Urban & Roundabout Dataset Format

The dataset includes measurement data extracted from one or more recording sites (locations) in the data directory as well as map files per location in the maps directory (if part of the dataset). Data and maps can be associated using a recording's location id. The data for each location is split into multiple continuous recordings.

In total four files are provided for each recording:

- An image of the recorded road section (XX_background.png)
- A csv file describing the recording location (XX_recordingsMeta.csv)
- A csv file containing an overview of recorded vehicle and VRU tracks (XX_tracksMeta.csv)
- A csv file for the tracks' trajectories (XX_tracks.csv)
  These files are created for each recording to ensure easy handling of the data.

In addition the following map data for each recording location are provided:

- Lanelet2 maps (.osm)
- ASAM OpenDrive maps (.xodr)
- 3D scene (.osgb & .fbx)

In the following, the dataset format and especially the meaning of every column is explained in detail.
Please note that we summarize pedestrians, bicyclists and motorcycles to vulnerable road users (VRUs) in the following tables.

Image of the Road Section (XX_background.png)

For each recording a georeferenced image of the road section is added.The image is based on the recording itself by removing all moving vehicles through filtering. Additionally the resolution of the image was
reduced.

Recording Meta Information (XX_recordingMeta.csv)

This file contains metadata for each recording. The metadata provides a general overview, e.g. of the time of recording, the road section considered and the total number of objects tracked.

Name	Description	Unit
recordingId	The id of the recording. Every recording has a unique id.	[-]

Name	Description	Unit
locationId	The id of the recording location.	[-]
frameRate	The frame rate which was used to record the video.	[hz]
speedLimit	The speed limit of the driving lanes. In all recordings, the speed limit is the same for every driving lane.	[m/s]
weekday	The weekday the recording was done.	[-]
startTime	The hour at which the recording was started	[hh]
duration	The duration of the recording.	[s]
numTracks	The number of objects tracked.	[-]
numVehicles	The number of vehicles tracked.	[-]
numVrus	The number of vulnerable road users (VRUs) tracked.	[-]
latLocation	Rough latitude coordinates of recording location. Not to be confused with UTM coordinates!	[deg]
lonLocation	Rough longitude coordinates of recording location. Not to be confused with UTM coordinates!	[deg]
xUtmOrigin	X value of UTM coordinate of origin of the local coordinate system for this recording location. Add this to xCenter to get UTM coordinates.	[m]
yUtmOrigin	Y value of UTM coordinate of origin of the local coordinate system for this recording location. Add this to yCenter to get UTM coordinates.	[m]
orthoPxToMeter	Scale factor from ortho image pixels to UTM meters. This value is needed for visualization.	[m/px]
exportVersion	Version of data format. (may be missing in some datasets)	[-]

Track Meta Information (XX_tracksMeta.csv)

This file contains an overview of all tracks.
The purpose of this file is to allow filtering tracks e.g. by class.

Name	Description	Unit
recordingId	The id of the recording. Every recording has a unique id.	[-]
trackId	The id of the track. The ids are assigned in ascending order for each recording.	[-]
initialFrame	The frame in which the track starts.	[-]
finalFrame	The frame in which the track ends.	[-]

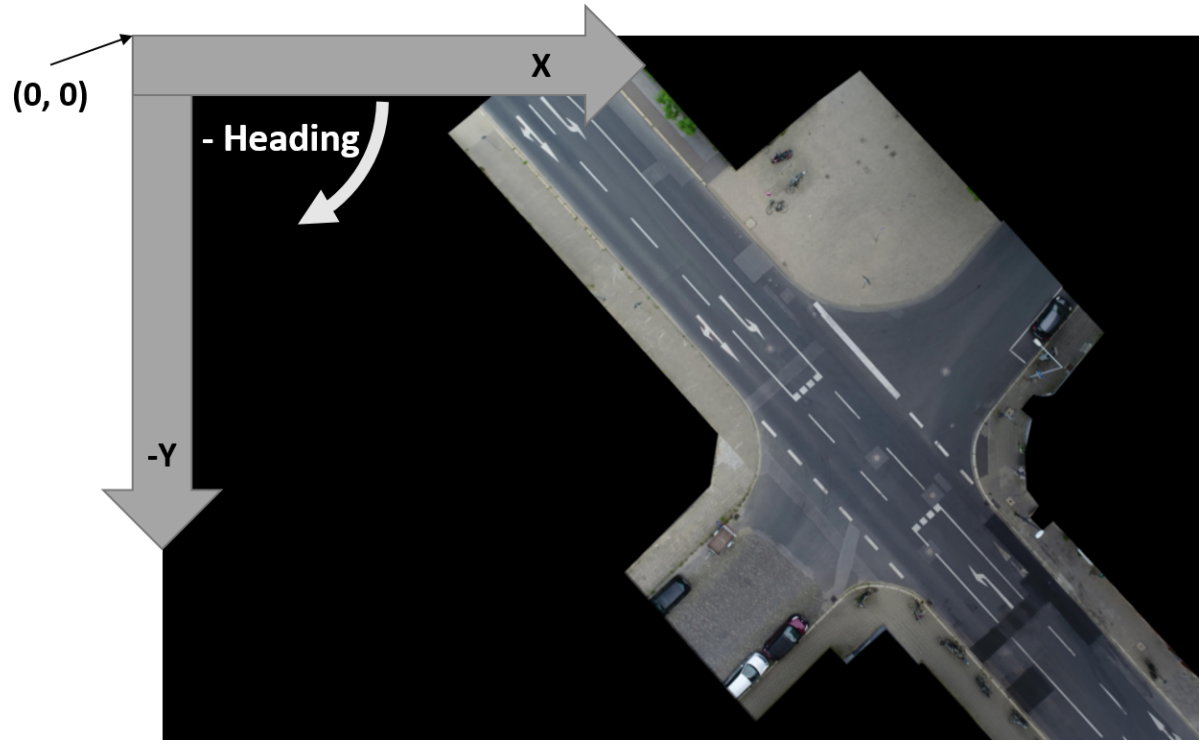
Name	Description	Unit
numFrames	The total lifetime in frames.	[-]
width	The width of the tracked object. This property is set to zero for VRUs.	[m]
length	The length of the tracked object. This property is set to zero for VRUs.	[m]
class	The class of the tracked object.	[-]

