ASAM OpenLABEL V1.0.0 Webinar

Multi-Sensor Data Labeling and Scenario Tagging

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OpenLABEL V1.0.0 Data format

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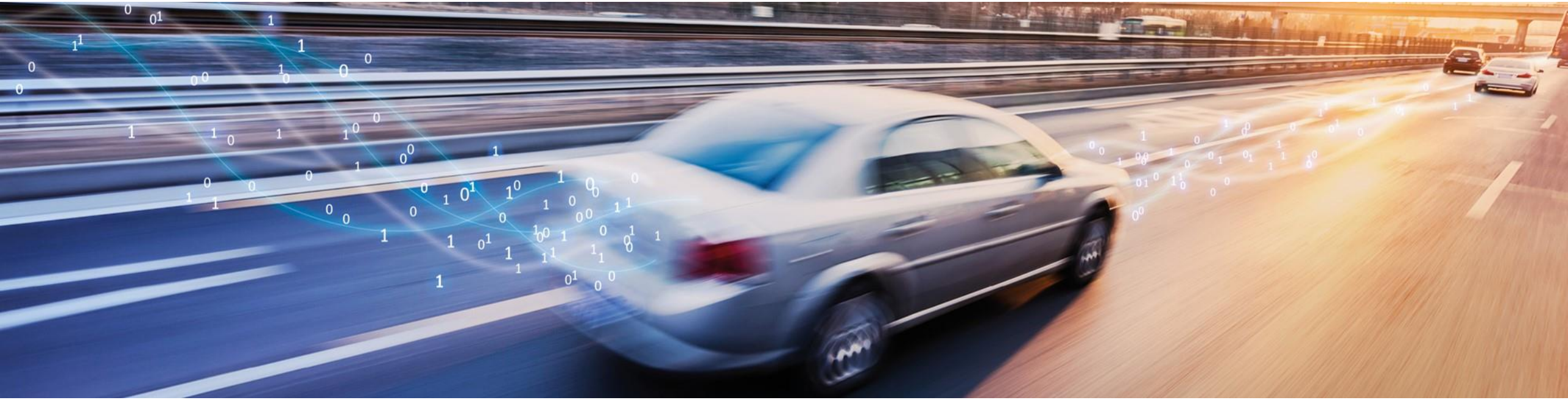

ASAM Association for Standardization of Automation and Measuring Systems

Agenda

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1	**Introduction to Data Format**
2	**OpenLABEL JSON Schema**
3	**Overview OpenLABEL JSON Structure**
4	**Data Types**

Introduction to Data Format

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Introduction to Data Format

https://openlabel.asam.net/V1-0-0/schema/openlabel_json_schema.json

Annotation format

- Defines the structure of annotations, data types and conventions needed to unambiguously interpret the annotations

Annotation file format

- Specifies how the annotation data is encoded for storage into computer files

JSON schema

- Defines the structure, data types and restrictions of annotations as JSON (JavaScript Object Notation) data for validation

OpenLABEL JSON Schema

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OpenLABEL JSON Schema

https://openlabel.asam.net/V1-0-0/schema/openlabel_json_schema.json

The Schema defines:

- The terms of the labels (keys)
- The types of the values
- The structure/hierarchy
- Restrictions (required/optional) and conditions of keys and values

The Schema is used to:

- Validate JSON files
- Provide formal documentation
- Be parsed by programming languages to build object data (e.g. classes in OOP)

```
{
    "$schema": "http://json-schema.org/draft-07/schema#",
    "additionalProperties": false,
    "definitions": {
        "action": {
            "additionalProperties": false,
            "properties": {
                "frame_intervals": {
                    "item": {
                        "$ref": "#/definitions/frame_interval"
                    },
                    "type": "array"
                },
                "name": {
                    "type": "string"
                },
                "ontology_uid": {
                    "type": "integer"
                },
                "stream": {
                    "type": "string"
                },
                "type": {
                    "type": "string"
                }
            },
            "required": [
                "name",
                "type"
            ],
            "type": "object"
        },
        "area_reference": {
            "properties": {
                "additionalProperties": false,
                "attributes": {
                    "$ref": "#/definitions/attributes"

...
```

Overview OpenLABEL JSON Structure

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Overview OpenLABEL JSON Structure

Basic JSON file

OpenLabel JSON

```
{
    "openlabel": {
        "metadata": {
            "schema_version": "1.0.0"
        }
    }
}
```

