

CommonRoad: List of Scenarios

(Version 2017a)

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Abstract

This document lists all traffic scenarios of *CommonRoad*. Our benchmark examples range from simple static scenarios with a few obstacles and a large driving corridor (i.e. region where collisions cannot take place) to complex scenarios with many dynamic obstacles and a small driving corridor. Each scenario is defined by a unique ID. We additionally briefly describe and visualize the traffic scenes which feature urban intersections, rural roads, and highways. The XML files of all scenarios are provided in the *CommonRoad* online repository.

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1 Introduction

This document is part of the *CommonRoad* benchmark repository for motion planning of road vehicles [1], alongside other documents for vehicle models, cost functions, and XML files. In this list, all traffic scenarios, which are currently available to compose a benchmark, are described with their unique ID, e.g. S=OV001. Please note that we continuously add more scenarios.

In Section 2, we present the scenarios obtained from real traffic data, e.g. through video recordings of public roads. Their ID contains a string to link them to their data set and an integer to count up, e.g. S=NGISM_US101_0.

In Section 3, hand-crafted scenarios are listed. We construct their ID as follows: S=x_y_i_z, where

x is the capitalized three letter country code, e.g. GER

y the three letter city code for rural scenarios, e.g. Muc, or the road code, e.g. A9

i an integer starting with 1 to distinguish between different scenarios which have equal x and y

z optional element: an alphabetic character if there exists multiple scenarios for the same road section, i.e. different states of the obstacle and/or ego vehicle on the same road network.

The data for each scenario is stored in separate XML files named by the scenario ID and can be downloaded from commonroad.in.tum.de. For details on the data in the XML files, please see our *XML documentation*, which is also available online.

In this list, we additional annotate information like the GPS coordinates (latitude and longitude), type of the road and features for each scenario. In the figures, the ego vehicle is always colored in red for easy identification and other obstacles (static and dynamic) are presented in the color blue.

2 Real Traffic Scenarios

2.1 NGSIM US Highway 101 Dataset (ID: NGISM_US101_i)

The dataset *US Highway 101* is provided by the Next Generation Simulation (NGSIM) program¹. The traffic data has been collected on a 0.6 km segment of US highway 101 (Hollywood

¹fhwa.dot.gov/

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Freeway) located in Los Angeles, California, on June 15th, 2005, see Fig. 1. The dataset contains detailed trajectory data for each vehicle for the entire time period from 07:50 am to 8:35 am. The vehicles were tracked using eight video cameras on different buildings.

Table 1: Data set: NGSIM_US101.

Characteristic	Value
GPS coordinates	34.1376853° N, 118.3629334° W
type of road	highway
features	5 lanes with slip road
total length	640 meter



Figure 1: Satellite image and plot of US101 section.

The following subsections present traffic scenes which we extracted from the NGSIM US101 dataset. Since only the environment of the ego vehicle within its sensor range is relevant for motion planning, we have adapted the length of the lanelets and only included surrounding traffic participants to keep the scenario specification as short as possible, but as detailed as necessary. For each scenario, we have identified one traffic participant to become the ego vehicle, i.e. the initial configuration and goal region of the ego vehicle is the state of this traffic participant at the corresponding time step. Thus, we can guarantee that one feasible solution of the motion planning problem exists, which is the trajectory of this traffic participant. To characterize each scenario, we list the number of lane changes the ego vehicle has to perform to reach the goal region, the time interval of the extracted data, and the number of obstacles (static and dynamic).

2.1.1 NGSIM_US101_0

Table 2: Scenario: S=NGSIM_US101_0.

Characteristic	Value
features	1 lane change
time interval	33.6 s - 39.6 s
number of obstacles	2

2. REAL TRAFFIC SCENARIOS

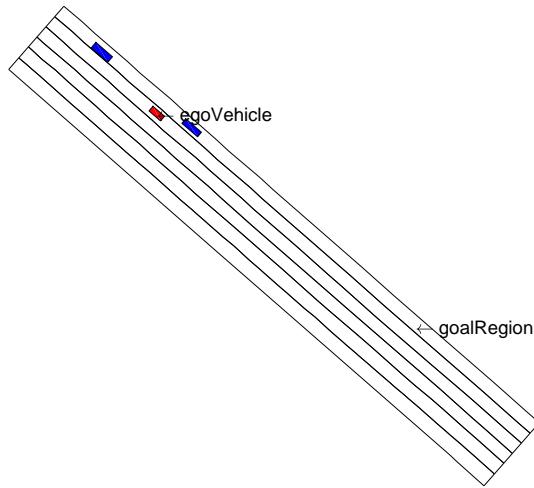


Figure 2: Scenario: S=NGSIM_US101_0.

