KI DELTA LEARNING
Scalable AI for Automated Driving

Detection of critical weather situations in scenario-based traffic simulations using optimization techniques

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Motivation

The performance of a neural network trained for **perception** is highly dependent on the training data set. This can lead to a weak performance of the network under specific circumstances if these circumstances occur only very rarely (or are not present) in the training data set.

Use case: Weather

We are looking at weather conditions. As weather is highly diverse, it is usually impossible to train a neural network for all possible weather conditions, which can affect the performance of the network.This is shown in Figure 1, where we used a specific traffic scenario and initialized it with different weather parameter values. For each set of weather parameter values we started a simulation run and measured the performance of the network using the mean IoU (intersection-over-union) metric.

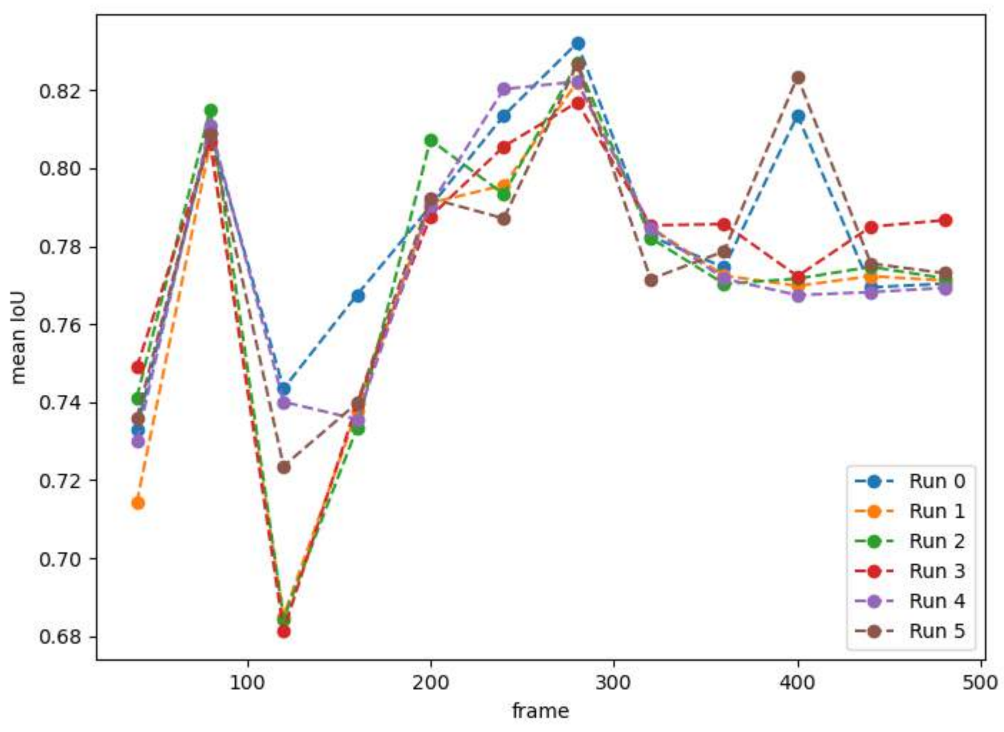

Figure 1: Depiction of six different simulation runs for a single scenario. A different weather situation was created for each simulation run, while everything else remained the same. The performance of the network was measured using the mean IoU (intersection-over-union) metric. (© Deutsches Zentrum für Luft- und Raumfahrt e.V.)

Task

We want to identify the most critical simulation parameters automatically and efficiently.

Figure 2: Depiction of the same scene in the CARLA traffic simulator for different weather parameters.
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Method

We use an optimization loop to steer the simulation towards (weather-) parameters that can lead to a critical situation. A visualiziation of this loop can be found in Figure 3. The steps are as follows:

1) Create an initial parameter set
2) Initialize the traffic scenario with the given parameter set
3) Simulate the scenario and retrieve the results
4) Use the neural network to create a semantic segmentation mask
5) Calculate a performance indicator (called criticality) for the current simulation run
6) Use optimization algorithms to create a new parameter set based on the criticality feedback
7) Go to (2).

