

ASAM OpenMATERIAL® & 3D model structures Current Status

Dr.-Ing. Ludwig Friedmann
BMW AG

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Online



ASAM OpenMATERIAL® & 3D model structures

Project Members

Project Release:
March 2025

65 Participants
25 Companies
9 Countries

Open-Source
Project

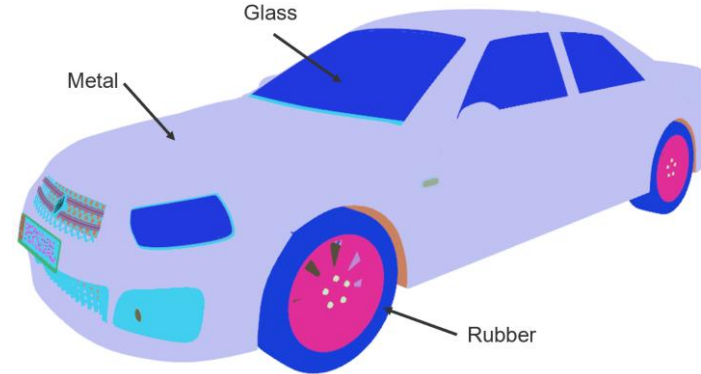


ASAM OpenMATERIAL® & 3D model structures

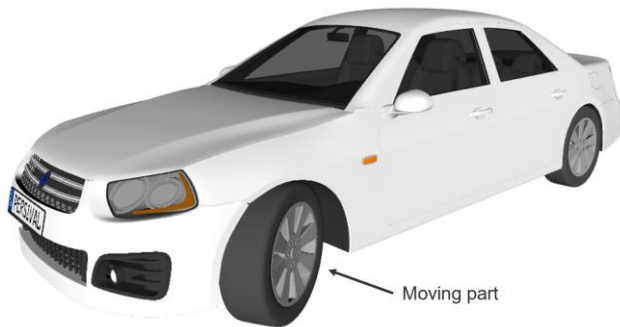
What is the project about?



