zenseact

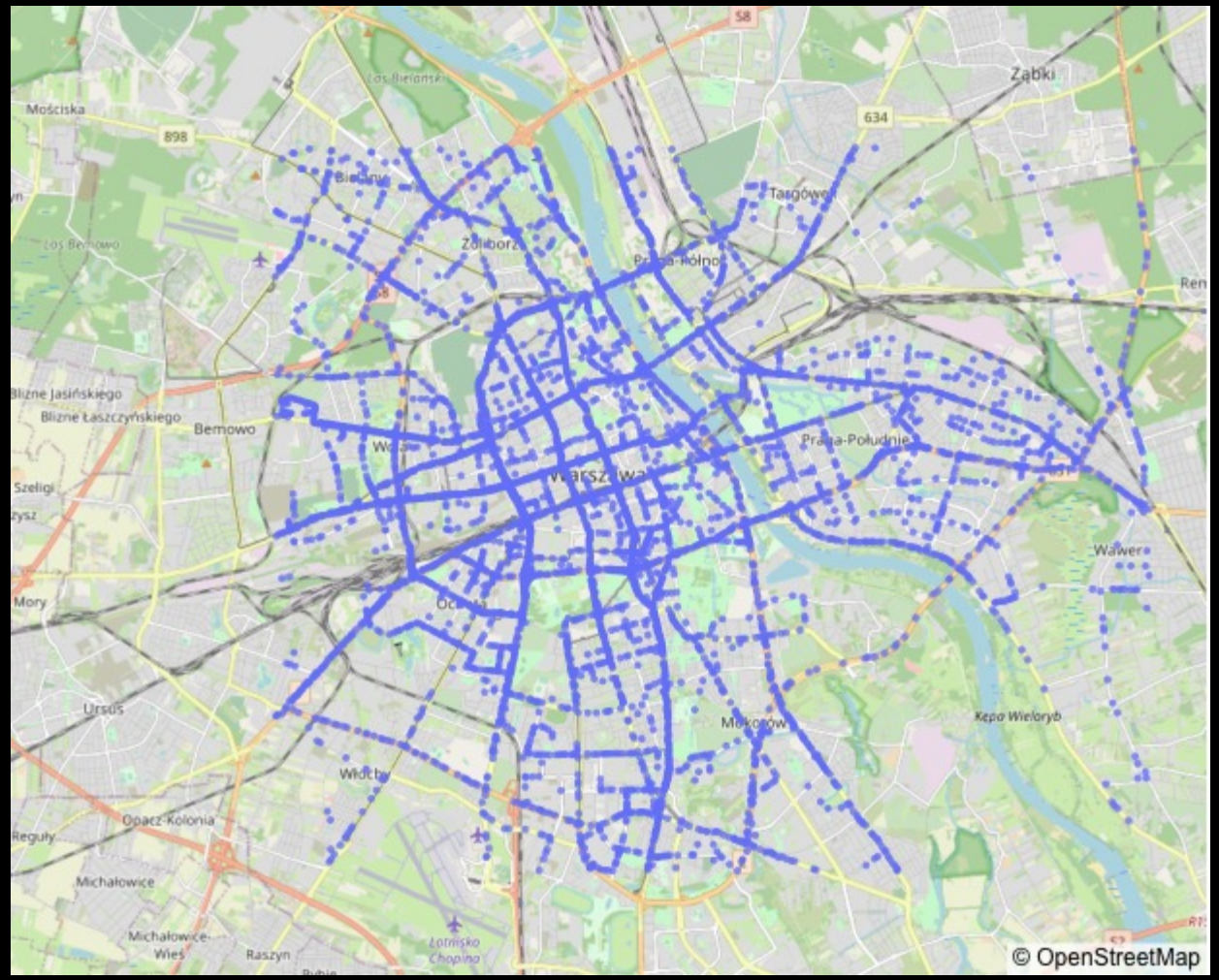
INTRODUCTION TO
ZENSEACT OPEN DATASET

Why release a dataset?