Environment

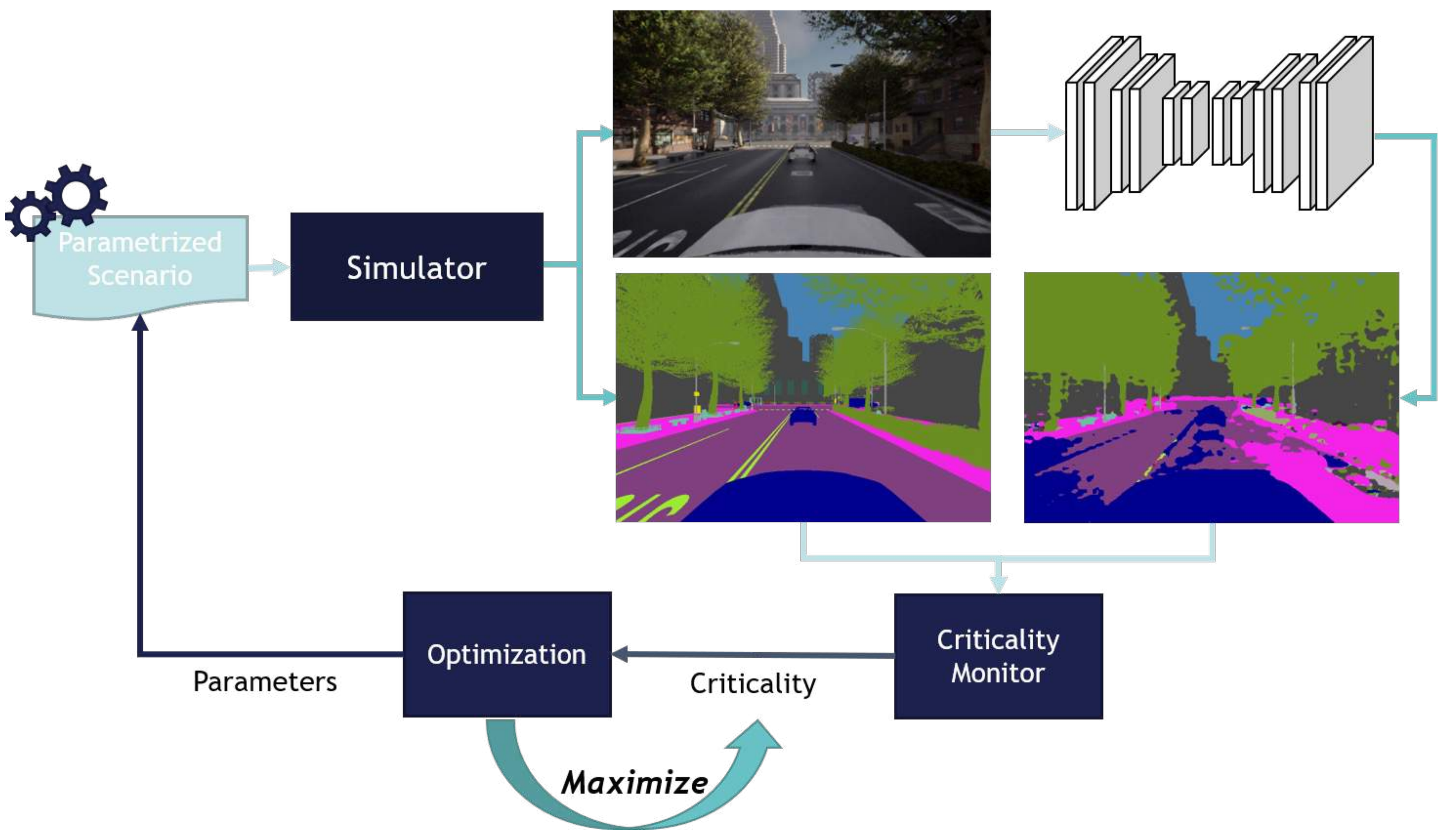

Figure 2: Visualization of the scenario-based optimization workflow. (© Deutsches Zentrum für Luft- und Raumfahrt e.V.)

Partners

External partners

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