Material Parameters in Radar Simulation

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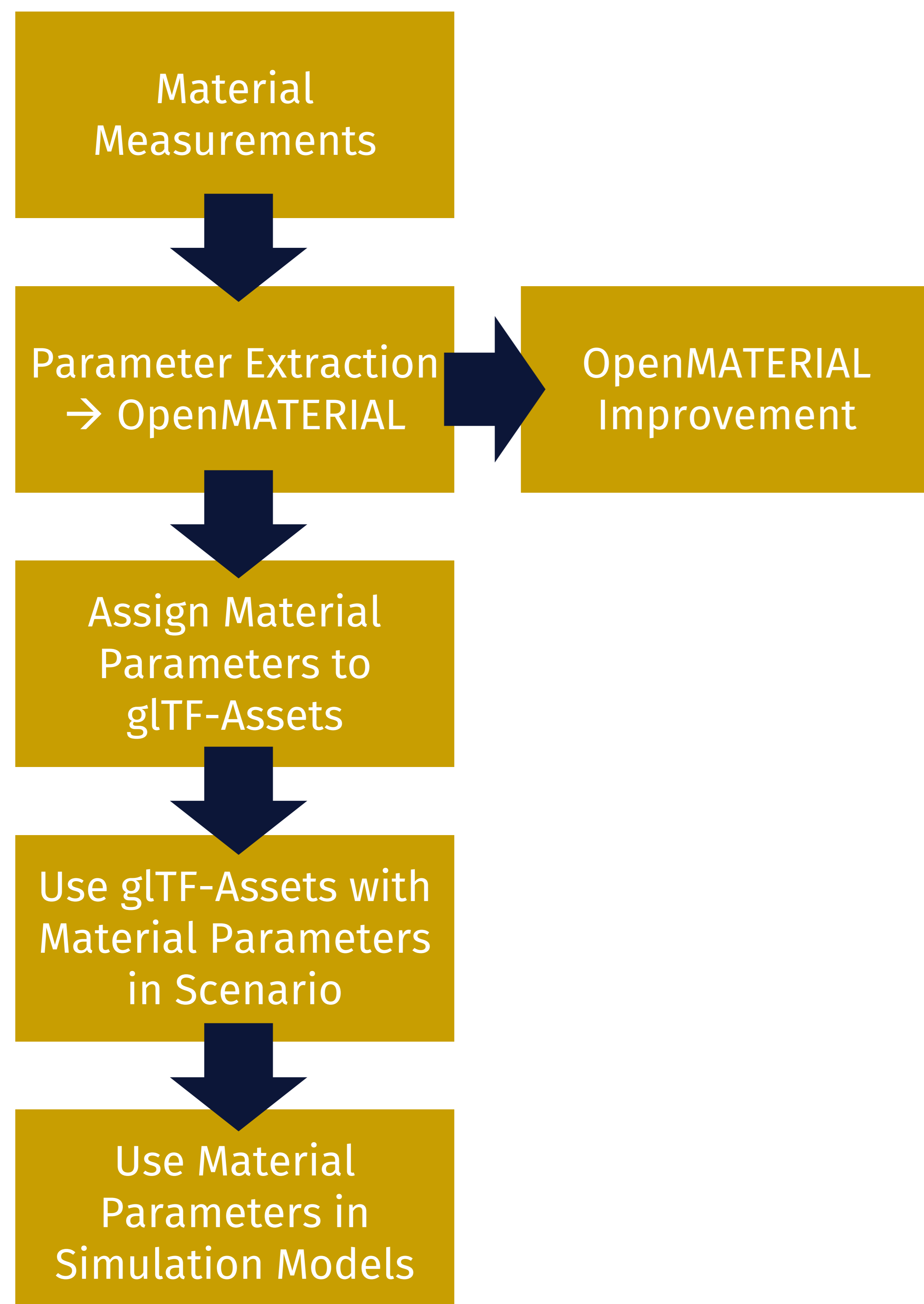Jacob Langner | FZI

