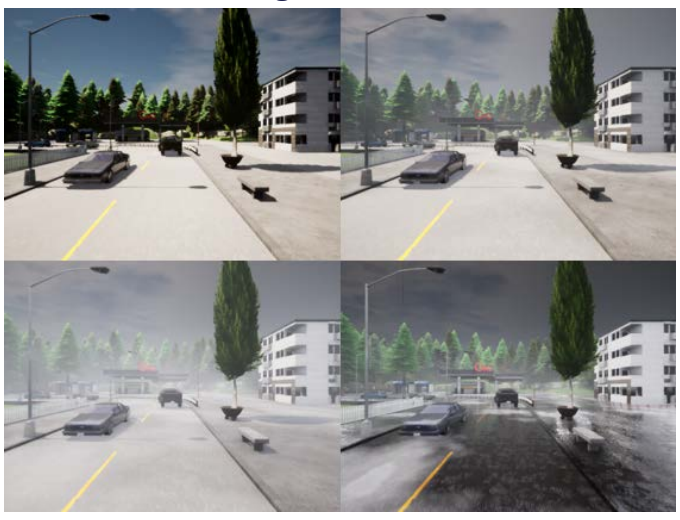

*Figure 2: Depiction of the same scene in CARLA for different weather parameters*

## Use-Case in Delta Learning

The approach is very general and thus can be applied to multiple different use-cases. It requires a real valued parameter space in which the parameters can be varied. In the KI Delta Learning project, the approach will be used to detect critical weather conditions for which the tested network is vulnerable for. An example of a scene in CARLA for different weather conditions can be found in Figure 2.

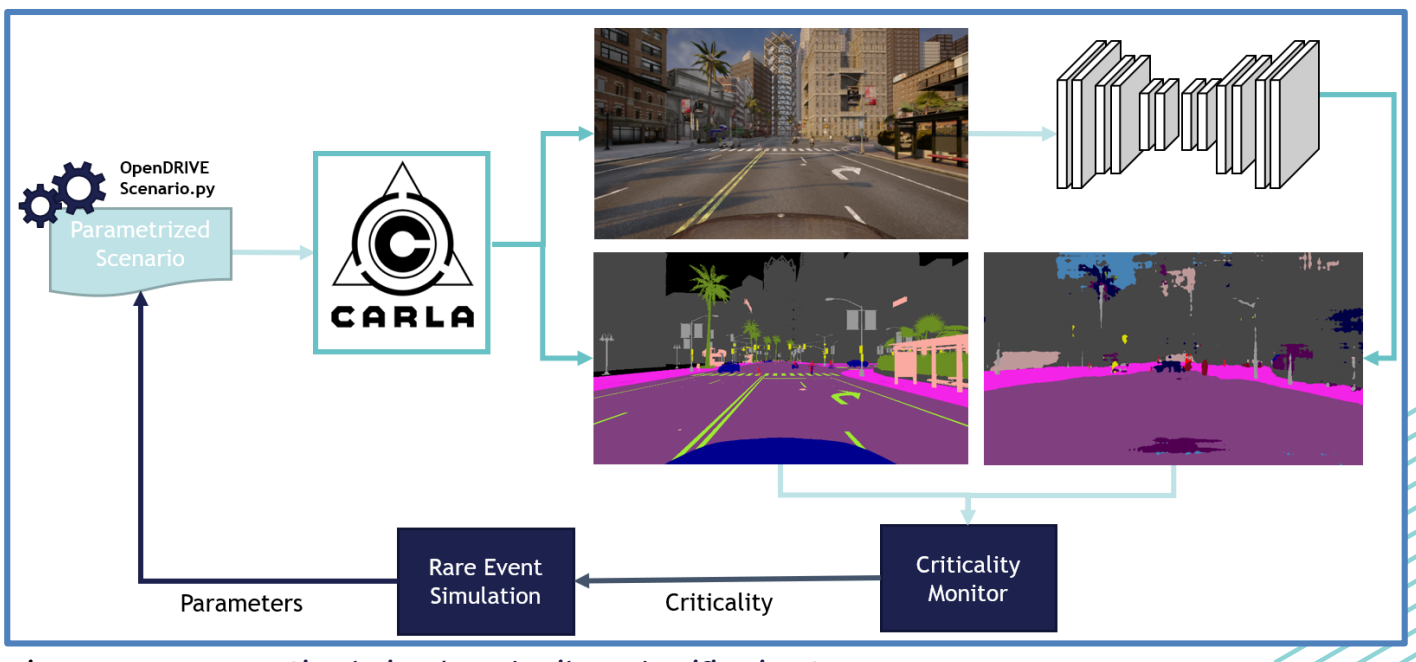


*Figure 1: Rare-Event-Simulation-based Failure Identification Setup*

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KI FAMILIE

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