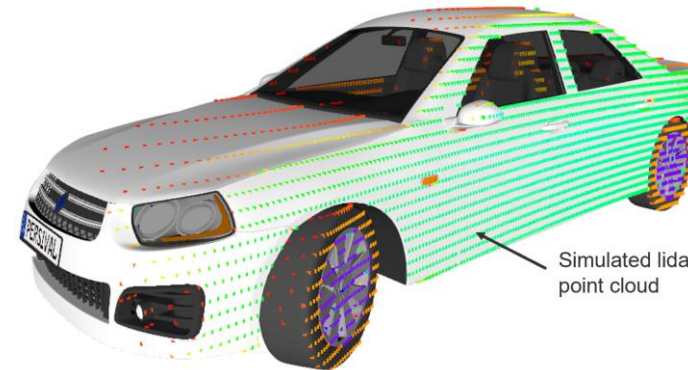
- 3D assets



- Define physical material properties
- Assign materials to 3D geometry



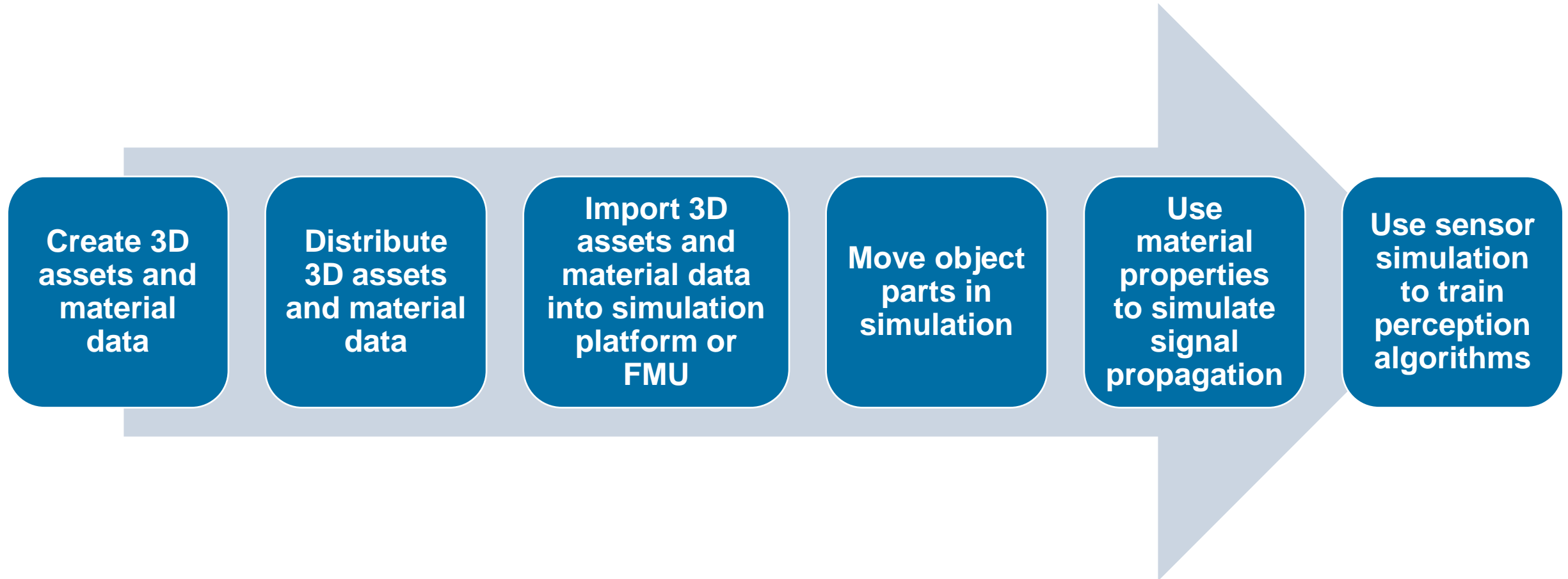
- Define hierarchy and structure
- Coordinate systems of moving parts



- Enable perception sensor simulation

ASAM OpenMATERIAL® & 3D model structures

Use-Cases



ASAM OpenMATERIAL® & 3D model structures

Project Structure, Focus and Resources

Project Structure

- **Geometry Subgroup**
3D Model Structure
- **Material Subgroup**
Material Properties & Data Structure