Abstract

In radar simulation, realistic results can only be obtained if the simulation input is realistic. This requires not only accurate 3D-models of the environment but also realistic material parameters. The flow chart below shows how radar material parameters were measured and used in KI-DT radar simulation.

```
Material
Measurements
    │
    ▼
Parameter Extraction  ──►  OpenMATERIAL
→ OpenMATERIAL              Improvement
    │
    ▼
Assign Material
Parameters to
glTF-Assets
    │
    ▼
Use glTF-Assets with
Material Parameters
in Scenario
    │
    ▼
Use Material
Parameters in
Simulation Models
```

Material Measurements & Parameter Extraction

Reflectivity and transmissivity of a material are determined by the complex permittivity which was measured for dozens of samples by PKTEC. The scattering behaviour is determined by the surface roughness and correlation length which were measured using 3D-microscopy.
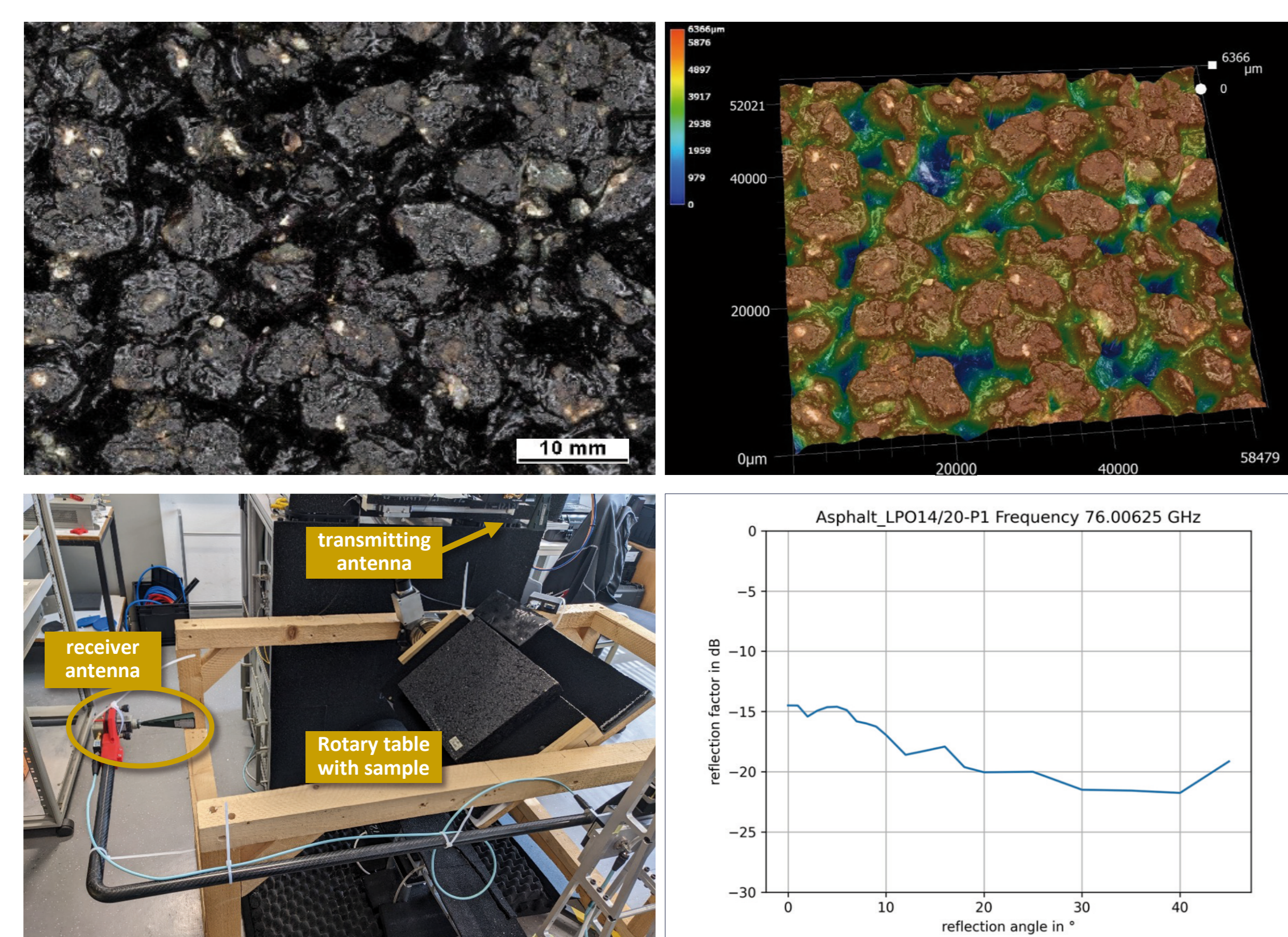

