
# KI-ASIC – Test Dataset

## OTH Amberg-Weiden

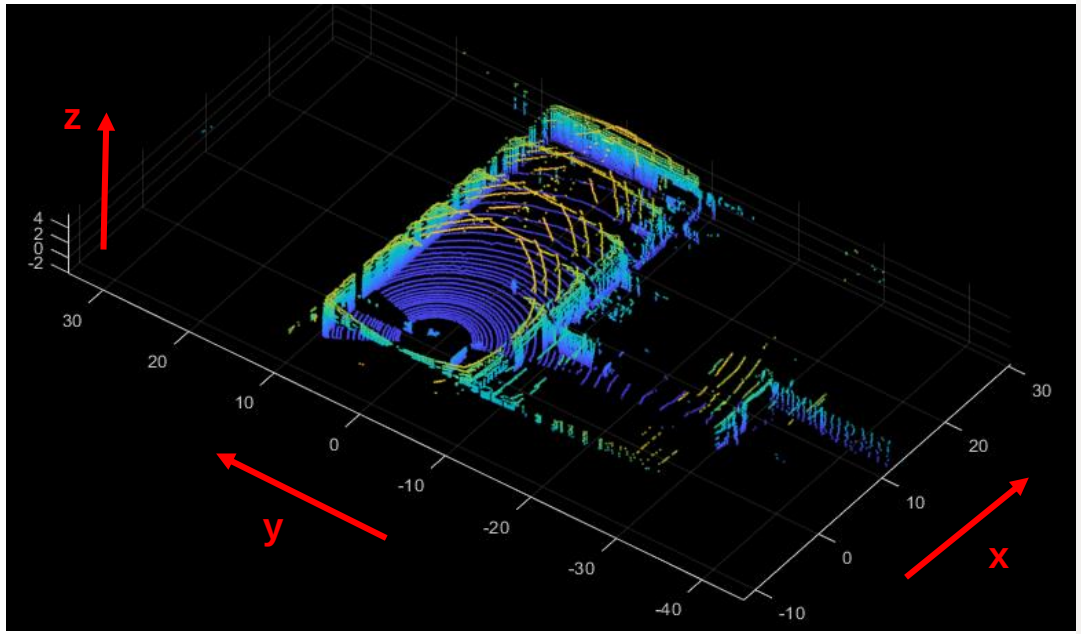
# General Information (1)

- Data collected with reference system consisting of stereo camera, Ouster lidar sensor and HighRes radar sensor from Infineon, **recorded with 10 Hz**
- Image of left camera from stereo camera system is used for labeling process and is calibrated with the Ouster lidar sensor → **calculated information (distances, angles, …) from detected objects refer to this left colour camera**
- HighRes radar sensor currently as a stand-alone sensor → not calibrated to lidar and sensor yet → will be developed as part of a master‘s thesis in the next months → **offset between camera-lidar-system and radar has to be taken into account** (translation array is in result file → description of result file later)
- Time synchronization between sensors has to be developed in the next month as well → only static test scenarios in the first run with test objects car, rider/bicycle and person → iterative improvement process
- Please provide us with feedback on how to improve the process of creating new test data sets for training the SNN

# General Information (2)

- Definition of the coordinate system as follows:
  - x: objects in front have always positive distance information
  - y: positive to the left
  - z: positive upwards

- Derived from this, the positive directions of rotation are as follows:
  - horizontal angle: positive clockwise (to the right)
  - vertical angle: positive upwards



# Structure Result Directory

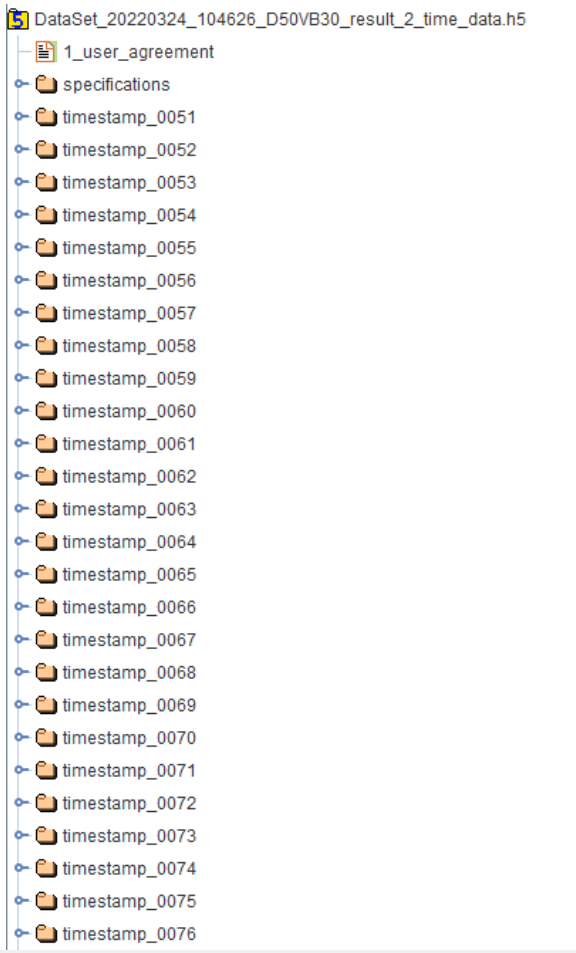
- The result directory consists of the result files with raw radar data and labeled images for checking