2.1.2 NGSIM_US101_1

Table 3: Scenario: S=NGSIM_US101_1.

Characteristic	Value
features	2 lane changes
time interval	157.6 s - 168.0 s
number of obstacles	55

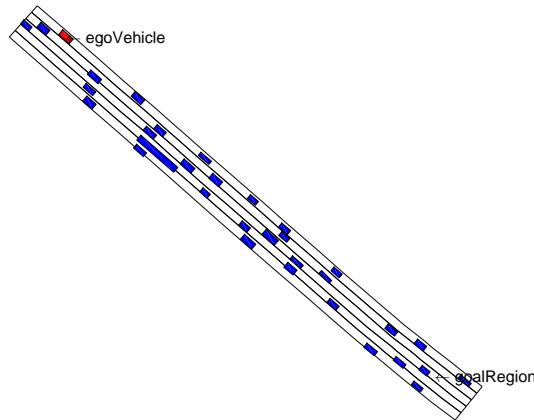


Figure 3: Scenario: S=NGSIM_US101_1.

2.1.3 NGSIM_US101_2

Table 4: Scenario: S=NGSIM_US101_2.

Characteristic	Value
features	1 lane change
time interval	113.6 s - 121.6 s
number of obstacles	39

2. REAL TRAFFIC SCENARIOS

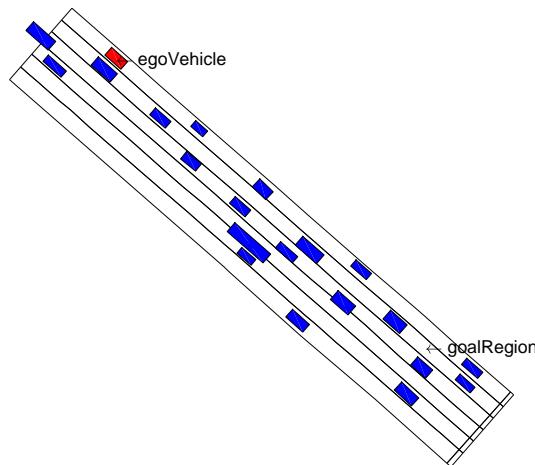


Figure 4: Scenario: S=NGSIM_US101_2.

2.1.4 NGSIM_US101_3

Table 5: Scenario: S=NGSIM_US101_3.

Characteristic	Value
features	complete stop
time interval	100.0 s - 110.0 s
number of obstacles	31

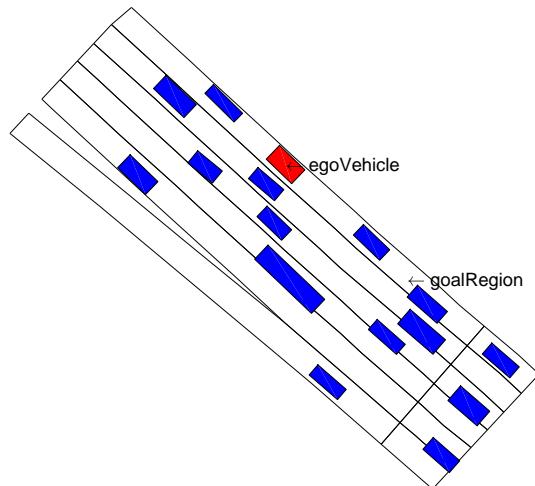


Figure 5: Scenario: S=NGSIM_US101_3.

2.1.5 NGSIM_US101_4

Table 6: Scenario: S=NGSIM_US101_4.

Characteristic	Value
features	complete stop
time interval	110.0 s - 120.0 s
number of obstacles	30

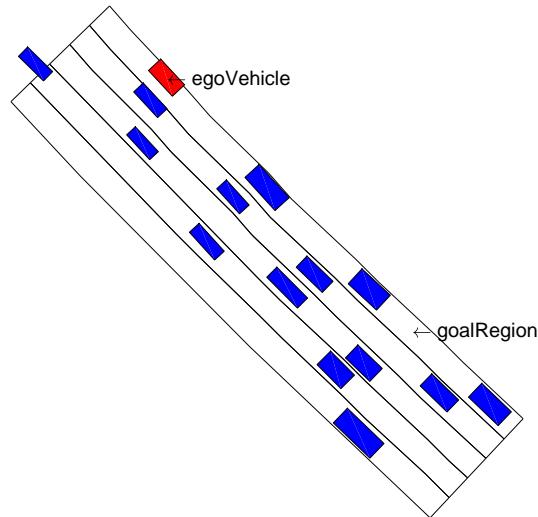


Figure 6: Scenario: S=NGSIM_US101_4.