- ✓ Accessing high-quality data has proven crucial to the development of autonomous vehicle systems
- ✓ Enabling researchers and developers to explore multimodal perception, sensor fusion and more
- ✓ Bringing real-world challenges to academia and startups to encourage research and products with significant impact
- ✓ Attracting talent and driving innovation
- ✓ Creating higher value for the company by using Zenseact dataset in publishing master and PhD project outcomes
- ✓ Enhancing collaboration with other researchers and 3rd parties

Dataset Overview

- ✓ Sequential multimodal dataset (Images, LiDAR, High-precision GPS, Vehicle data) with several annotation tasks
- ✓ 6666 sequences captured by Zenseact developmental vehicles (India & Golf) during a three-week timespan
- ✓ Data from highway, country, and urban roads in and around Warsaw, Poland
- ✓ Day/night under varying weather conditions
- ✓ Licensed under CC BY-SA 4.0



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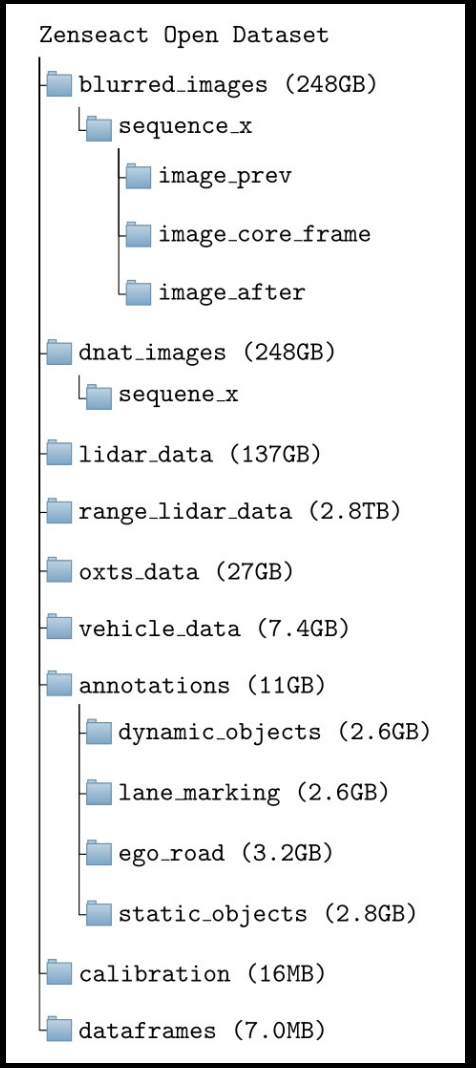
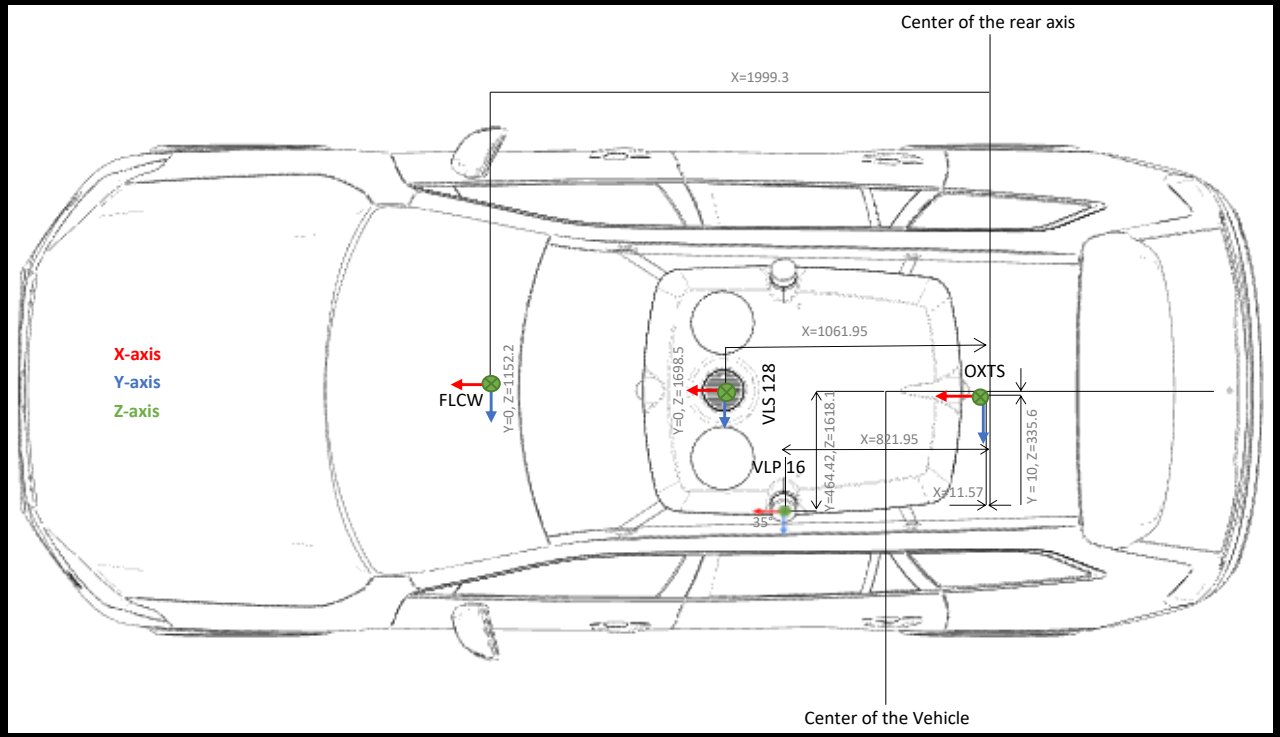
Dataset Overview