“openlabel” root key

Overview OpenLABEL JSON Structure

Basic JSON file – root level

OpenLabel root level

Keys defined in **JSON schema**

Values subject to schema types and properties

Overview OpenLABEL JSON Structure

Basic JSON file – object

OpenLabel JSON simple **object**

```
{
    "openlabel": {
        "metadata": {
            "schema_version": "1.0.0"
        },
        "objects": {
            "0": {
                "name": "car1",
                "type": "Car",
            }
        }
    }
}
```

```
{
   "openlabel": {
       "metadata": {
           "schema_version": "1.0.0"
       },
       "objects": {
          "c44c1fc2-ee48-4b17-a20e-829de9be1141": {
              "name": "van1",
              "type": "Van"
          },
       }
   }
}
```

uid unique identifier as numerical string

name of the instance
type of the class

uuid Universal Unique Identifier

Overview OpenLABEL JSON Structure

Basic JSON file – object class from ontology

OpenLabel JSON simple object

```
{
    "openlabel": {
        "metadata": {
            "schema_version": "1.0.0"
        },
        "ontologies": {
            "0": "https://www.somedomain.org/ontology",
            "1": "https://openlabel.asam.net/V1-0-0/ontologies/openlabel_ontology_scenario_tags.ttl"
        },
        "objects": {
            "0": {
                "name": "car1",
                "type": "VehicleCar",
                "ontology_uid": "1",
            }
        }
    }
}
```

`ontologies` can contain as many ontologies as needed

`ontology_uid` specifies the ontology that contains the definition of the `type` of objects and other elements

Overview OpenLABEL JSON Structure

Basic JSON file – tags

OpenLabel JSON simple tag

```
{
    "openlabel": {
        "metadata": {
            "schema_version": "1.0.0",
            "tagged_file": "../resources/scenarios/scenario_file",
        },
        "ontologies": {
            "0": {
                "uri": "https://code.asam.net/simulation/standard/openxontology/ontologies/openlabel",
                "boundary_list": ["motorway", "road"],
                "boundary_mode": "include"

            },
            "1": "http://mycompany/ontologies/v1",
        },
        "tags": {
            "0": {
                "type": "DoubleRoundabout",
                "ontology_uid": "1",
                "tag_data": {
                    "num": [{"type": "value", "val": 2}]
                }
            }
        }
    }
}
```

`tagged_file` specifies which (e.g. scenario) file is being tagged

`ontologies` can be specified and sub-defined via `boundary_list` and `boundary_mode`

Overview OpenLABEL JSON Structure

Basic JSON file – object with object_data

OpenLabel JSON simple **object** with **object_data**


```
{
   "openlabel": {
        "metadata": {
            "schema_version": "1.0.0"
        },
        "objects": {
           "0": {
               "name": "pedestrian1",
               "type": "Pedestrian",
               "object_data": {
                   "bbox" : [{
                             "name" : "body",
                             "val" : [303.73, 935.58, 135.62, 330.88]
                         }, {
                             "name" : "head",
                             "val" : [289.93, 814.08, 38.20, 39.96]
                         }
                   ]
               }
           }
        }
   }
}
```

bbox array, to allow multiple entries per object

object_data contains data about object

name of bbox
val (x, y, w, h)

Overview OpenLABEL JSON Structure

Basic JSON file – object with object_data with attributes

OpenLabel JSON simple **object** with **object_data** with **attributes**

```
{
    "openlabel": {
        "metadata": {
            "schema_version": "1.0.0"
        },
        "objects": {
            "0": {
                "name": "car1",
                "type": "Car",
                "object_data": {
                    "bbox" : [{
                            "name" : "shape",
                            "val" : [100, 100, 500, 300],
                            "attributes": {
                                "boolean": [{
                                        "name": "visible",
                                        "val": true
                                    },
                                    {
                                        "name": "interpolated",
                                        "val": false
                                    }
                                ]
                            }
                        }
                    ]
                }
            }
        }
    }
}
```