Figure 1: Roughness (top) and permittivity measurement (bottom) of the asphalt sample. Source: Bosch (Analytics Department), FZI Forschungszentrum Informatik, pkTec

OpenMATERIAL Improvement

We observed that many surfaces posses an anisotropic roughness and recommended a respective extension of the roughness definition in OpenMATERIAL. This would extend the use of the standard for anisotropic materials, such as brushed metal (or fiber reinforced plastic).
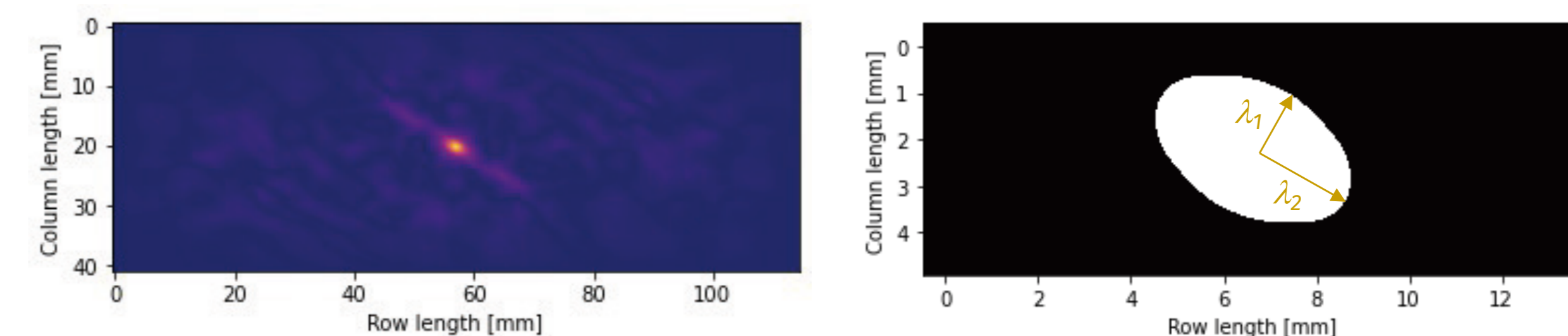