Overarching Topics

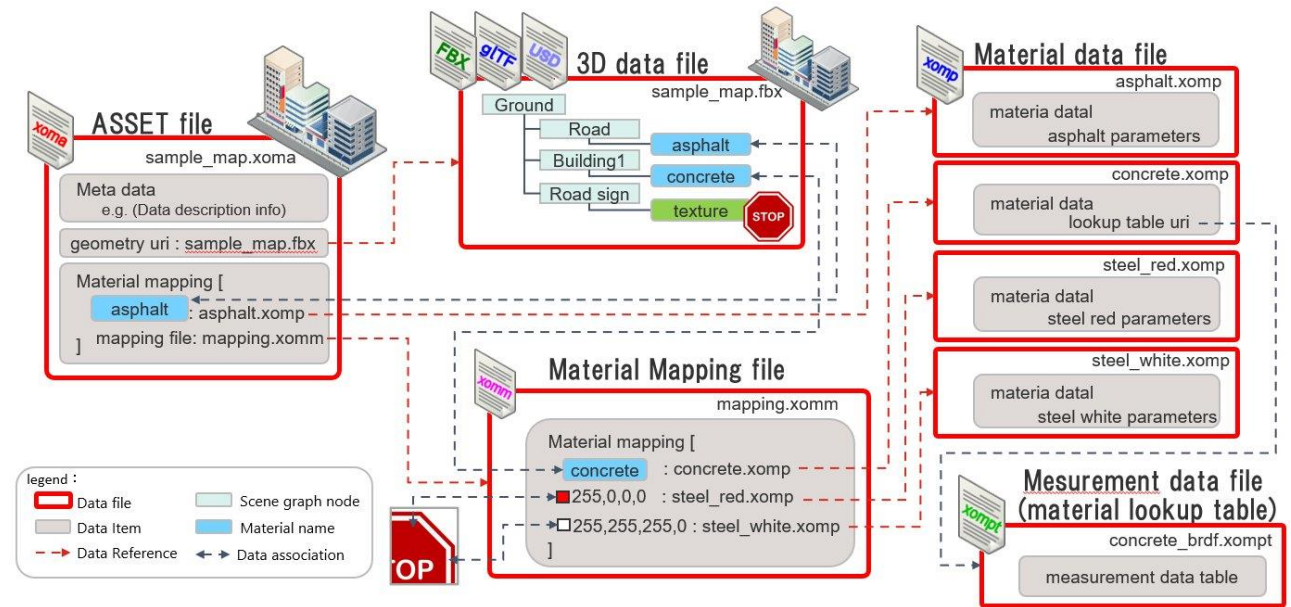
- Metadata
- Material Association

Postponed Topics

- Environmental Conditions

Resources

- Project Website: <https://www.asam.net/project-detail/asam-openmaterial/>
- GitHub: <https://github.com/asam-ev/OpenMATERIAL>



Geometry Subgroup



Geometry Subgroup

Table of Content

1. General Structure

- Dimensions
- Coordinate Systems
- Naming Conventions
- Asset File
- Requirements
- Recommendations

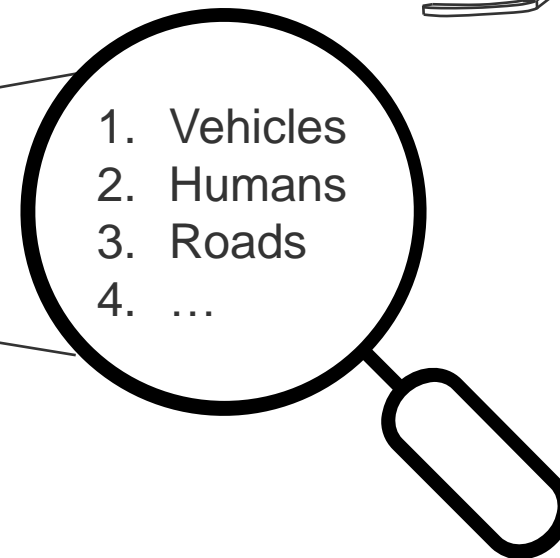
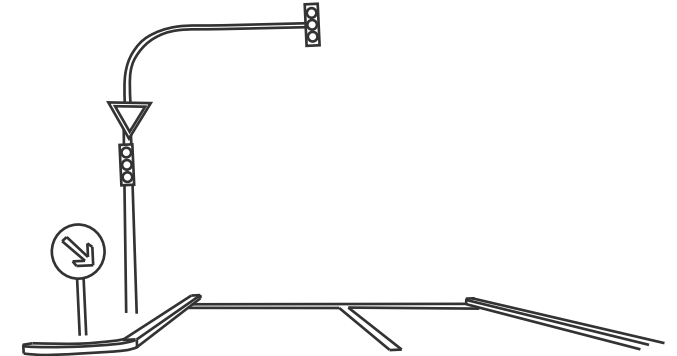
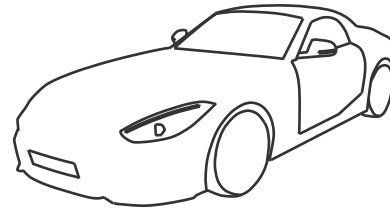
2. Object Classes and Segmentation