2.1.6 NGSIM_US101_5

Table 7: Scenario: S=NGSIM_US101_5.

Characteristic	Value
features	1 lane change
time interval	131.63 s - 139.3 s
number of obstacles	43

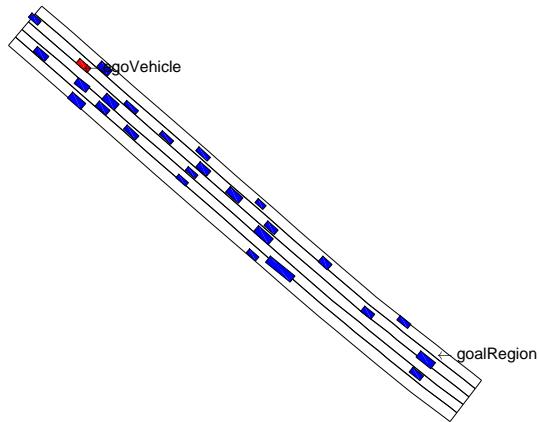


Figure 7: Scenario: S=NGSIM_US101_5.

2.1.7 NGSIM_US101_6

Table 8: Scenario: S=NGSIM_US101_06

Characteristic	Value
features	1 lane change
time interval	132.0 s - 140.0 s
number of obstacles	42

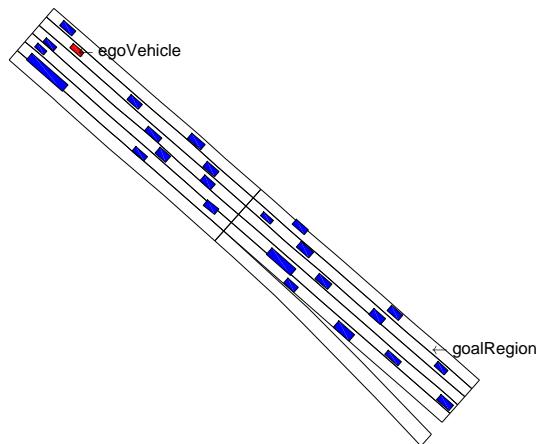


Figure 8: Scenario: S=NGSIM_US101_6.

2.1.8 NGSIM_US101_7

Table 9: Scenario: S=NGSIM_US101_7.

Characteristic	Value
features	1 lane change
time interval	11.3 s - 18.8 s
number of obstacles	48

2. REAL TRAFFIC SCENARIOS

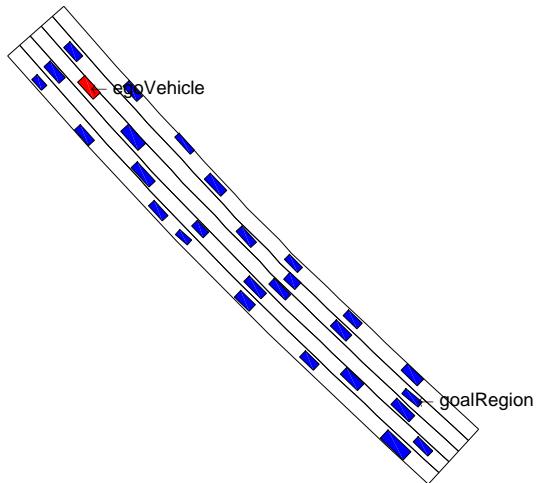


Figure 9: Scenario: S=NGSIM_US101_7.

2.1.9 NGSIM_US101_8

Table 10: Scenario: S=NGSIM_US101_8.