Tracks (XX_tracks.csv)

This file contains all time dependent values for each track. Information such as current position, velocity and acceleration.

Name	Description	Unit
recordingId	The id of the recording. Every recording has a unique id.	[-]
trackId	The track's id. The ids are assigned in ascending order for each recording.	[-]
frame	The frame for which the information are given.	[-]
trackLifetime	The current age of the track at this frame.	[-]
xCenter	The x position of the object's centroid in the local coordinate system. Add xUtmOrigin to get UTM coordinates.	[m]
yCenter	The y position of the object's centroid in the local coordinate system. Add yUtmOrigin to get UTM coordinates.	[m]
heading	The heading in the local coordinate system.	[deg]
width	The width of the object. This property is set to zero for VRUs.	[m]
length	The height of the object. This property is set to zero for VRUs.	[m]
xVelocity	The velocity in x-axis direction in the local coordinate system.	[m/s]
yVelocity	The velocity in y-axis direction in the local coordinate system.	[m/s]
xAcceleration	The acceleration in x-axis direction in the local coordinate system.	[m/s^2]
yAcceleration	The acceleration in y-axis direction in the local coordinate system.	[m/s^2]
lonVelocity	The longitudinal velocity.	[m/s]
latVelocity	The lateral velocity.	[m/s]
lonAcceleration	The longitudinal acceleration.	[m/s^2]
latAcceleration	The lateral acceleration.	[m/s^2]

Coordinate System



The global coordinate system used is the UTM coordinate system, as we geo-referenced our data. For easier handling of data of the same intersection in different recordings, we introduced a local UTM-like coordinate system.
The only difference is, that the origin (0, 0) is very close to the recorded road section and the same for all recordings at each location.
To transform positions into the global UTM coordinate system, just add xUtmOrigin and yUtmOrigin to all positions.
The local coordinate system looks as follows: The horizontal axis is the x-axis, which grows to the right.
The vertical axis is the y-axis, which grows upwards.
The heading is calcuated as in the UTM coordinate system.
Finally, we use SI units only.

Maps

ASAM OpenDRIVE maps

For all locations, a digital map in OpenDRIVE® v1.4 format is provided. For more information about OpenDrive refere to the ASAM website. ASAM OpenDRIVE is supperted by several simulation tools such as esmini, Carla, etc. The information in the map is based on the georeferenced drone images and speed limit information from OpenStreetMap.

The maps contain the following map object types:

- Road network, Road and Lane connections, predeces-sors / successors
- Road shape and width
- Lane number, width, and type (including sidewalks & bicycle lanes)

- Markings (type, color)
- Speed Limits
- Flat terrain
- Generalized curb stone heights
- Traffic islands
- Parking areas
- Road stencil markings (text, arrows, etc.)
- Important Traffic Signs (Stop, Yield, Turn,...)
- Roundabouts
- Guardrail, concrete divider, noise protection wall
- Further markings
    - Crosswalks (including zebra markings)
    - Restricted area markings

Lanelet2 maps

For all locations, a digital map according to the core format described in the Lanelet2 library is provided to the customer. The information in the map is based on the georeferenced drone images and speed limit information from OpenStreetMap.

The maps contain the folllowing information:

- Road network, Road and lane connections, predecessors/successors
- Road shape and width
- Lane number, and type (including sidewalks & bicycle lanes)
- Lane markings
- Traffic islands
- Parking areas
- Surroundings (buildings/parks/vegetation)
- Generalized curb stone heights
- Intersections areas
- (Virtual) connection lanes on intersections
    - For drivable lanes and bicycle lanes
- Roundabouts
- Regulatory elements
    - Traffic Lights (focus on vehicle lights)
    - Right of way (including traffic signs and stop/wait lines, if available)
- Further markings
    - Crosswalks (including zebra markings)
    - Restricted area markings

Custom lanelet tags

The maps also contain additional tags for lanelets which are not explicitly specified in the original documentation.

Name	Description

Name	Description
speed_limit	All lanelets which have the type "road" or a variation of it are tagged with a speed_limit tag which denotes the speed limit of the lanelet. The value of the tag contains the speed limit and its unit (either km/h or mph).