- Object Classes
- Class Specific Structure

3. File Format Support

4. Metadata

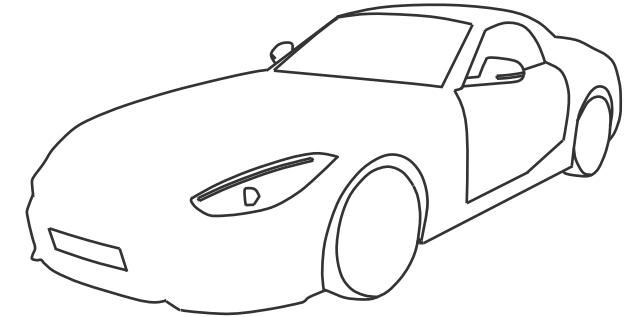
5. Performance



Geometry Subgroup

Vehicle Model Node Structure

```
Grp_Vehicle_Part_<keyword>_<vehicle_part_idx> (T)
|_ Grp_Exterior
|_ Grp_Exterior_Static
|_ Grp_Exterior_Dynamic
|_ Grp_Wheel_<axle_idx>_<wheel_idx> (T)
|_ Grp_Wheel_<axle_idx>_<wheel_idx>_Steering
|_ Grp_Wheel_<axle_idx>_<wheel_idx>_Steering_Rotating (T)
|_ Grp_Door_Front_<door_front_idx> (T)
|_ Grp_Door_Left_<door_left_idx> (T)
|_ Grp_Door_Right_<door_right_idx> (T)
|_ Grp_Door_Rear_<door_rear_idx> (T)
|_ Grp_Door_Top_<door_top_idx> (T)
|_ Grp_Door_Bottom_<door_bottom_idx> (T)
|_ Grp_Light_Day_Left_<day_left_idx> (T)
|_ Grp_Light_Day_Right_<day_right_idx> (T)
|_ Grp_Light_Low_Beam_Left_<low_beam_left_idx> (T)
|_ Grp_Light_Low_Beam_Right_<low_beam_right_idx> (T)
|_ Grp_Light_High_Beam_Left_<high_beam_left_idx> (T)
|_ Grp_Light_High_Beam_Right_<high_beam_right_idx> (T)
|_ Grp_Light_Position_Left_<position_left_idx> (T)
|_ Grp_Light_Position_Right_<position_right_idx> (T)
|_ Grp_Light_Park_Left_<park_left_idx> (T)
|_ Grp_Light_Park_Right_<park_right_idx> (T)
|_ Grp_Light_Tail_Left_<tail_left_idx> (T)
|_ Grp_Light_Tail_Right_<tail_right_idx> (T)
|_ Grp_Light_Brake_Left_<brake_left_idx> (T)
|_ Grp_Light_Brake_Center_<brake_center_idx> (T)
|_ Grp_Light_Brake_Right_<brake_right_idx> (T)
|_ Grp_Light_Reverse_Left_<reverse_left_idx> (T)
|_ Grp_Light_Reverse_Right_<reverse_right_idx> (T)
|_ Grp_Light_Fog_Left_<fog_left_idx> (T)
|_ Grp_Light_Fog_Right_<fog_right_idx> (T)
|_ Grp_Light_Corner_Left_<corner_left_idx> (T)
|_ Grp_Light_Corner_Right_<corner_right_idx> (T)
|_ Grp_Light_Indicator_Left_<indicator_left_idx> (T)
|_ Grp_Light_Indicator_Right_<indicator_right_idx> (T)
|_ Grp_Number_Plate_<number_plate_idx> (T)
|_ Grp_Light_Number_Plate_<number_plate_light_idx> (T)
|_ Grp_Light_Warning_<warning_idx> (T)
|_ Grp_Convertible_Top
|_ Grp_Sensors (T)
|_ Grp_Side_Mirror_Mounting_Left_<side_mirror_mounting_left_idx> (T)
|_ Grp_Side_Mirror_View_Left_<side_mirror_view_left_idx> (T)
|_ Grp_Side_Mirror_Mounting_Right_<side_mirror_mounting_right_idx> (T)
|_ Grp_Side_Mirror_View_Right_<side_mirror_view_right_idx> (T)
|_ Grp_Blindspot_Mirror_Mounting_<blindspot_mirror_mounting_idx> (T)
|_ Grp_Blindspot_Mirror_View_<blindspot_mirror_view_idx> (T)
|_ Grp_Interior
|_ Grp_Interior_Static
|_ Grp_Interior_Dynamic
|_ Grp_Steering_Wheel (T)
|_ Grp_Eyepoint_<eyepoint_idx> (T)
|_ Grp_Rearview_Mirror_Mounting_<rearview_mirror_mounting_idx> (T)
|_ Grp_Rearview_Mirror_View_<rearview_mirror_view_idx> (T)
|_ Grp_Seat_<seat_idx> (T)
```



Decisions:

1. Define 'vehicle parts' to enable complex vehicles
2. Use ASAM Open Simulation Interface (OSI) definition for iterators (front → back, right → left)

