

Autonomous vehicle data gathering

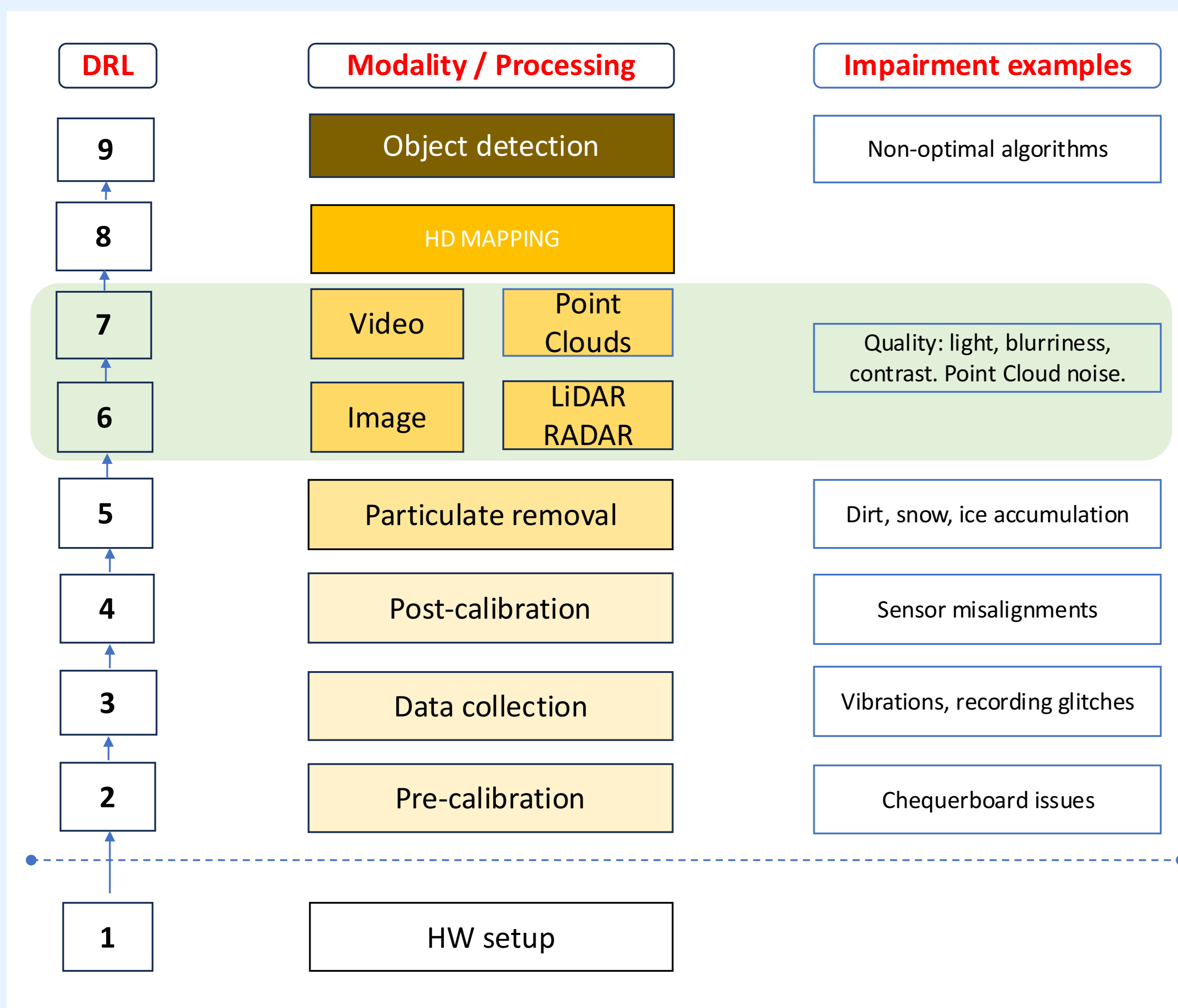


The data gathering vehicle used evaluating DRLs in this poster. *Photo credit:* The Finnish Geospatial Research Institute FGI.

Technical overview

1. This poster shows how we *derived* a novel measure for quantifying data quality for autonomous driving.
2. Akin to Technical Readiness Levels (TRL), Data Readiness Levels (DRL) per dataset have been developed.
3. As well as a DRL value and a framework, our work normalise outputs from various assessment tools, real data, augmented real data over varying time scales.
4. To evaluate the concept, three autonomous driving datasets were used (see opposite), augmented with additional weather conditions not present in most scenes.
5. Two of the datasets are from open-road driving scenes, and one from a test track. Images were further distorted with rain and fog, and point clouds with fog. That is to show scenes that might be encountered in real driving, but not captured in the test drive(s).
6. This poster shows *how a single metric* can be derived from 46 image and 2 point cloud quality metrics evaluated across nearly 5 TB of data.
7. Through considerable statistical processing, two image quality metrics performed well, at some computational cost, whilst state of the art point cloud metrics were inconclusive across our data.