object_data contains data about object

attributes of bbox

Overview OpenLABEL JSON Structure

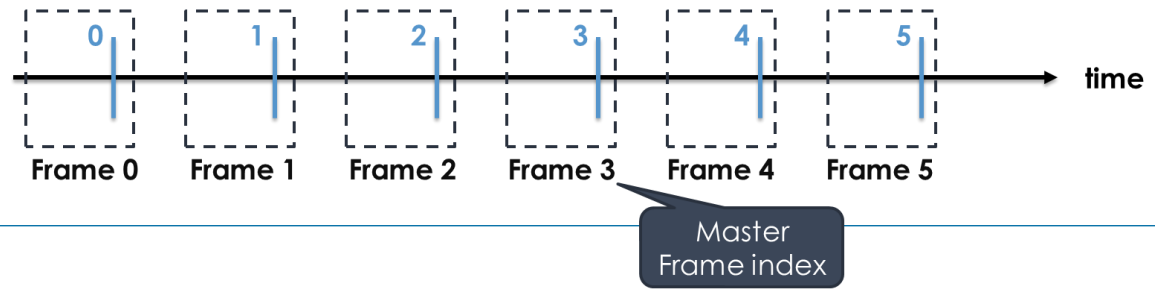
Basic JSON file – frames

OpenLabel JSON simple **frames**

```
{
   "openlabel": {
       "metadata": {
           "schema_version": "1.0.0"
       },
       "frame_intervals": [{
               "frame_start": 0, "frame_end": 1
           }, {
               "frame_start": 5, "frame_end": 7
           }
       ],
       "frames": {
           "0": { ... },
           "1": { ... },
           "5": { ... },
           "6": { ... },
           "7": { ... }
       }
   }
}
```

Frame_intervals ranges of frame numbers with data

frames contains dictionary of frames



Overview OpenLABEL JSON Structure

Basic JSON file – frames with object_data

OpenLabel JSON object_data at frame

```
{
    "openlabel": {
        "metadata": {
            "schema_version": "1.0.0"
        },
        "frames": {
            "0": {
                "objects": {
                    "1": {
                        "object_data": {
                            "bbox": [{
                                    "name": "shape",
                                    "val": [12, 867, 600, 460]
                                }
                            ]
                        }
                    }
                }
            },
            "1": { ... }
        },
        "objects": {
            "1": {
                "name": "van1",
                "type": "Van",
                "frame_intervals": [{"frame_start": 0, "frame_end": 1}]
            },
        }
    }
}
```

bbox specified for frame "0" for object "1"

Overview OpenLABEL JSON Structure

Basic JSON file – streams

OpenLabel JSON **streams**

```
{
   "openlabel": {
        "metadata": {
            "schema_version": "1.0.0"
        },
        "streams": {
            "Camera1": {
                "type": "camera",
                "uri": "./some_path/some_video.mp4",
                "description": "Frontal camera",
                "stream_properties": {
                    "intrinsics_pinhole": {
                        "camera_matrix_3x4": [ 1000.0,    0.0, 500.0, 0.0,
                                               0.0, 1000.0, 500.0, 0.0,
                                               0.0,    0.0,   0.0, 1.0],
                        "distortion_coeffs_1xN": [],
                        "height_px": 480,
                        "width_px": 640
                    },
                }
            }
        }
    }
}
```