- ✓ Three consecutive camera frames in each sequence at 30 HZ (Blurred and DNAT anonymized)
- ✓ Lidar data contains single LiDAR scans closest to the core frames
- ✓ Range lidar data contains LiDAR scans in [-1s,+1s] around the core frames
- ✓ OXTS data covers [-1s, ~10s] around the core frames
- ✓ Vehicle data covers [-1s, +1s] around the core frames
- ✓ Calibration files are provided per date



Sensor setup

- ✓ 1 x Forward-looking camera, with 120° field of view and 8MP resolution
- ✓ 1 x Velodyne VLS128, 2 x Velodyne VLP16
- ✓ 1 x OXTS RT3000
- ✓ Vehicle Data Sensors

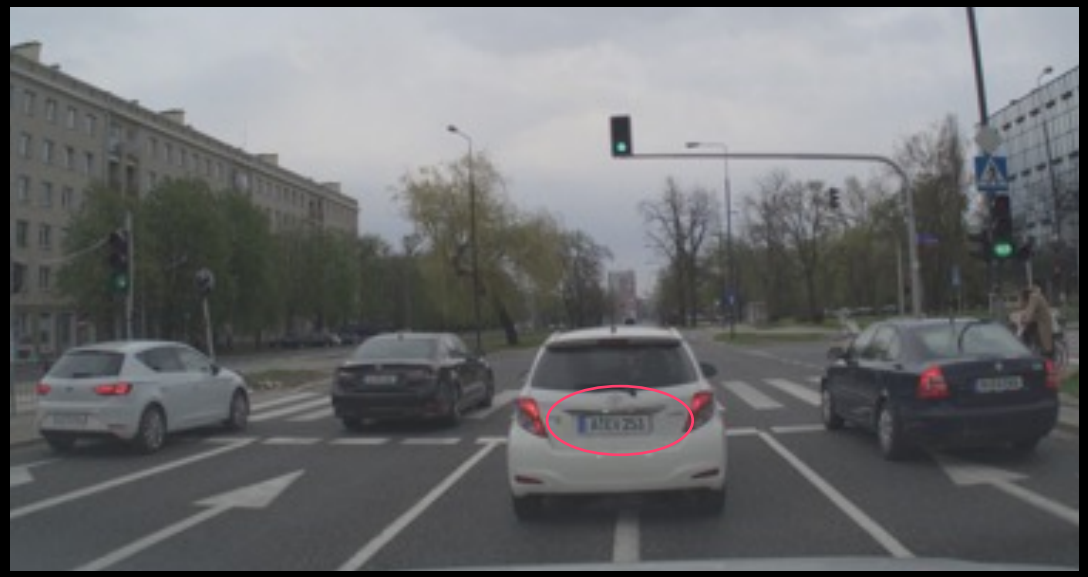


Anonymization

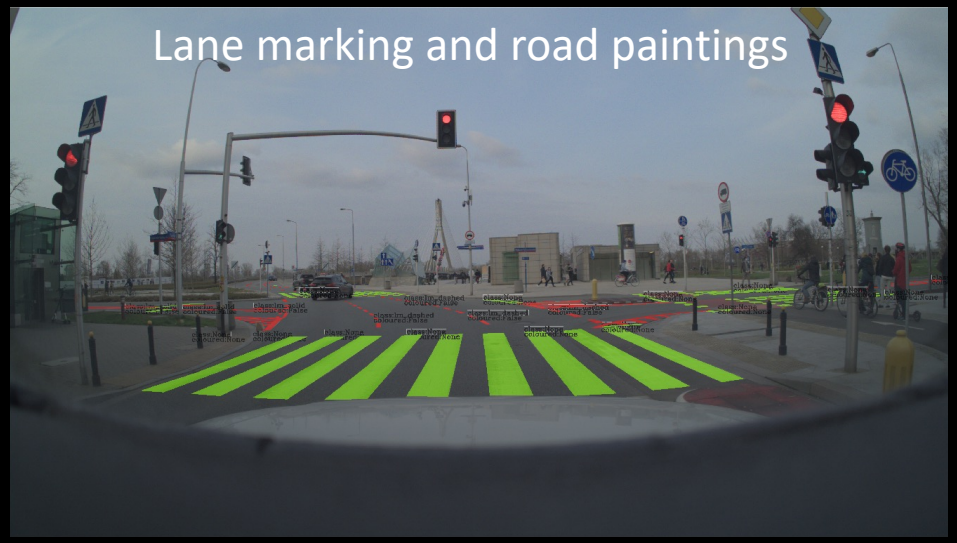
- ✓ Anonymizing faces and vehicle license plates to comply with the privacy regulations such as GDPR in Europe.
- ✓ BrighterAI's tool (i.e., precision blur and deep natural anonymization, DNAT) is used to protect personal information visible in the images.