Data Readiness Levels



Leftmost: Data Readiness Levels. Data flows from calibration upwards to object detection. *Central:* Process names associated with a Readiness Level. *Rightmost:* example impairments. The shaded green section indicates this poster's focus. Levels 6 and 7 are in this poster. Each modality is handled separately and then combined into a single scalar value, as formalised in the Algorithm.

Metric methods

Name	Technical Basis
IL-NIQE	NSS-based
DBCNN	CNN-based
TOPIQ	Attention-based
QualiCLIP	CLIP-based
Q-Align	LMM-based

Five selected image quality metrics showing the different technical techniques used.

46 responses to image quality degradation

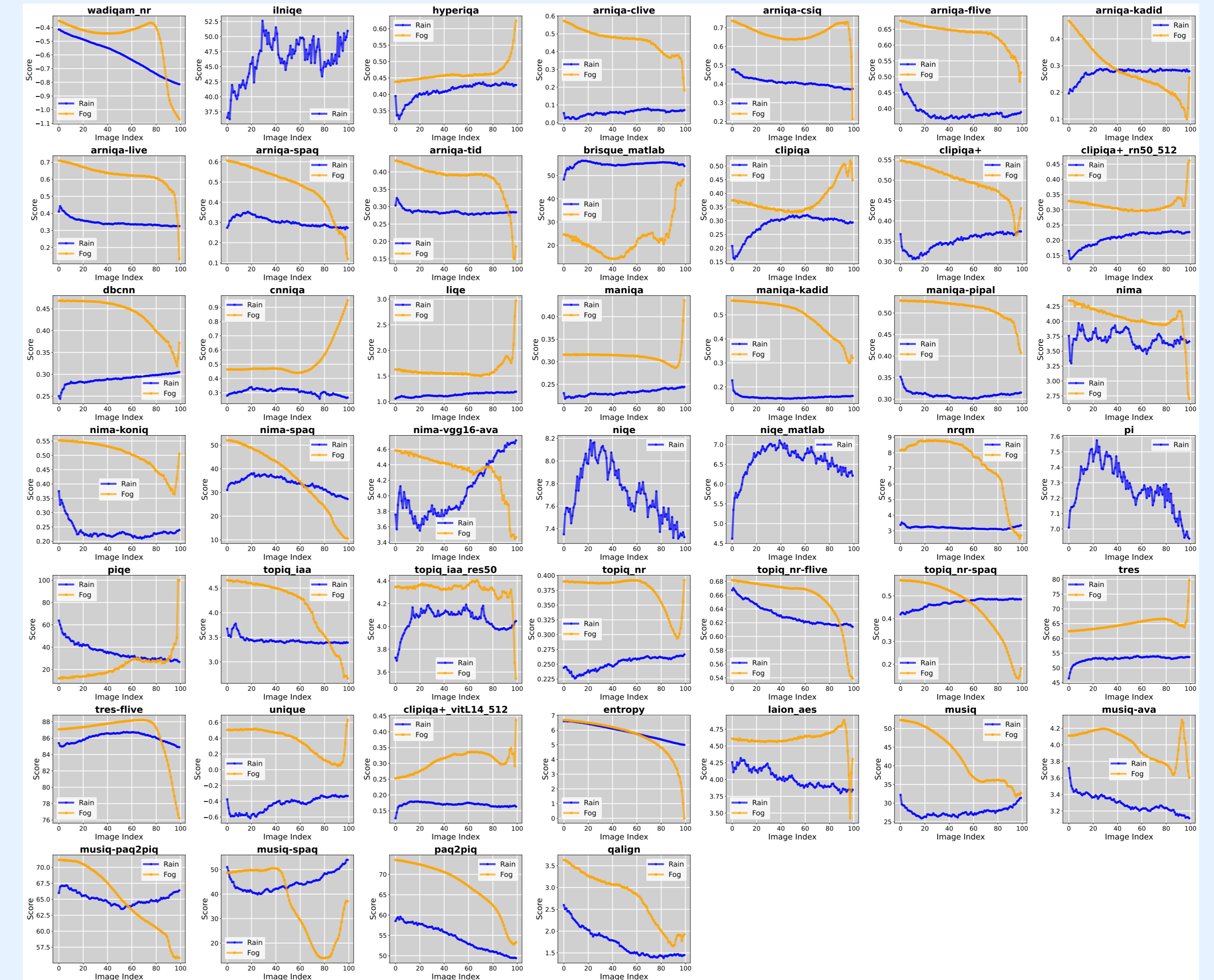
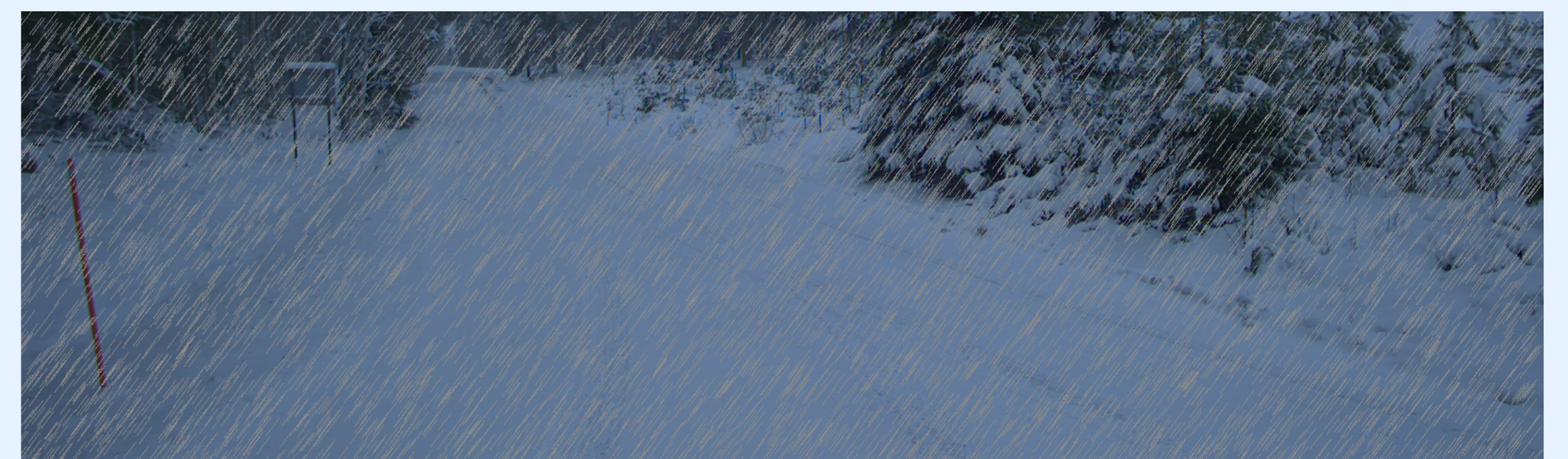