Characteristic	Value
features	1 lane change
time interval	121.2 s - 129.2 s
number of obstacles	42

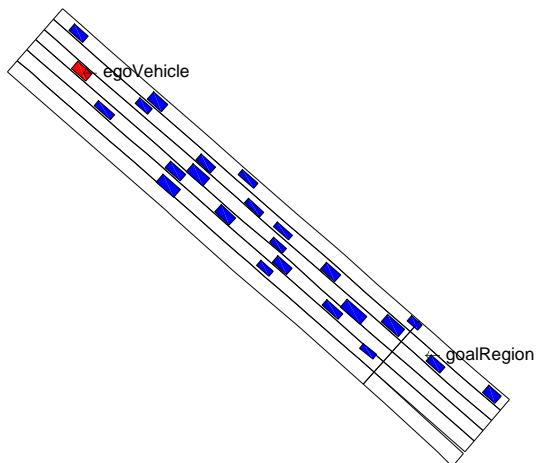


Figure 10: Scenario: S=NGSIM_US101_8.

2.1.10 NGSIM_US101_9

Table 11: Scenario: S=NGSIM_US101_9.

Characteristic	Value
features	1 lane change
time interval	135.8 s - 143.8 s
number of obstacles	45

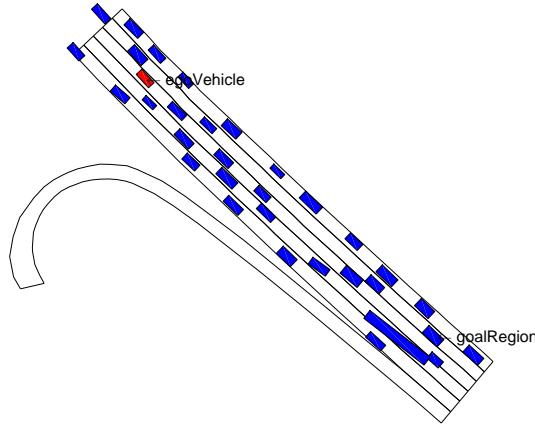


Figure 11: Scenario: S=NGSIM_US101_9.

2.1.11 NGSIM_US101_10

Table 12: Scenario: S=NGSIM_US101_10.

Characteristic	Value
features	1 lane change
time interval	64.3 s - 71.5 s
number of obstacles	42

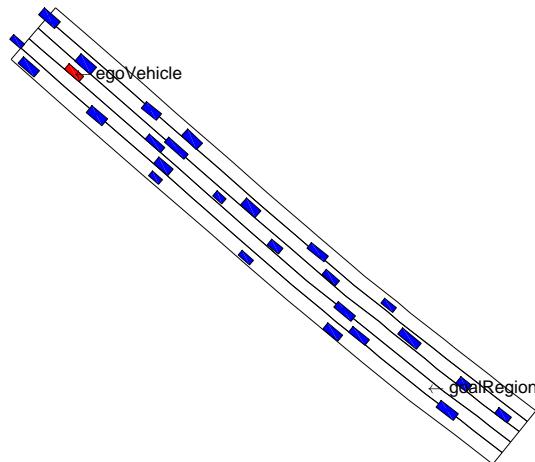


Figure 12: Scenario: S=NGSIM_US101_10.

2.1.12 NGSIM_US101_11

Table 13: Scenario: S=NGSIM_US101_11.

Characteristic	Value
features	1 lane change
time interval	80.2 s - 88.2 s
number of obstacles	51

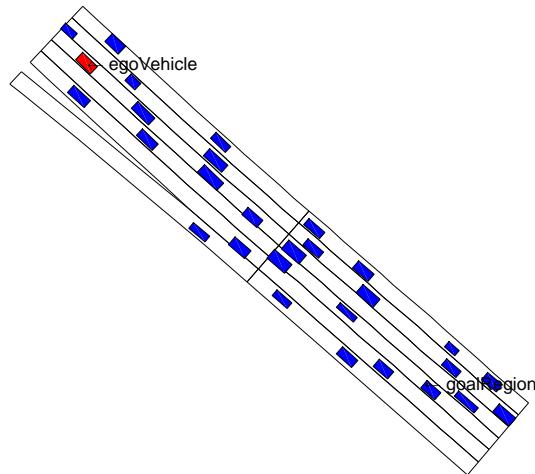


Figure 13: Scenario: S=NGSIM_US101_11.

2.1.13 NGSIM_US101_12

Table 14: Scenario: S=NGSIM_US101_12.