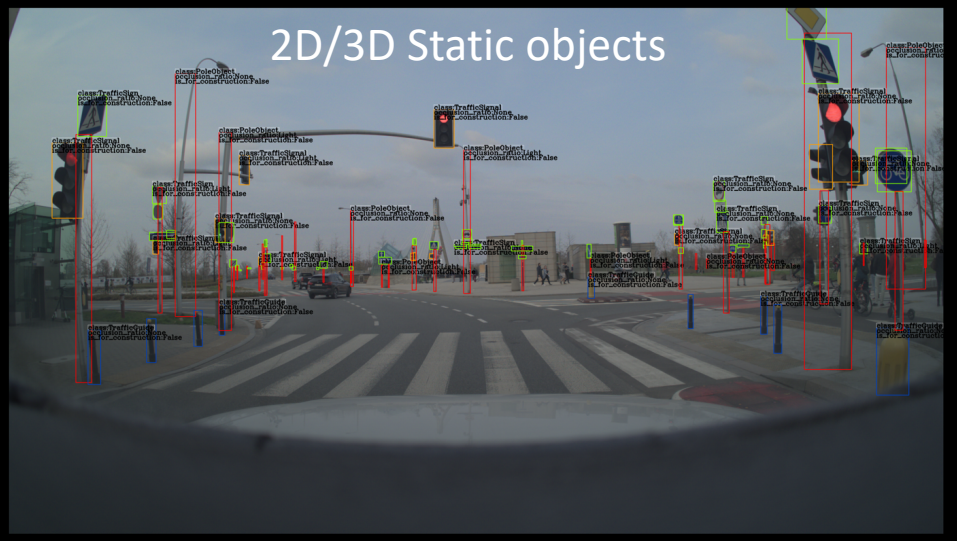
Anonymized image with Precision Blur

Anonymized image with DNAT



Annotations

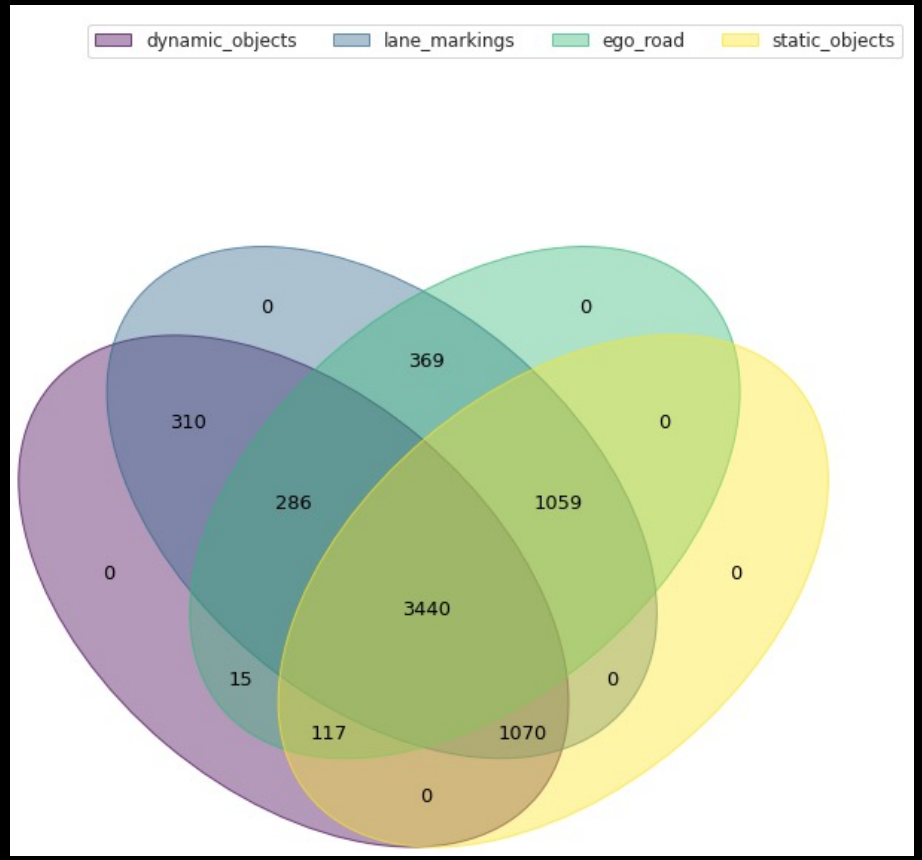




Annotations

- ✓ Each annotation task has a separate JSON annotation file