streams contain dictionary of sequences of data subject of labeling

stream_properties define properties of stream **"Camera1"**

intrinsics_pinole
intrinsics_fisheye
intrinsics_custom

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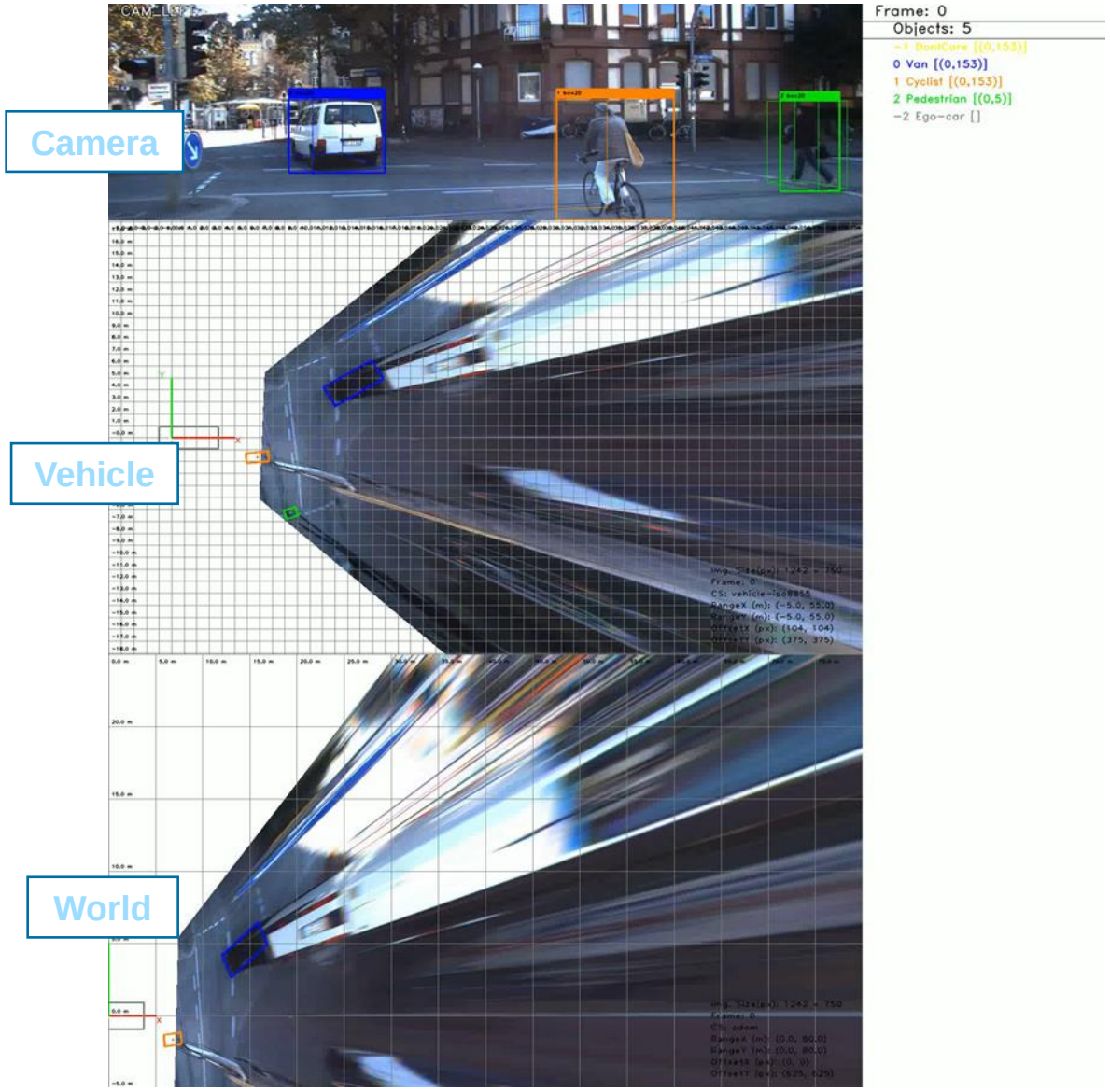
Overview OpenLABEL JSON Structure

Basic JSON file – coordinate_systems and transforms

```
{
    "openlabel": {
        "metadata": {
            "schema_version": "1.0.0"
        },
        "coordinate_systems": {
            "odom": {
                "type": "scene_cs",
                "parent": "",
                "children": [
                    "vehicle-iso8855"
                ]
            },
            "vehicle-iso8855": {
                "type": "local_cs",
                "parent": "odom",
                "children": [
                    "CAM_1",
                    "CAM_2"
                ]
            },
            "CAM_1" : {
                "type" : "sensor_cs",
                "parent" : "base",
                "children" : [],
                "pose_wrt_parent" : {
                    "matrix4x4" : [0.984807753012208, 0.0, 0.17364817766693033, 2.3, 0.0, 1.0, 0.0, 0.0, -
0.17364817766693033, 0.0, 0.984807753012208, 1.3, 0.0, 0.0, 0.0, 1.0]
                }
            },
            "CAM_2" : {
                "type" : "sensor_cs",
                "parent" : "base",
                "children" : [],
                "pose_wrt_parent" : {
                    "euler_angles" : [0.0, 0.17453292519943295, 0.0],
                    "translation" : [2.3, 0.0, 1.3],
                    "sequence" : "ZYX"
                }
            }
        },
        ...
    }
}
```

coordinate_systems contain dictionary of defined coordinate systems

Hierarchy of **"parent"** and **"children"** poses



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OpenLABEL Data Types

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OpenLABEL Data Types

Generic data types

OpenLabel JSON generic data types: object_data

```
"num": [{
    "name": "height_m",
    "val": 1.98
}]
```

```
"text": [{
    "name": "license plate",
    "val": "8440CMN"
}]
```

```
"vec": [{
    "name": "scores",
    "val": [0.98, 0.76, 0.98]
}]
```

```
"vec": [{
    "name": "locations",
    "val": ["Madrid", "Paris", "Rome"]
}]
```

```
"boolean": [{
    "name": "visible",
    "val": true
}]
```