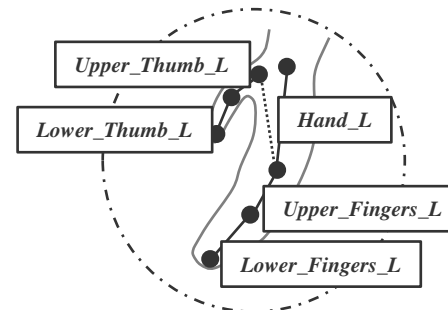
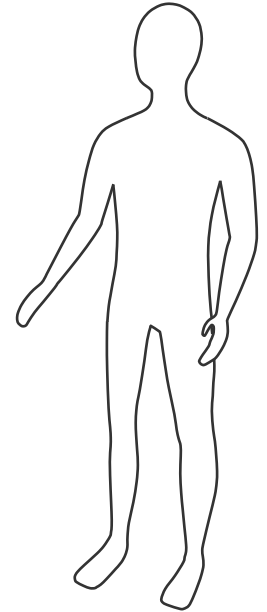
Geometry Subgroup

Human Model Node Structure

```
Skeleton (T)
|_ Root_Bone (T)
|_ Hip (T)
|_ Sitting_Point (T)
|_ Lower_Spine (T)
|_ Upper_Spine (T)
|_ Neck (T)
|_ Head (T)
|_ Eye_Right (T)
|_ Eye_Left (T)
|_ Shoulder_Right (T)
|_ Upper_Arm_Right (T)
|_ Lower_Arm_Right (T)
|_ Full_Hand_Right (T)
|_ Hand_Right (T)
|_ Upper_Fingers_Right (T)
|_ Lower_Fingers_Right (T)
|_ Upper_Thumb_Right (T)
|_ Lower_Thumb_Right (T)
|_ Gripping_Point_Right (T)
|_ Shoulder_Left (T)
|_ Upper_Arm_Left (T)
|_ Lower_Arm_Left (T)
|_ Full_Hand_Left (T)
|_ Hand_Left (T)
|_ Upper_Fingers_Left (T)
|_ Lower_Fingers_Left (T)
|_ Upper_Thumb_Left (T)
|_ Lower_Thumb_Left (T)
|_ Gripping_Point_Left (T)
```

```
|_ Upper_Leg_Right (T)
|_ Lower_Leg_Right (T)
|_ Full_Foot_Right (T)
|_ Standing_Point_Right (T)
|_ Upper_Leg_Left (T)
|_ Lower_Leg_Left (T)
|_ Full_Foot_Left (T)
|_ Standing_Point_Left (T)
```

Body
Hair
Clothing



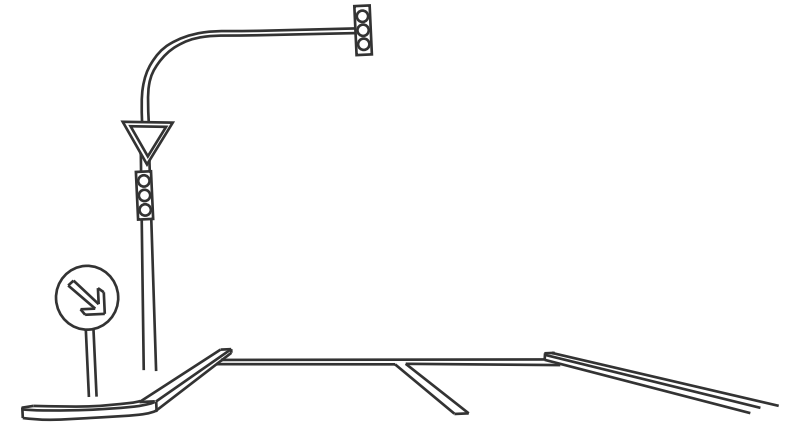
Decisions:

1. Consider static equipment (e.g. bicycles) as separate models
2. Add 'complex' bone structure for hands to enable gripping/carrying