- ✓ Annotations are provided for the core frames in the sequences with the GeoJSON format
- ✓ Core frames of 3440 sequences are annotated for all four annotation tasks enabling multi-task learning

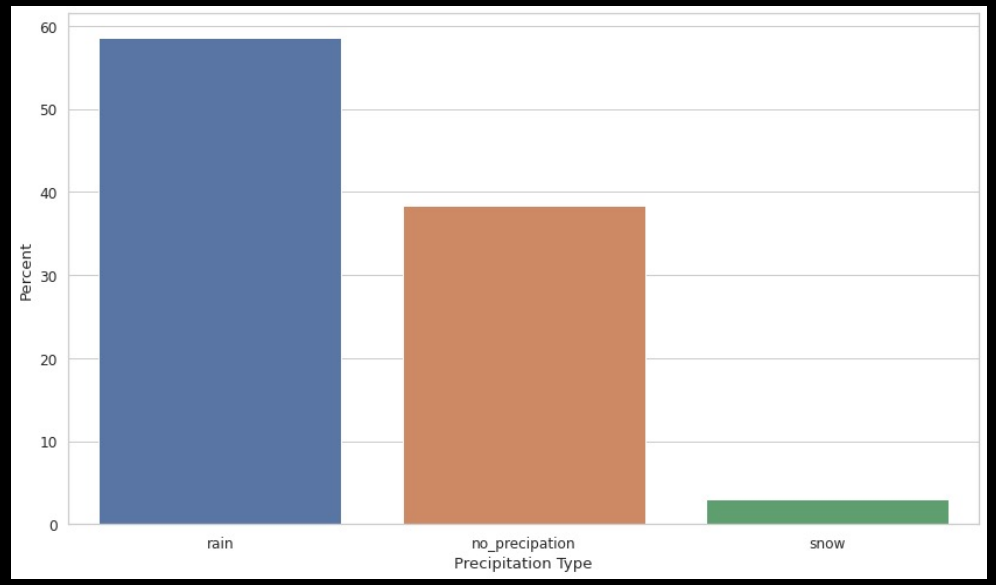
Venn diagram for different annotation tasks

