KI DATA TOOLING
The Data Kit for Automotive AI

Validation Tools for 3D Models and Materials

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Scenarios & Synthetic Data

Validation Tools for 3D Models and Materials

Training of AI-based driving functions requires high-quality synthetic data generated from 3D scenes. In order to evaluate the potentially large number of required 3D models and materials, appropriate tools are indispensable. Therefore, software was developed within the project that allows physics-based rendering and validation of the aforementioned artifacts:

Path Tracer

The path tracer software enables physics-based rendering of 3D models, materials, reflections and lighting by calculating and evaluating bi-directional propagation and reflection of statistically distributed virtual light rays in space.

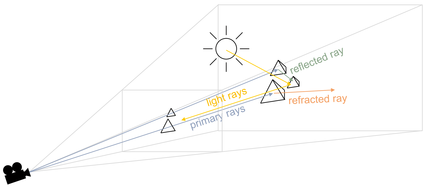

Figure 1: Bi-directional ray tracing (© BMW AG)

Implementation of two different reflection equations enables support for rendering materials (e.g. PBR Metallic-Roughness) and materials for physics-based sensor simulation (OpenMATERpIAL).

Figure 2: Rendering of PBR materials (© BMW AG)

Reflection modeling

Ray reflection is modeled using a Lambertian approach and a microfacet model that describes roughness and specular reflection. The corresponding BSDF (Bidirectional Scattering Distribution Function) is approximated using multiple importance sampling. The Fresnel coefficients for transparency and metalness are calculated differently for PBR and OpenMATERIAL materials: For PBR, they are approximated using the Cook-Torrance approach, for OpenMATERIAL, they are calculated from the complex index of refraction.

Further Features

Configurability of camera and lighting parameters enable batch processing, e.g. rendering of large numbers of 3D models and scenes at pre-defined camera perspectives and lighting situations. Light-box rendering extends the functionality by automatically generated camera perspectives.

Validation

Besides physics-based rendering, the path tracer software supports false-color rendering for validation of mesh topologies, surface properties, primitive geometries and materials:

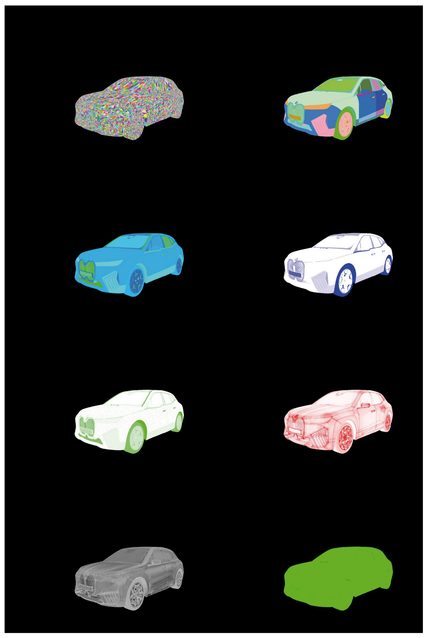

Figure 3: Validation modes, line by line from left to right: Primitive IDs, Geometry IDs, Material IDs, Metallic Maps, Roughness Maps, Mesh Density, Surface Gradient, Inverted Normals (© BMW AG)

Public Release

https://github.com/LudwigFriedmann/OpenMATERIAL-Validation

Partners

BMW GROUP, BOSCH, Continental, Valeo, ZF, Ansys, AVL, dSPACE, DLR, FKFS, FZI, Bergische Universität Wuppertal, Technische Universität München, UNIKASSEL VERSITÄT, Universität Passau

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KI FAMILIE

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