Geometry Subgroup

Road Model Node Structure

```
Road_Network (T)
|_ Road_<road_idx>
|_ Lane_<lane_idx>
|_ Lane_Marking_<lane_marking_idx>
|_ Object_<object_idx> (T)
|_ Signal_<signal_idx> (T)
|_ Sign_<sign_idx> (T)
|_ Bulb_<bulb_idx> (T)
|_ Junction_<junction_idx>
|_ Junction_Connection_<junction_connection_idx>
|_ Direct_Junction_<direct_junction_idx>
|_ Direct_Junction_Connection_<direct_junction_connection_idx>
|_ Virtual_Junction_<virtual_junction_idx>
|_ Virtual_Junction_Connection_<virtual_junction_connection_idx>
```



Decisions:

1. Consider information from OpenDRIVE objects:
 - (Sub-)Type
 - (Cartesian) Bounding Boxes
2. Postpone railways, stations and platforms
3. Postpone OpenCRG integration

Geometry Subgroup

Material Mapping and Assignment

Two ways to assign OpenMATERIAL material properties

1. Assign a material of a 3D model to a Material Data File (.xomp)
2. Assign a value in a dedicated texture to a Material Data File (.xomp)

Mapping

- Material mapping is stored in separate Material Mapping File (.xomm)
- Material textures are referenced within the ASSET File (file ending .xoma)

Example

```
"materialTextureAssignment": [  
  ["example_material_name", "example_texture.png"]  
]
```

```
"materialMapping": [  
  ["material_red", "materials/material_a.xomp", "metal with red paint"],  
  ["rgba:10;50;255;127", "materials/material_a.xomp", "metal with red paint"],  
  ["material_green", "materials/material_b.xomp", "metal with green paint"],  
  ["material_blue", "materials/material_c.xomp", "metal with blue paint"]  
]
```

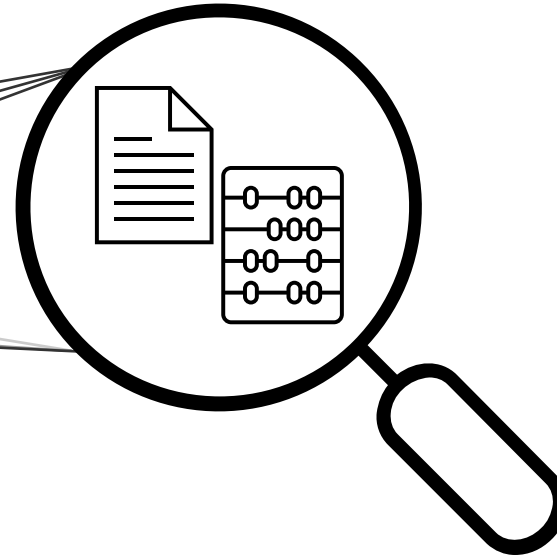
Material Subgroup



Material Subgroup

Table of Content

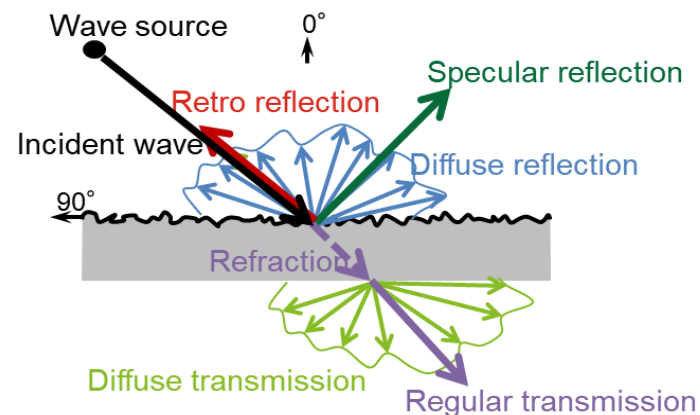
1. Material Association
2. File Structure
3. Material Schema
4. Material EMP Schema
5. Material BRDF Schema