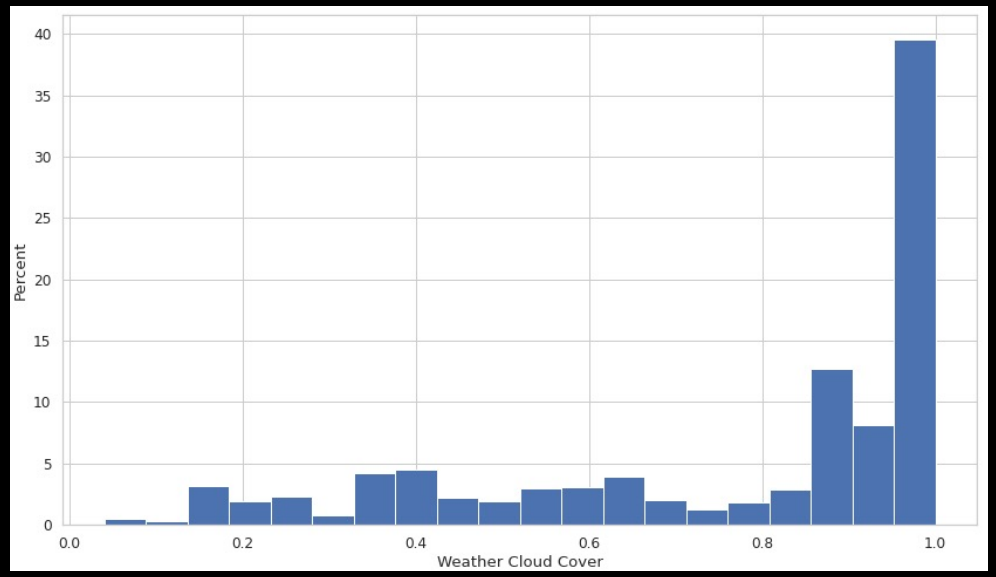


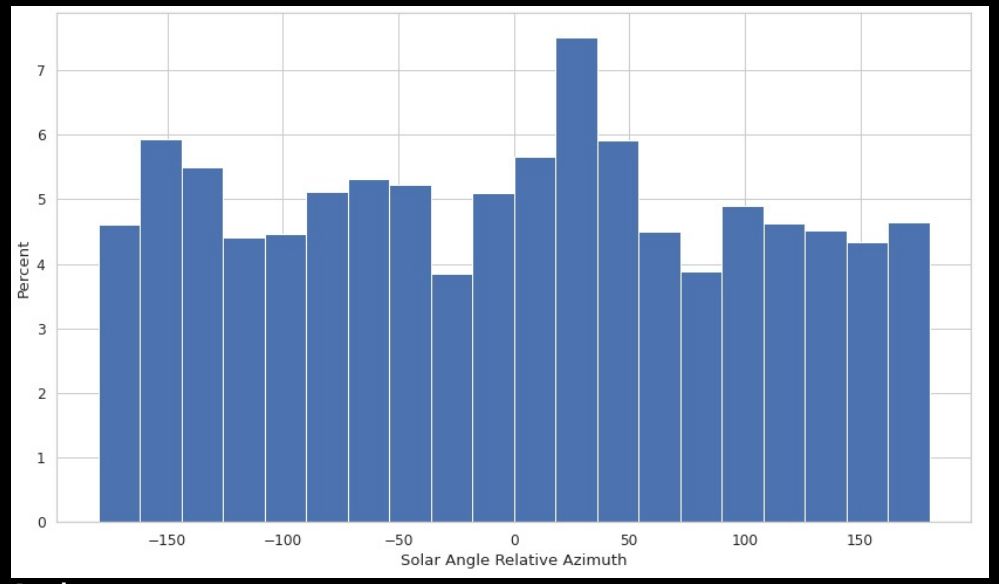
Dataset Analysis

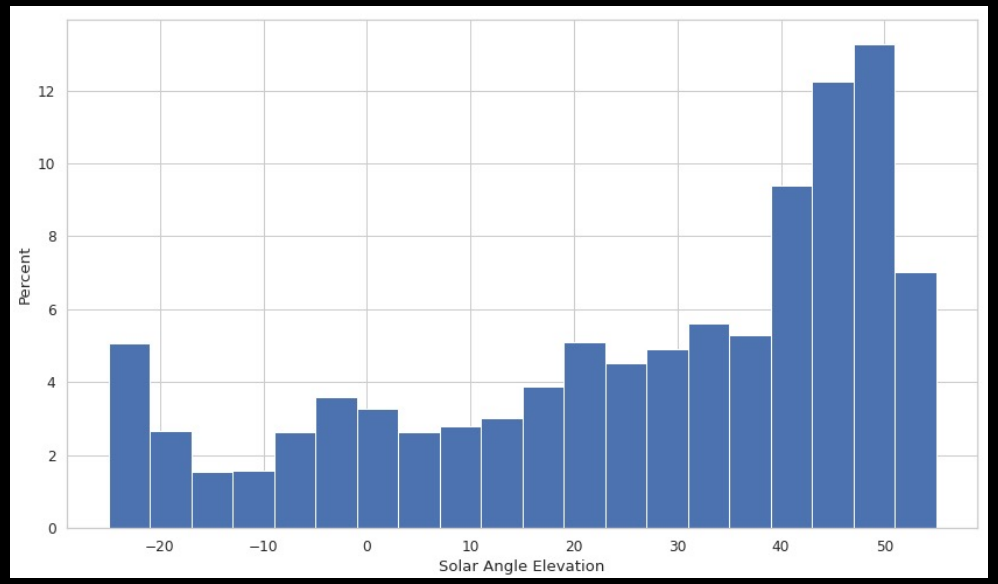
	Solar angle relative azimuth	Solar elevation angle	Cloud coverage	Precipitation encoded (1-rain, 2-snow)	Number of pedestrians	Number of vehicles	Number of vulnerable vehicles
Mean	-3.41	26.10	0.77	0.65	4.6	25.94	1.31
Std	101.87	22.88	0.27	0.54	6.33	15.54	2.92
Min	-179.99	-24.53	0.04	0	0	0	0
25%	-89.99	10.25	0.57	0	0	14	0
50%	1.4	33.10	0.89	1	2	24	0
75%	79.53	45.91	0.98	1	6	35	1
Max	179.52	54.11	1	2	66	118	29

