Corner Case Generation and Detection Approaches

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KI DATA TOOLING
The Data Kit for Automotive AI

ML Function Development

Corner Case Generation

To generate scenarios with corner cases, both expert- and data-driven approaches are possible. While data-driven approaches are more suitable to challenge a certain system, expert-driven approaches enable the representation of known scenarios. Here, we will focus on the latter. Ontologies are a highly powerful tool to represent such scenarios, but they are typically very specific [6]. Based on our conceptual work on description languages for corner cases [1], we have developed a scalable ontology [2] capable of representing all known corner case categories [7,8].

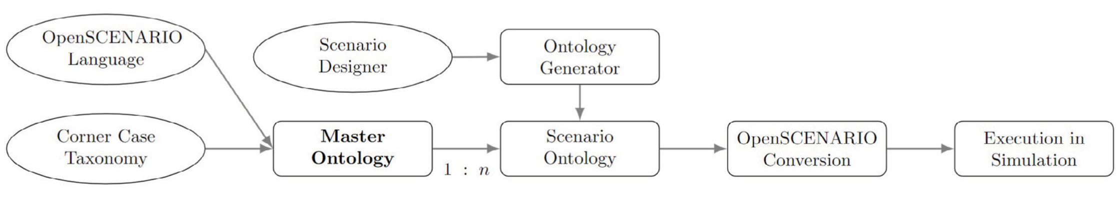

Figure 1: Design of master ontology; derivation and specification of individual scenario ontologies; execution in simulation [2]

Based on a master ontology, specific scenarios can be derived. Our initial catalogue comprises ten corner case scenarios. The core advantage compared to classical human-designed scenarios lies in the storage of all scenario-related data in a human- and machine-readable format, allowing for a comprehensive analysis of scenario catalogs.

Figure 2: Exemplary simulation of a scenario ontology containing a single-point anomaly, based on the simulation engine CARLA [2]

Corner Case Detection

In order to better understand the suitability of different methods based on different sensor data for the task of corner case detection, we have conducted two extensive surveys [3,4]. Both for methods and datasets, we found a strong focus on RGB imagery.

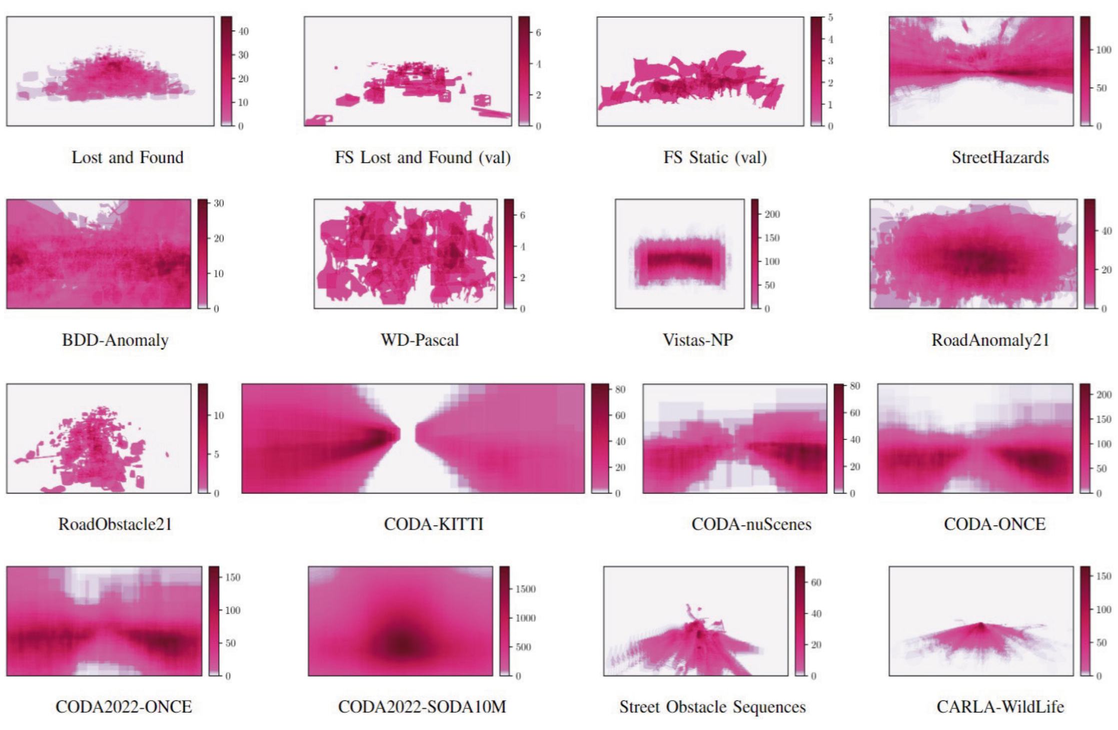

Figure 3: In-depth analysis of distribution and frequency of corner cases in RGB-based public datasets [4]

Our overview in Figure 3 also shows that the definition of corner cases across existing datasets varies a lot, making them challenging to detect over multiple benchmarks. On a method level, we follow the categorization proposed by Breitenstein et al. [9] and observe that methodologies vary strongly based on the utilized data source.