OpenLabel JSON data type extension

```
"num": [{
    "name": "height_m",
    "val": 1.98
}]
```

```
"num": [{
    "name": "height_m",
    "val": 1.98,
    "coordinate_system": "WORLD",
    "attributes": {
        "num": [{
            "name": "confidence",
            "val": 0.98
        }]
    },
    "custom_prop1": "SomeValue",
    "custom_prop2": 0.99
}]
```

Any **object_data** *can* have other generic **object_data** as attributes

All **object_data** *can* be specified to correspond to specific **coordinate_systems**

All **object_data** *can* have custom additional properties

OpenLABEL Data Types

Generic geometric data types

OpenLabel JSON geometric data types: object_data

```
"bbox": [{
    "name": "head",
    "val": [400, 200, 100, 120]
}]
```

```
"rbbox": [{
    "name": "outline",
    "val": [400, 200, 100, 120, 0.785]
}]
```

```
"cuboid": [{
    "name": "shape",
    "val": [12.0, 20.0, 0.0, 1.0, 1.0, 1.0, 1.0,
 4.0, 2.0, 1.5]
}]
```

```
“image": [{
    "name": "color",
    "val": "iVBORw0KGgoAA..."
    “mime_type": "image/png",
    “encoding": "base64"
}]
```

```
“mat": [{
    "name": “points3d_4xN",
    "val": [...].
    “width": 325,
    “height": 4,
    “channels": 1,
    “data_type": “uint32",
}]
```

```
“image": [{
    "name": "color",
    "val": "iVBORw0KGgoAA..."
    “mime_type": "image/png",
    “encoding": "base64"
}]
```

```
"poly2d": [
    {
        "name": "poly1",
        "val": ["5","5","1","mBIIOIII"],
        "mode": "MODE_POLY2D_SRF6DCC",
        "closed": false
    }, {
        "name": "poly2",
        "val": [5,5,10,5,11,6,11,8,9,10,5,10,3,8,3,6,4,5],
        "mode": "MODE_POLY2D_ABSOLUTE",
        "closed": false
    }
]
```

```
"poly3D" : [{
    "closed" : false,
    "coordinate_system" : "vehicle_iso8855",
    "name" : "lane_marking",
    "val" : [557.02, 29.69, -1.63, 562.51, 29.97, -
1.59, 568.00, 30.36, -1.58, 571.98, 30.76, -1.57]
}]
```

```
“point2d": [{
    "name": “A2",
    "val": [400, 200],
    “id": 1
}]
```

```
“point3d": [{
    "name": “A3",
    "val": [400, 200, 0],
    “id": 1
}]
```

```
"mesh" : [{
    "name" : "parkslot1",
    "point3d" : {
        "0" : {
            "name" : "Vertex0",
            "val" : [25, 25, 0],
        },
        …
    },
    "line_reference" : {
        "0" : {
            "name" : "Edge",
            "reference_type" : "point3d",
            "val" : [0, 1],
        },
        "1" : {
            "name" : "Edge",
            "reference_type" : "point3d",
            "val" : [1, 2],
        },
        …
    },
    "area_reference" : {
        "0" : {
            "name" : "Slot",
            "reference_type" : "line_reference",
            "val" : [0, 1, 2, 3],
        },
        "1" : {
            "name" : "Slot",
            "reference_type" : "line_reference",
            "val" : [4, 5, 6, 1],
        }
    }
}]
```

Thank you for your attention!