Dataset Analysis







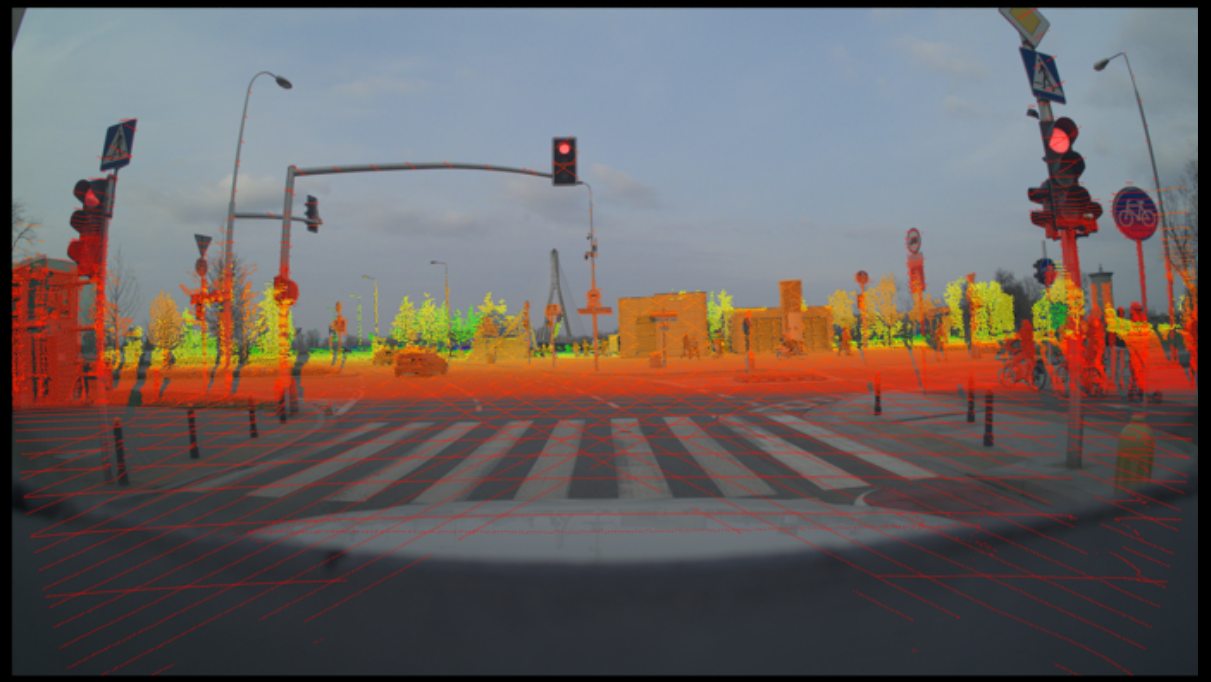


Development Kit

- ✓ Data loaders for images, LiDAR point clouds, OXTS, and vehicle data
- ✓ Calibration file reader
- ✓ Readers for GeoJSON annotation files
- ✓ Visualize polygon/bounding box annotations on images
- ✓ Data sampling using the provided metadata information
- ✓ Coordinate transformations (camera, OXTS, LiDAR, reference frame)
- ✓ The development kit will be available on Zenseact GitHub

Development Kit

- ✓ Functionality for projecting LiDAR point clouds into the camera coordinate system and overlaying projections on images



Development Kit

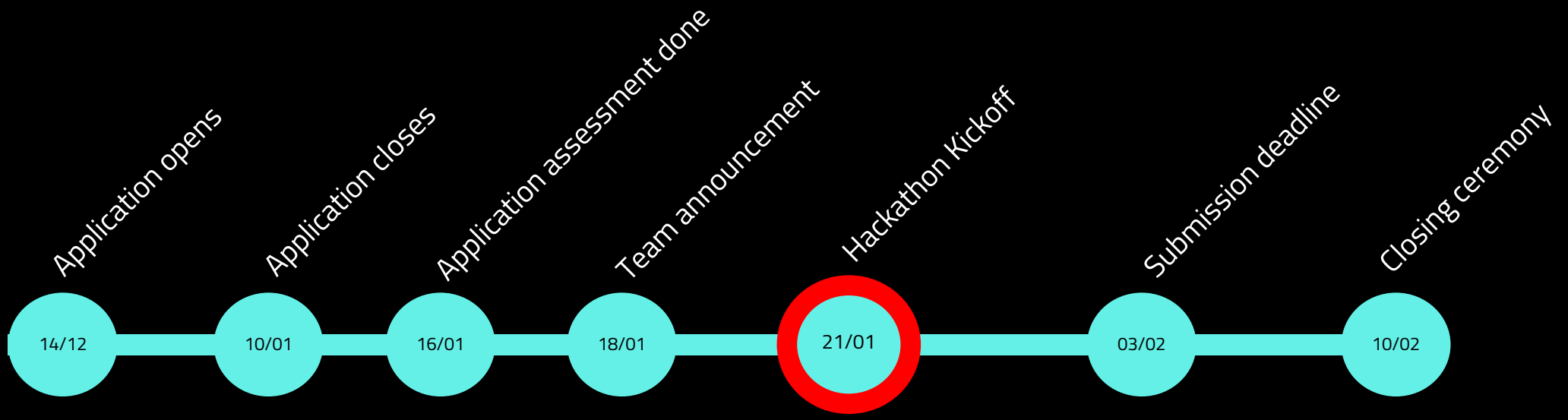
- ✓ Functionality for converting OXTS navigation frame to ISO-8855 reference coordinate system, computing odometry relative to the frame and visualize GPS track projected on the image plane.