Figure: No-reference to image quality degradation.

Each minifigure shows a normalised quality score on the Y-axis and increasing impairments on the X-axis. Rain is shown in blue and fog is in orange.

Data Augmentation



Rain generation using the `Albumentations` package on the FGI dataset. In this case a rain impairment, at a level of 20, on a scale from 0-100.

Data Readiness Level (DRL) calculation

Algorithm: DRL-derived metrics from four modalities $D_{[1,4]}$ downsampled, weighted, time-averaged and output.

1. **Input:** Data streams $D_1(t), D_2(t), D_3(t), D_4(t)$
2. **Parameters:** Weights $\alpha, \beta, \gamma, \delta$; decay factor λ ; downsample rate r
3. **for** $i = 1$ to 4 **do**
4. Downsample $D_i(t)$ with rate r : $D_i^r(t) \leftarrow \text{Downsample}(D_i(t), r)$
5. Initialize $EWMA_i \leftarrow D_i^r(1)$
6. **for** $t = 2$ to N **do**
7. $EWMA_i \leftarrow \lambda \cdot D_i^r(t) + (1 - \lambda) \cdot EWMA_i$
8. **end for**
9. **end for**

$$DRL \leftarrow \alpha \cdot EWMA_1 + \beta \cdot EWMA_2 + \gamma \cdot EWMA_3 + \delta \cdot EWMA_4$$

11. **Output:** Combined value DRL

EWMA - Exponential Weighted Moving Average. $\lambda \in [0, 1]$

Datasets

^aNot snow and ice.

Name / Type	Provider	Size	Details
FGI, Open Road	FGI, FI	14 GB	1 urban & 1 rural, 49 km
REHEARSE, Test Track	TH Ingolstadt / Cerema	320 GB	2 grounds, H ₂ O conditions ^a
AVL, Open Road	AVL Software, DE	2.5 TB	Southern Germany, 2023–25

The three datasets utilised in this work. A full dataset release will occur in 2026, parts are available now (REHEARSE). Full source available from [ROADVIEW Repo](#).

Bibliography

1. Neil Lawrence, *Data Readiness Levels*, arXiv, 2017.
2. Haoning Wu et. al, *Q-Align: Teaching LMMs for Visual Scoring via Discrete Text-Defined Levels*, 2023.

Acknowledgments

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