Material Subgroup

File Structure

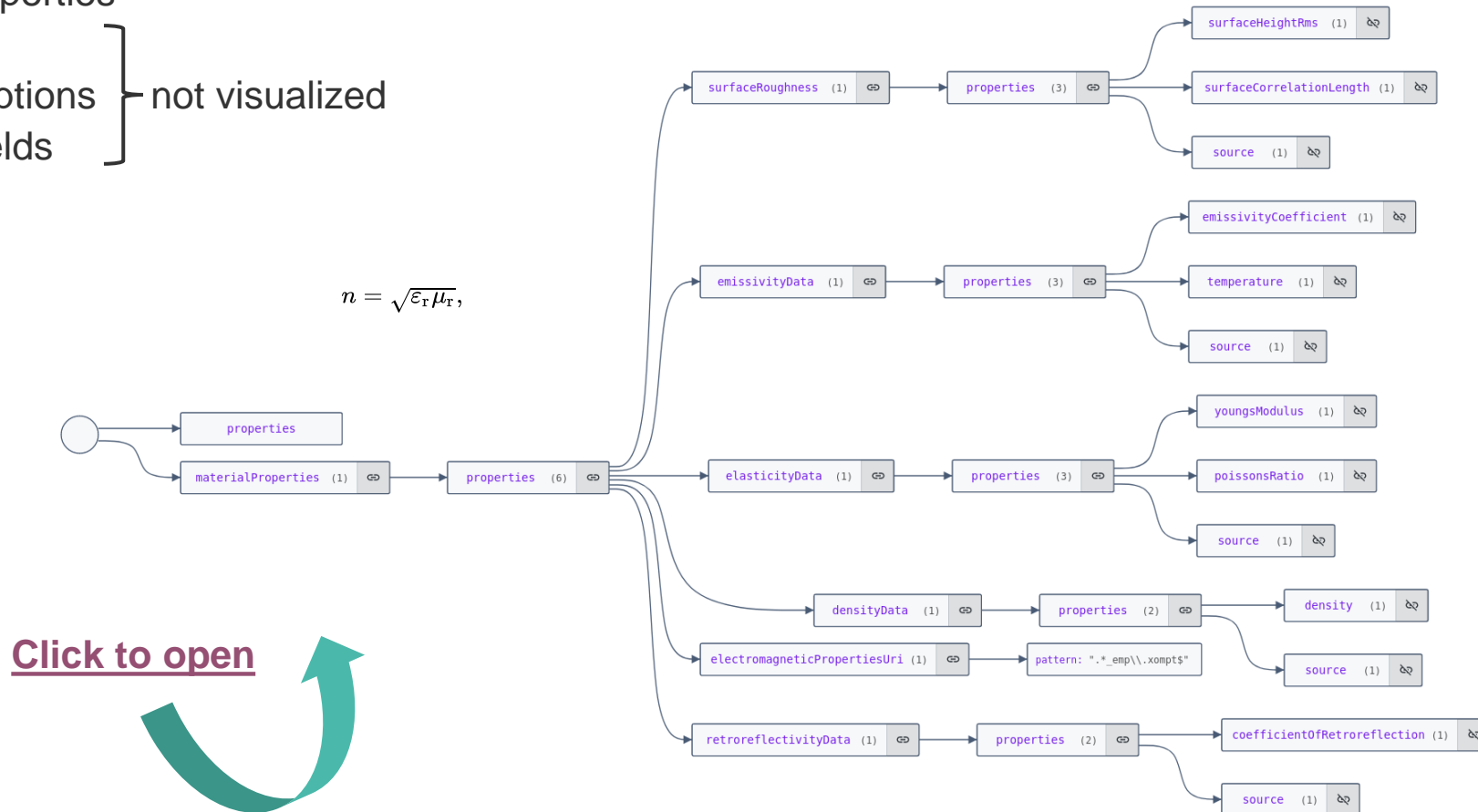
- Invariant material properties are stored in Material Data Files (.xomp).
- Material properties that depend on variables (e.g., wavelength, temperature, angle) are stored in separate Material Look-Up Tables (.xompt):
 - Electromagnetic Properties
 - BRDFs (Bidirectional Reflectance Distribution Functions)
- Material Look-Up Tables are referenced in Material Data Files.
- Both file types are based on JSON format and comprise a metadata section with information about copyright, author, origin, etc.