Characteristic	Value
features	2 lane changes
time interval	40.5 s - 53.0 s
number of obstacles	68

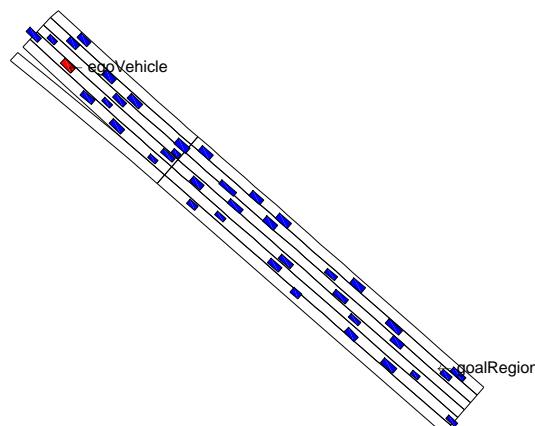


Figure 14: Scenario: S=NGSIM_US101_12.

2.1.14 NGSIM_US101_13

Table 15: Scenario: S=NGSIM_US101_13.

Characteristic	Value
features	1 lane change
time interval	33.4 s - 40.0 s
number of obstacles	46

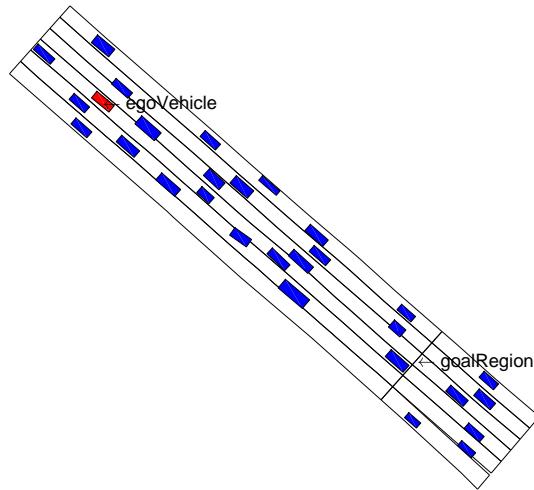


Figure 15: Scenario: S=NGSIM_US101_13.

2.1.15 NGSIM_US101_14

Table 16: Scenario: S=NGSIM_US101_14.

Characteristic	Value
features	1 lane change
time interval	115.3 s - 123.3 s
number of obstacles	51

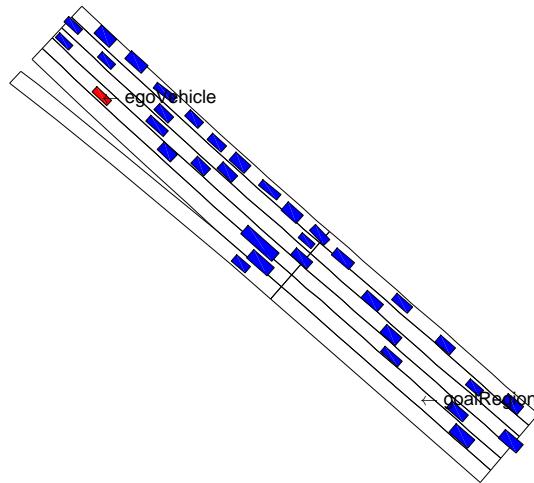


Figure 16: Scenario: S=NGSIM_US101_14.

2.1.16 NGSIM_US101_15

Table 17: Scenario: S=NGSIM_US101_15.

Characteristic	Value
features	1 lane change
time interval	90.3 s - 98.3 s
number of obstacles	41

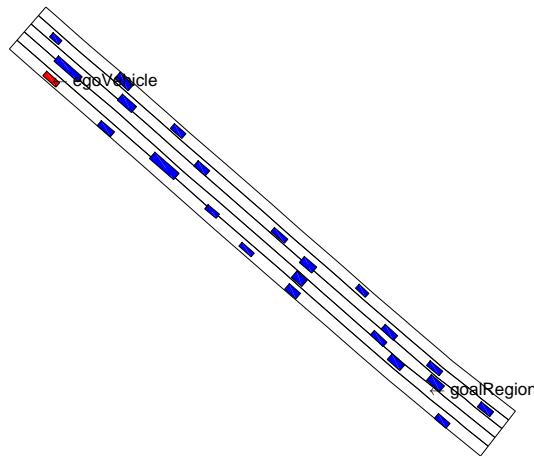


Figure 17: Scenario: S=NGSIM_US101_15.

2.1.17 NGSIM_US101_16

Table 18: Scenario: S=NGSIM_US101_16.