- Due to file size limitation of H5 files, the result files are split into blocks of 50 timestamps, which is why they are named “_1“, “_2“, etc.

- Furthermore, all labeled images with the detected objects are saved in a separate directory. Such an image contains the merged lidar points as well as the object mask and the class affiliation of the object.

# Structure Result File (1)

- Each test scenario consists of specifications and timestamps (scenes)
- Per scene, one image per camera, one point cloud and one radar measurement are recorded, saved in the result file and processed
- All processed information is also stored in the result file

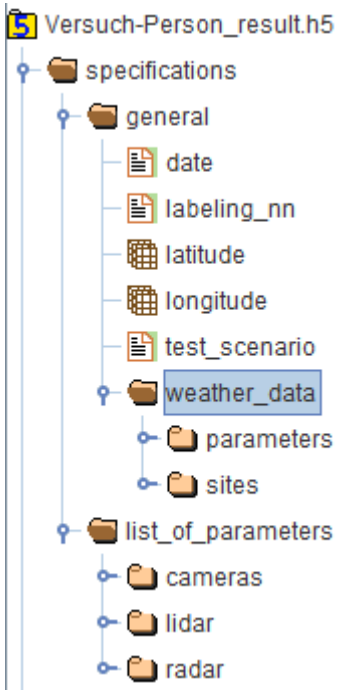


# Structure Result File (2)

- Specifications consist of general information about the recorded test scenario, a list of parameters specifying the different sensors (cameras, lidar, radar) and the prevailing weather at the time of recording

- General specifications
  - **Classes to be analyzed**
  - **Timestamp of recording** (e. g. „2021-Nov-01 12:00:00“)
  - **NN for labeling** (e. g. „DetectoRS“, which we‘re using at the moment)
  - **Latitude and longitude** of the area where the tests were carried out
  - **Name of the recorded test scenario (label)** (e.g. “static_car”, designation is later chosen according to test scenario catalogue)
  - **Weather data** (parameters with value/unit and sites of weather stations)
  - **Translation between left camera and front-mid radar sensor**

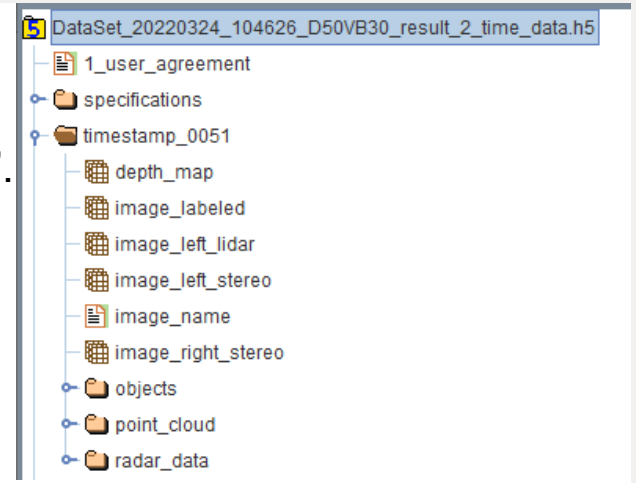
- **List of parameters** → specification of camera system, lidar and radar



# Structure Result File – Timestamp

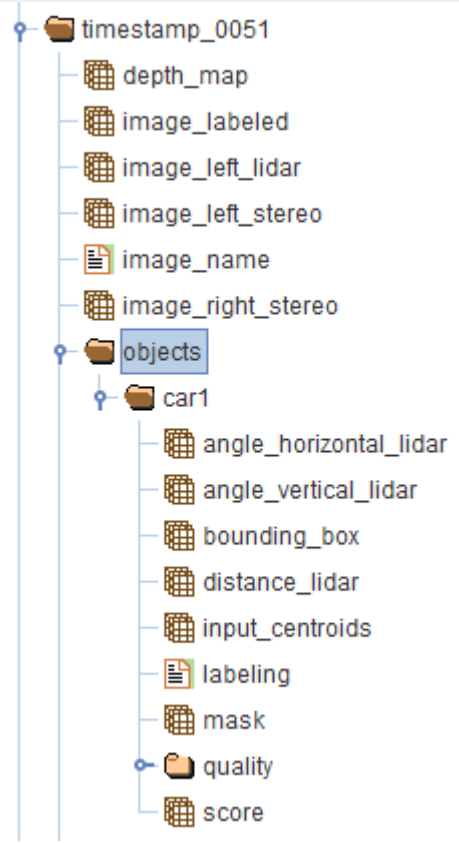
- Besides the specifications of the sensors, the collected data and calculated information are saved in a new folder numbered consecutively starting from “0001”.

