highD Dataset Format

The highD dataset includes data extracted from 60 recordings. For each recording, in total four files are provided: An image of the recorded highway section, a csv file describing the recording location, another csv file containing an overview of recorded vehicle tracks and a csv file for the tracks' trajectories. These files are created for each recording to ensure easy handling of the data. In the following, the dataset format and especially the meaning of every column is explained in detail.

Image of the Highway Section (XX_highway.jpg)

For each recording an image of the highway section is added. The image was created from the used recording itself by removing all vehicles through a filter. 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 highway section considered and the total number of vehicles recorded.

Name	Description	Unit
id	The id of the recording. Every recording has a unique id.	[-]
frameRate	The frame rate which was used to record the video.	[hz]
locationId	The id of the recording location. In total six different locations exist in the dataset.	[-]
speedLimit	The speed limit of the driving lanes. In all recordings, the speed limit is the same for every driving lane.	[m/s]
month	The month the recording was done.	[-]
weekDay	The week day the recording was done.	[-]
startTime	The start time at which the recording was done.	[hh:mm]
duration	The duration of the recording.	[s]
totalDrivenDistance	The total driven distance of all tracked vehicles.	[m]
totalDrivenTime	The total driven time of all tracked vehicles.	[s]
numVehicles	The number of vehicles tracked including cars and trucks.	[-]
numCars	The number of cars tracked.	[-]
numTrucks	The number of trucks tracked.	[-]
upperLaneMarkings	The y positions of the upper lane markings. The positions are separated by a ";".	[m]
lowerLaneMarkings	The y positions of the lower lane markings. The positions are separated by a ";".	[m]

Example

Track Meta Information (XX_tracksMeta.csv)

This file contains an overview of all tracks. For each track there are summary values like the distance covered or the average speed. The purpose of this file is to allow to filter tracks e.g. by class or driving direction.

Name	Description	Unit
id	The id of the track. The ids are assigned in ascending order.	[-]
width	The width of the post-processed bounding box of the vehicle. This corresponds to the length of the vehicle.	[m]
height	The height of the post-processed bounding box of the vehicle. This corresponds to the width of the vehicle.	[m]
initialFrame	The initial frame in which the vehicle track starts.	[-]
finalFrame	The frame in which the track of the vehicle ends.	[-]
numFrames	The total lifetime of the track as number of frames.	[-]
class	The vehicle class of the tracked vehicle (Car or Truck).	[-]
drivingDirection	The driving direction of the vehicle. Either 1 for the left direction (upper lanes) or 2 for the right direction (lower lanes).	[-]
traveledDistance	The distance covered by the track.	[m]
minXVelocity	The minimal velocity in driving direction.	[m/s]
maxXVelocity	The maximal velocity in driving direction.	[m/s]
meanXVelocity	The mean velocity in driving direction.	[m/s]
minDHW	The minimal Distance Headway (DHW). This value is set to -1, if no preceding vehicle exists.	[m]
minTHW	The minimal Time Headway (THW). This value is set to -1, if no preceding vehicle exists.	[s]
minTTC	The minimal Time-to-Collision (TTC). This value is set to -1, if no preceding vehicle or valid TTC exists.	[s]
numLaneChanges	Number of lane changes detected by changing lane id.	[-]

Example

Tracks (XX_tracks.csv)

This file contains all time dependent values for each track. Information such as current velocities, viewing ranges and information about surrounding vehicles are included.

Name	Description	Unit
frame	The current frame.	[-]
id	The track's id.	[-]
x	The x position of the upper left corner of the vehicle's bounding box.	[m]
y	The y position of the upper left corner of the vehicle's bounding box.	[m]
width	The width of the bounding box of the vehicle.	[m]
height	The height of the bounding box of the vehicle.	[m]
xVelocity	The longitudinal velocity in the image coordinate system.	[m/s]
yVelocity	The lateral velocity in the image coordinate system.	[m/s]
xAcceleration	The longitudinal acceleration in the image coordinate system.	[m/s^2]
yAcceleration	The lateral acceleration in the image coordinate system	[m/s^2]
frontSightDistance	The distance to the end of the recorded highway section in driving direction from the vehicle's center.	[m]
backSightDistance	The distance to the end of the recorded highway section in the opposite driving direction from the vehicle's center.	[m]
dhw	The Distance Headway. This value is set to 0, if no preceding vehicle exists.	[m]
thw	The Time Headway. This value is set to 0, if no preceding vehicle exists.	[s]
ttc	The Time-to-Collision. This value is set to 0, if no preceding vehicle or valid TTC exists.	[s]
precedingXVelocity	The longitudinal velocity of the preceding in the image coordinate system. This value is set to 0, if no preceding vehicle exists.	[-]
precedingId	The id of the preceding vehicle in the same lane. This value is set to 0, if no preceding vehicle exists.	[-]
followingId	The id of the following vehicle in the same lane. This value is set to 0, if no following vehicle exists.	[-]
leftPrecedingId	The id of the preceding vehicle on the adjacent lane on the left in the direction of travel. This value is set to 0, if no such a vehicle exists.	[-]
leftAlongsideId	The id of the adjacent vehicle on the adjacent lane on the left in the direction of travel. In order for a vehicle to be adjacent and not e.g. preceding, the vehicles must overlap in the longitudinal direction. This value is set to 0, if no such a vehicle exists.	[-]
leftFollowingId	The id of the following vehicle on the adjacent lane on the left in the direction of travel. This value is set to 0, if no such a vehicle exists.	[-]
rightPrecedingId	The id of the preceding vehicle on the adjacent lane on the right in the direction of travel. This value is set to 0, if no such a vehicle exists.	[-]
rightAlsongsideId	The id of the adjacent vehicle on the adjacent lane on the right in the direction of travel. In order for a vehicle to be adjacent and not e.g. preceding, the vehicles must overlap in the longitudinal direction. This value is set to 0, if no such a vehicle exists.	[-]

rightFollowingId	The id of the following vehicle on the adjacent lane on the right in the direction of travel. This value is set to 0, if no such a vehicle exists.	[-]
laneId	The IDs start at 1 and are assigned in ascending order. Since the Lane ids are derived from the positions of the lane markings, the first and last ids typically do not describe any useable lanes. For details, see the definition of the coordinate system.	[-]

Coordinate System

The global coordinate system used corresponds to the image coordinate system of the video recording. This means that the origin of the coordinate system is in the upper left corner, as shown in the image. The horizontal axis is the x-axis. This corresponds to the direction of travel of the vehicles and grows to the right. The vertical axis is the y-axis. However, this axis grows downwards. In addition no units in pixels are used, since all sizes were converted into SI units. The video recordings were stabilized so that the lane markings run horizontally in the image. Therefore, their positions can be indicated by a y-coordinate. The individual lanes were numbered starting with 1. The areas above the uppermost lane mark, between the driving directions and below the lowermost lane mark are also taken into account for counting. All data is given in the global coordinate system unless otherwise specified. This means that a vehicle on the upper lanes in the image is moving to the left and therefore has a negative speed in X direction.