Figure 2: Anisotropic correlation lengths λ_1 and λ_2 of an asphalt sample

Material Assignment to Assets using OpenMATERIAL

OpenMATERIAL is an glTF-extension that allows assigning physical material parameters to a 3D-model. In below example this is demonstrated for a car and the 3 materials iron, rubber and glass. The parameters can then directly be used by sensor models.
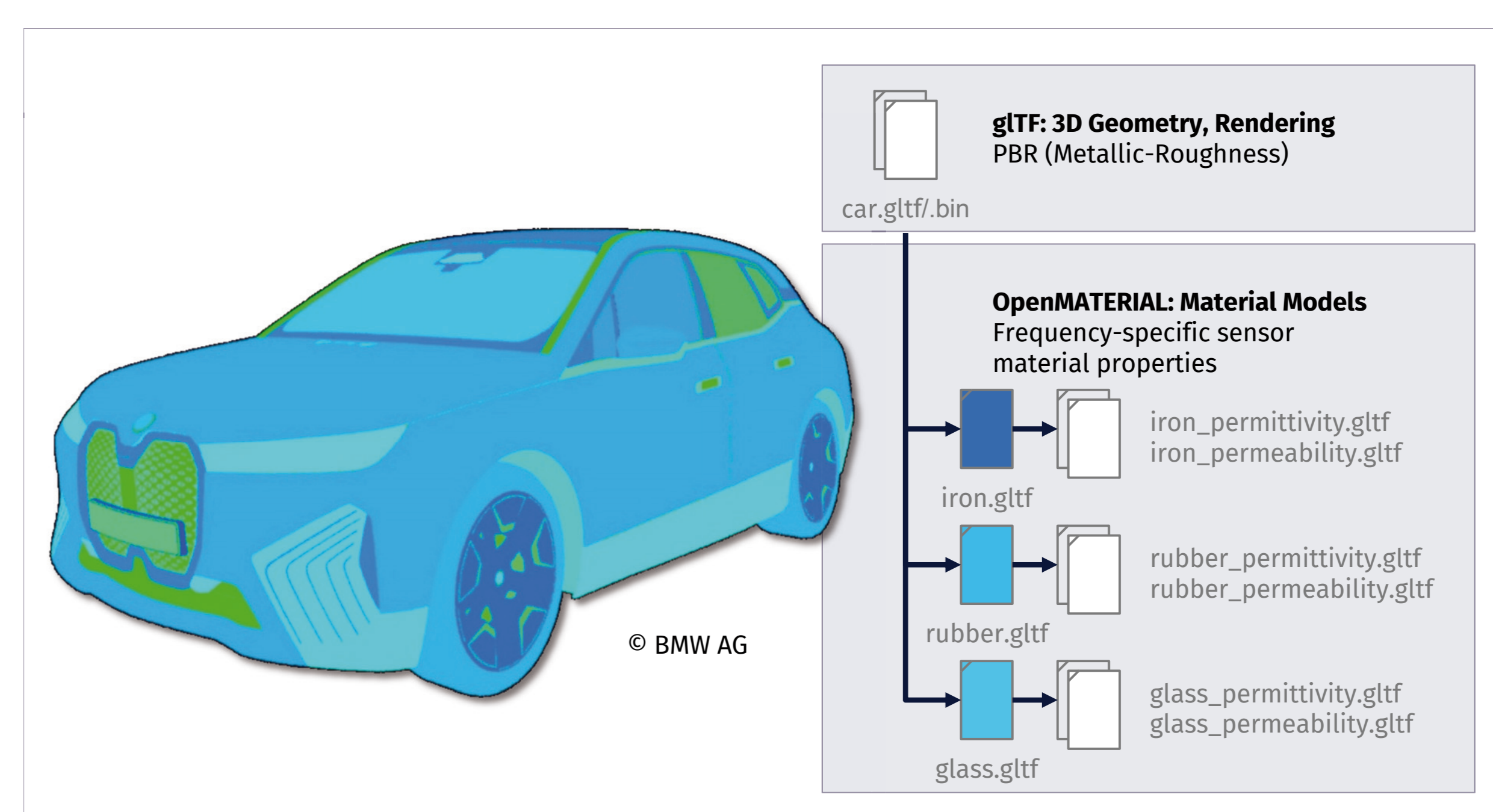