- Every timestamp folder consists of the following parameters:
  - **Image Name**
  - **Depth Map** (calculated from stereo camera system)
  - **Image of left camera** undistorted with parameters from Lidar-camera-calib
  - **Left and right image** from stereo camera system calibrated to each other
  - **Detected objects** from labeling process with calculated information
  - **Point Cloud** from Ouster lidar sensor
  - **Collected raw data** from HighRes radar sensor from Infineon



# Structure Result File – Objects (1)

- Within the objects folder, a separate subfolder with a characteristic name is created for each detected object. The first object of the object class is also given the number "1"; if there are several objects of the same object class, they are numbered accordingly. Such a subfolder, in the example named as “car1” contains the following information:
  - **Horizontal angle lidar:** Calculated with lidar data and labeling of image
  - **Verticale angle lidar:** Calculated with lidar data and labeling of image
  - **Bounding box:** Bounding box from labeling of image from left camera
  - **Distance lidar:** Calculated distance of detected object with lidar data
  - **Input centroids:** Centroids of labeled object
  - **Quality:** Quality of lidar points within mask regarding density
  - **Mask:** Mask of detected object from labeled left camera image
  - **Score:** Confidence of detected object from labeled left camera image




- More subfolders in objects folder **with each additional detected object** using the labeling process

# Structure Result File – Objects (2)

- The values stored in the individual subfolders of the object folder, i.e. the information calculated for the individual detected objects, can be interpreted as follows:
  - **Horizontal and vertical angles** (values in rad): e. g. [0.01 0.05] → object appears in 0.01 rad +/- 0.05 rad
  - **Bounding box** (values in pixel): e. g. [1157 236 151 526] → objects appears in image of left colour camera between 1157 and 1157+151 pixel horizontally and between 236 and 236+526 pixel vertically. The pixel origin of the image is in the upper left corner.
  - **Distances** (values in meter): e. g. [5.12 0.08] → distance of object with mean 5.12 meters with a standard deviation of 0.08 meters
  - **Mask** (logical array): 0 means that image pixel is not detected object, 1 means that object is detected in pixel
  - **Score:** e. g. 0.999 → object is assigned to the class with a probability of 99.9 %; value between 0 and 1

- The **horizontal angle** is as already described earlier **positive to the right (clockwise)**

- The **vertical angle** is as already described earlier **positive upwards**

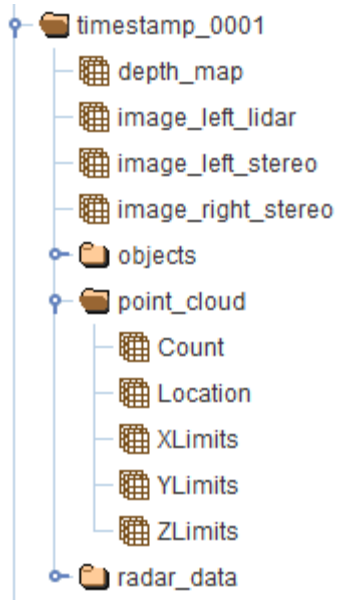
# Structure Result File – Objects (3)

- It could also be possible that sometimes (5% of cases) there is no point cloud available for processing the data. In such a case, the auxiliary depth information from the stereo camera system will be used to determine distance and angle information of the detected objects.

# Structure Result File – Point Cloud

- Besides the detected objects including ther calculated information, the point cloud collected from the Ouster lidar sensor is stored in the result file with the following parameters:
  - **Count:** Number of recorded lidar points, with the current setting 65536 points
  - **Location:** x,y and z values in meters from every lidar point for the 64 channels and selected lines (e. g. 1024 lines)
  - **XLimits:** Limits of lidar points in x direction in meters, e. g. from -10 to 30 meters
  - **YLimits:** Limits of lidar points in y direction in meters
  - **ZLimits:** Limits of lidar points in z direction in meters

- One point cloud is recorded per timestamp



# Structure Result File – Radar Data

- Besides the point cloud from the lidar sensor, the raw radar data from the HighRes radar is stored and can be can be processed (time data, range and range-Doppler-map) and displayed using the exemplary scripts at https://gitlab.com/oth-aw_automotive/scripts-for-ki-asic-dataset.
- Arrangement of the HiRes radar sensor Tx and Rx: