KI DATA TOOLING
The Data Kit for Automotive AI

Camera Challenges and Evaluation of Camera Specific Properties

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1Scenarios & Synthetic Data

Camera Challenges

The appearance of, e.g., objects in an image is the result of interactions between light, transmission channel, geometry, material characteristics, relative positions, temporal properties and a camera. These “world to camera” interactions lead to artifacts caused by camera constraints but are also challenging to model in a virtual world.

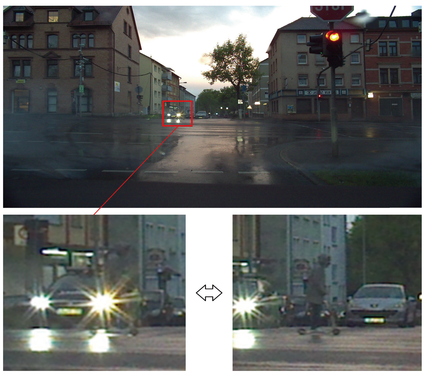

Figure 1: The contrast and contour of a person is hidden by the high intensity star-burst effect of the headlights and reflections on the ground, while simultaneously being in front of a similar colored wall. (© 1. KI DATATOOLING | 2. Bosch)

Camera specific characteristics have a high impact on image appearance, e.g.:

- Geometric and motion distortions
- Stray-light effects
- Limited contrast resolution
- Noise characteristics
- Sampling and reconstruction

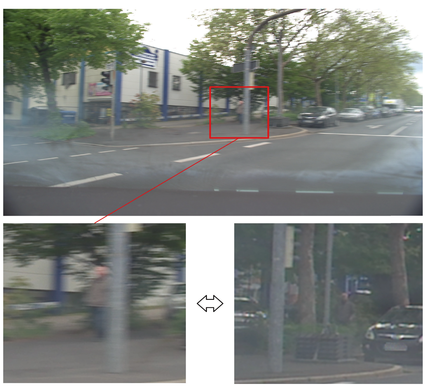

Figure 2: Partly occluded, highly blurred appearing person. Different methods for, e.g., high dynamic range capture lead to a camera specific appearance of motion blur in an image. (© 1. KI DATATOOLING | 2. Bosch)

Some camera challenges observed in real life can also be **provoked and measured** in a **lab environment** with the Dynamic Test Stand (Image Engineering [1]).

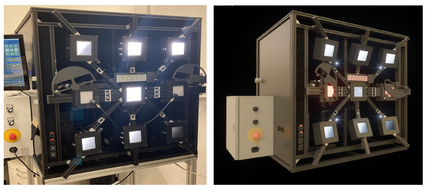

Figure 3: Left: real DTS, Right: digital twin DTS rendered (©Bosch)

The **Dynamic Test Stand (DTS)** was developed to measure

- Dynamic range and contrast transfer
- Flicker response for modulated light
- Color response
- Motion artifacts

of a camera, conform to the currently discussed IEEE/P2020 [2]. By measuring a camera sensor model in a digital twin DTS, the simulation can be compared against measurements with a real camera.

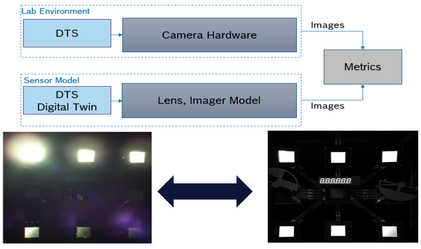

Figure 4: Comparison of real (left) and synthetic (right) digital twin result in a lab environment. Strong differences between real and synthetic image without sensor model visible. (© Bosch)

Evaluation of Sensor Characteristics

One property evaluated is the transfer of input luminance $[cd/m^2]$ to the camera output [digital numbers (DN)].

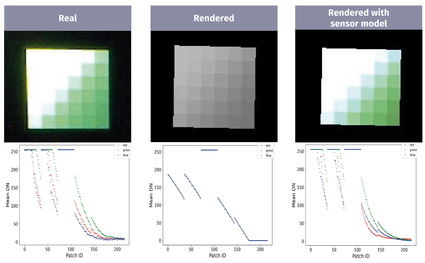

Figure 5: First row: Extract (field 1 – Patch ID 1-36) of real, rendered without and with sensor model with gain of green channel (w\o noise, straylight); Second row: Analysis of DN of all fields. (© Bosch)

The measurement enables the targeted improvement of sensor models. By **applying the developed camera model,** the difference between real and synthetic can be reduced for specific sensor characteristics (see Fig. 5).

References:

[1] https://www.image-engineering.de/content/products/solutions/dynamic_test_stand/downloads/DTS_flyer.pdf
[2] https://site.ieee.org/sagroups-2020/

Partners

External partners

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