Material Subgroup

File Content – Material Schema

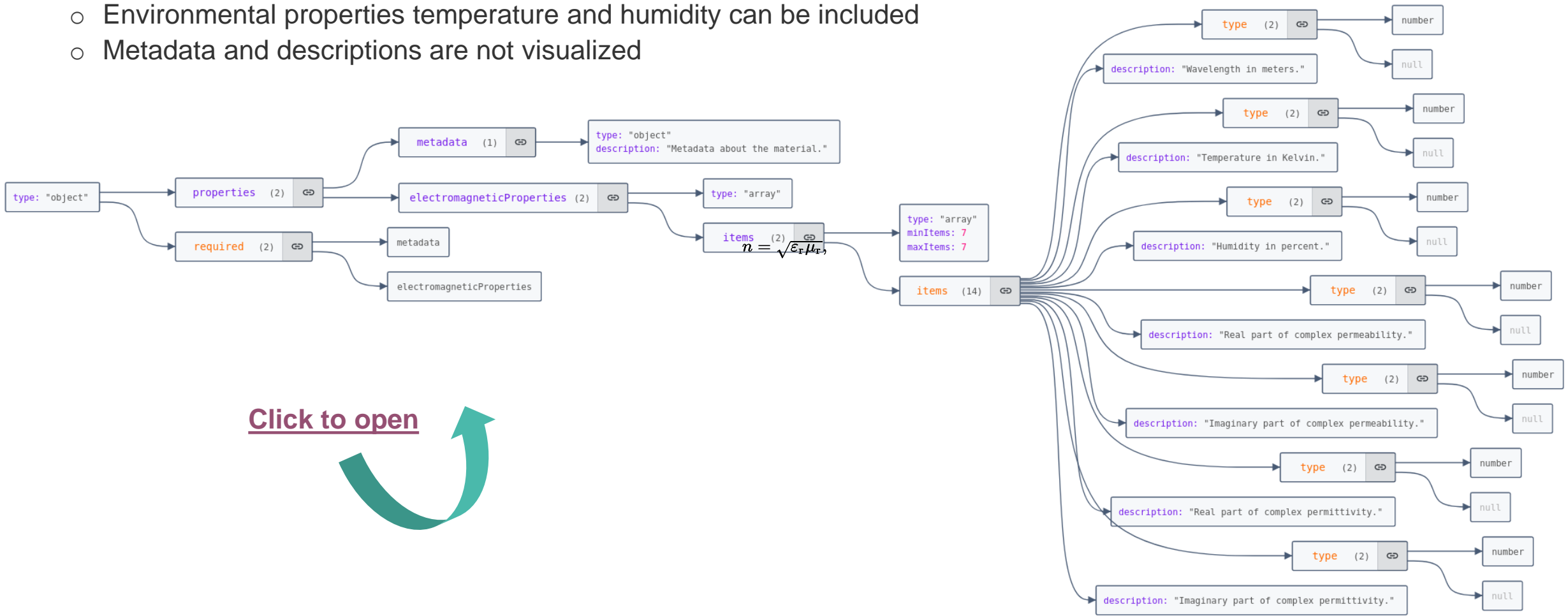
- Material properties
 - Metadata
 - Field descriptions
 - Required fields
- } not visualized



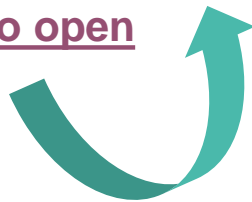
Material Subgroup

File Content - Electromagnetic Properties Schema

- All properties are defined with respect to wavelength
- Environmental properties temperature and humidity can be included
- Metadata and descriptions are not visualized



Click to open



Next Steps



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Next Steps

General Topics

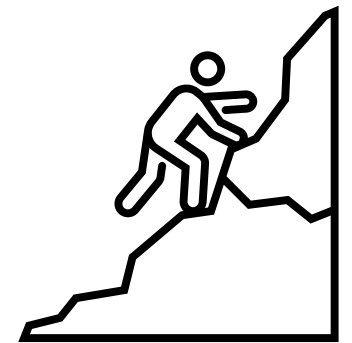
- Finalizing the approaches for mapping material data to 3D models
- Discussion about whether to split up the specification into two different standards for material and geometry

Geometry Subgroup

- Going over all sections of the documentation and refinement of the definitions
- Creating examples to test the definitions

Material Subgroup

- Finalizing the data format for look-up tables
- Adding more properties
- Creating an example to test the definitions



Thank you for your attention

Dr.-Ing. Ludwig Friedmann (BMW AG)
ludwig.friedmann@bmw.de