Dataset applications

- ✓ Self-supervised learning, and spatio-temporal semantic segmentation and object detection
- ✓ Lidar perception and Tracking
- ✓ Trajectory learning, path planning, and holistic-path prediction
- ✓ Visual odometry, Optical flow, SLAM
- ✓ Bus data, enables end-to-end learning, reinforcement learning
- ✓ Predictive modelling
- ✓ Transfer learning
- ✓ Multi-task learning

Next Steps

- ✓ Launching "Edge AnnotationZ Challenge" on Zenseact dataset with AI Sweden, and RoDL project committee on 14 December 2021
  - ✓ https://www.ai.se/en/events/launch-edge-annotationz-challenge



- ✓ Share dataset for public soon and extend it with more sequences, annotations, and some internal signals

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Dataset File Structure

Zenseact Open Dataset

- blurred_images (248GB)
  - <sequence_id>_<core_frame_camera_timestamp>: *3 camera frames at 30 HZ*
    - <vehicle_name>_<camera_name>_<camera_timestamp>_<seq_id>.png
    - <vehicle_name>_<camera_name>_<camera_timestamp>_<seq_id>.png *(core frame)*
    - <vehicle_name>_<camera_name>_<camera_timestamp>_<seq_id>.png
- dnat_images (248GB)
  - <sequence_id>_<core_frame_camera_timestamp>: *3 camera frames at 30 HZ*
    - <vehicle_name>_<camera_name>_<camera_timestamp>_<seq_id>.png
    - <vehicle_name>_<camera_name>_<camera_timestamp>_<seq_id>.png *(core frame)*
    - <vehicle_name>_<camera_name>_<camera_timestamp>_<seq_id>.png
- lidar_data (137GB)
  - <sequence_id>_<core_frame_camera_timestamp>: *LiDAR scan closest to core frame*
    - <vehicle_name>_<lidar_timestamp>_<seq_id>.npy
- range_lidar_data (2.8TB)
  - <sequence_id>_<core_frame_camera_timestamp>: *LiDAR scans in [-1s,+1s] around core frame*
    - <vehicle_name>_<lidar_timestamp>_<seq_id>.npy
- oxts_data (27GB)
  - <sequence_id>_<core_frame_camera_timestamp>: *OXTS data in [-1s,~10s] around core frame*
    - <vehicle_name>_<first_OXTS_timestamp>_<last_OXTS_timestamp>_<seq_id>.hdf5
    - <vehicle_name>_<first_OXTS_timestamp>_<last_OXTS_timestamp>_<seq_id>_preprocessed.hdf5
- vehicle_data (7.4GB)
  - <sequence_id>_<core_frame_camera_timestamp>: *Data in [-1s,+1s] around core frame*
    - <vehicle_name>_<first_data_timestamp>_<last_data_timestamp>_<seq_id>.hdf5
- annotations (11GB)
  - dynamic_objects (2.6GB)
    - <sequence_id>_<core_frame_timestamp>
      - <vehicle_name>_<camera_name>_<camera_timestamp>_<seq_id>.json
  - ego_road (2.6GB)
    - <sequence_id>_<core_frame_timestamp>
      - <vehicle_name>_<camera_name>_<camera_timestamp>_<seq_id>.json
  - lane_markings (3.2GB)
    - <sequence_id>_<core_frame_timestamp>
      - <vehicle_name>_<camera_name>_<camera_timestamp>_<seq_id>.json
  - static_objects (2.8GB)
    - <sequence_id>_<core_frame_timestamp>
      - <vehicle_name>_<camera_name>_<camera_timestamp>_<seq_id>.json
- calibration (16MB)
  - <vehicle_name>_<date>.json
- dataframes (7.0MB)
  - weather_codes.json
  - metdadata_info.csv: *Metadata information about the dataset*