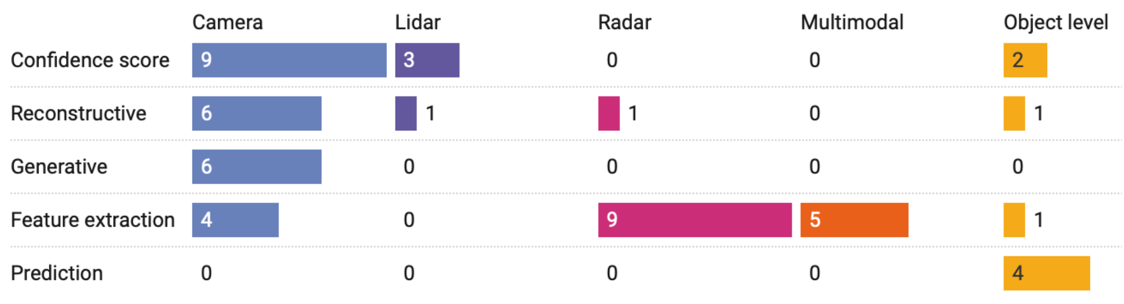

Figure 4: Overview of state-of-the-art corner case detection methods for most sensor modalities, categorized by detection approach [3]

In our work on corner case detection, we make use of a multitude of existing RGB datasets to train our networks. We represent imagery in a latent space in order to classify samples with corner cases.

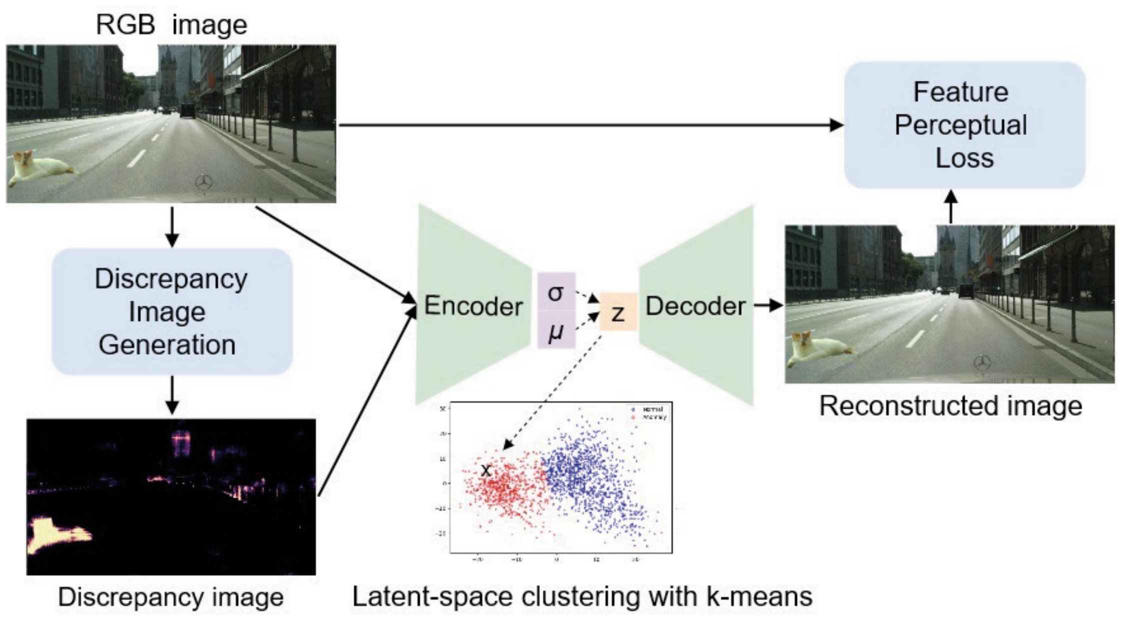

Figure 5: Overview of our VAE-based corner case detection method [5]

Here, our experiments used both a feature perceptual loss and discrepancy images as additional input. We are able to clearly identify clusters for normal scenarios and such containing corner cases. However, high false-positive rates remain challenging.

References:

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Partners

External partners

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