Figure 3: Vehicle with material assignment

Use of Material Parameters in BIT-Simulation Model

Measured material parameters and displacement maps are used to model angle dependent scattering for integration in the rendering process.
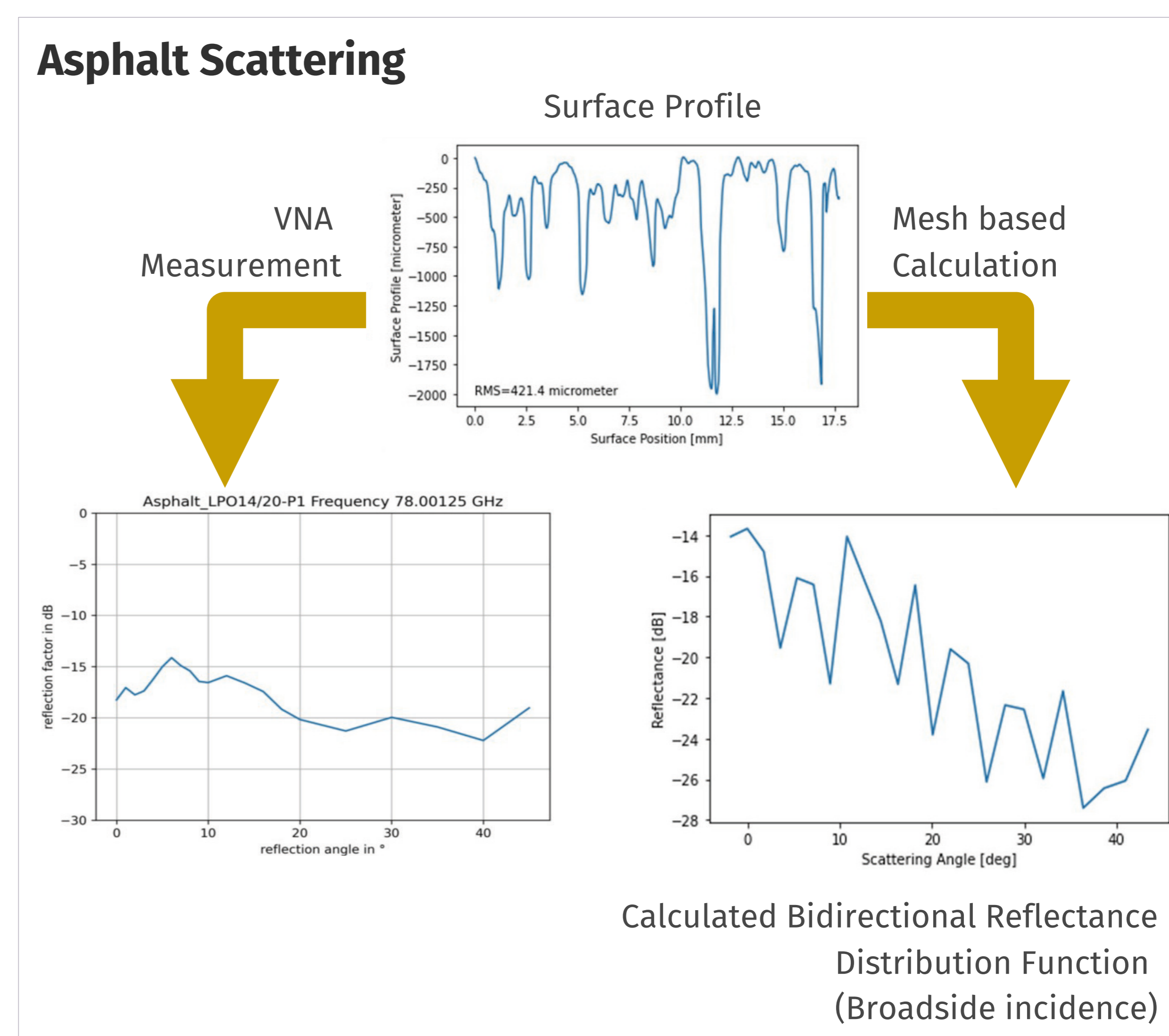
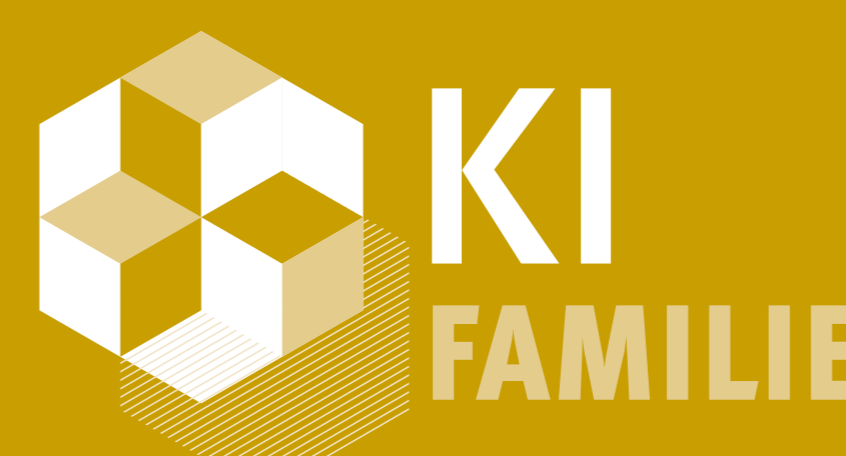

Figure 4: Model based BRDF calculation and validation

Scenarios & Synthetic Data