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ASAM OpenLABEL V1.0.0 Data Format

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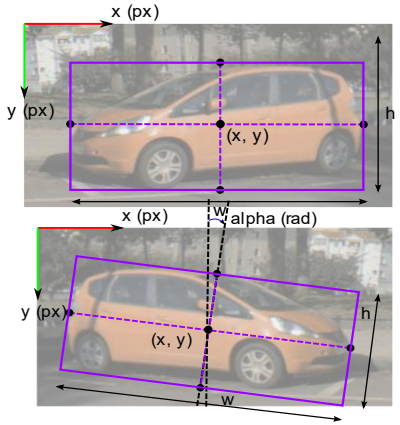
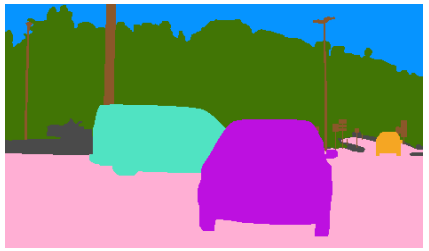
OpenLABEL Data Types

Use cases

bbox
rbbox



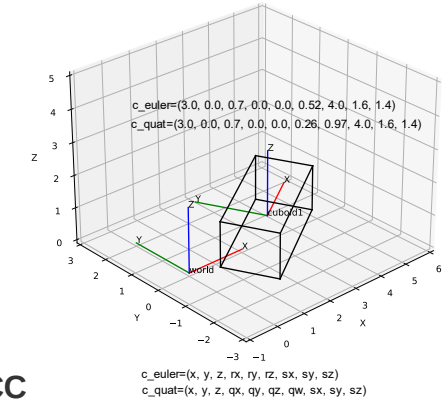
poly2d



Lossless SRF6DCC algorithm

The **ASAM OpenLABEL SRF6DCC** approach produces a **63 kB JSON file** for a 2048x1536 image

cuboid

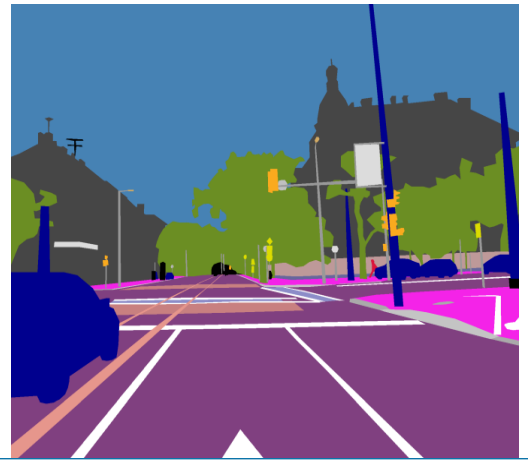


binary

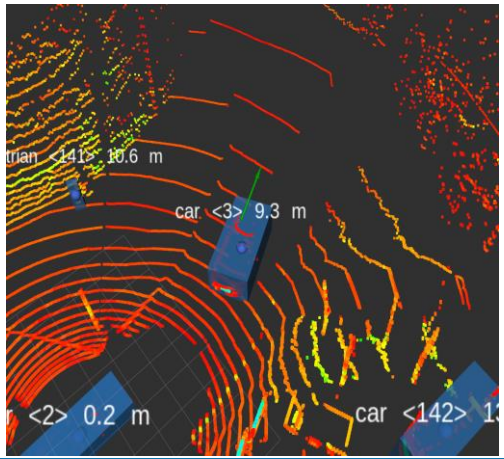
Lossless RLE-based binary data

The **ASAM OpenLABEL RLE-based** approach produces a **88 kB JSON file** from ~89 MB CSV files

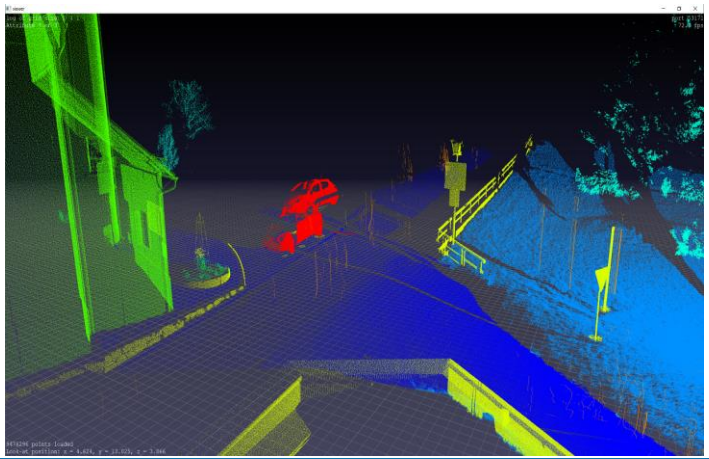
2D Objects - Bounding Box



2D Objects - Segmentation



3D Objects - Cuboids



3D Objects - Segmentation

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