Characteristic	Value
features	1 lane change
time interval	73.5 s - 81.5 s
number of obstacles	56

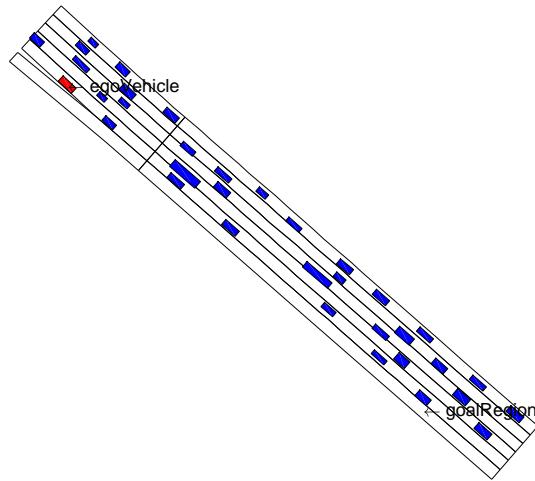


Figure 18: Scenario: S=NGSIM_US101_16.

2.1.18 NGSIM_US101_17

Table 19: Scenario: S=NGSIM_US101_17.

Characteristic	Value
features	1 lane change
time interval	96.7 s - 104.7 s
number of obstacles	62

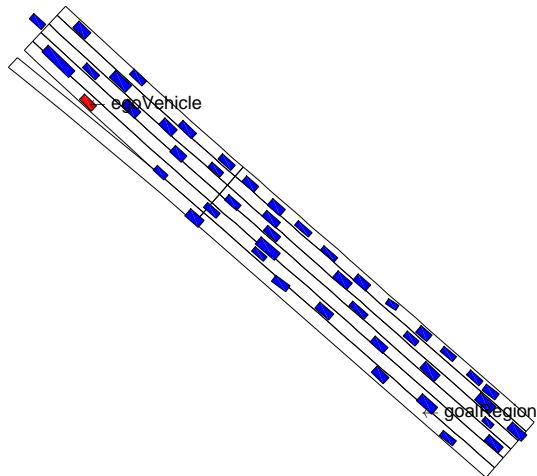


Figure 19: Scenario: S=NGSIM_US101_17.

2.1.19 NGSIM_US101_18

Table 20: Scenario: S=NGSIM_US101_18.

Characteristic	Value
features	1 lane change
time interval	124.5 s - 132.5 s
number of obstacles	46

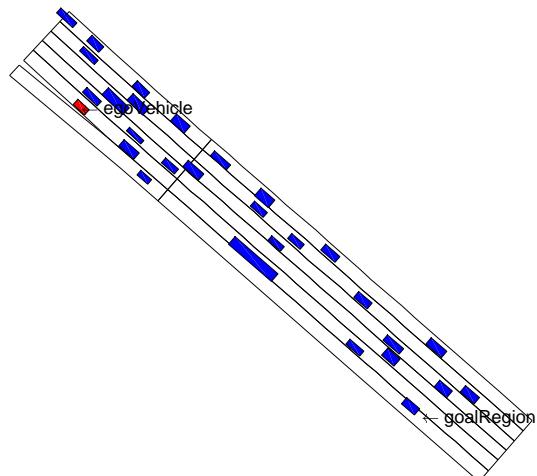


Figure 20: Scenario: S=NGSIM_US101_18.

2.1.20 NGSIM_US101_19

Table 21: Scenario: S=NGSIM_US101_19.

Characteristic	Value
features	1 lane change
time interval	125.7 s - 133.7 s
number of obstacles	49

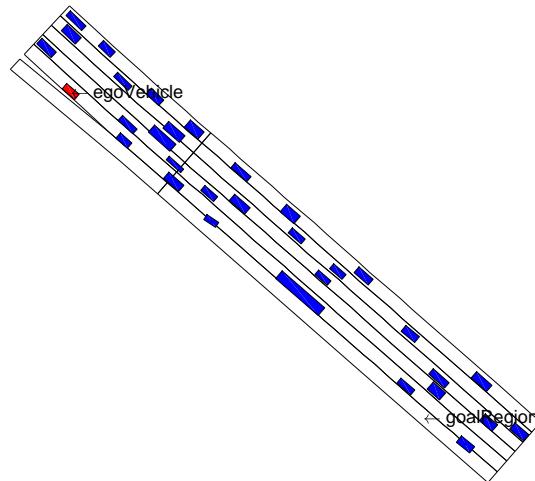


Figure 21: Scenario: S=NGSIM_US101_19.

2.1.21 NGSIM_US101_20

Table 22: Scenario: S=NGSIM_US101_20.

Characteristic	Value
features	1 lane change
time interval	170.3 s - 178.3 s
number of obstacles	52

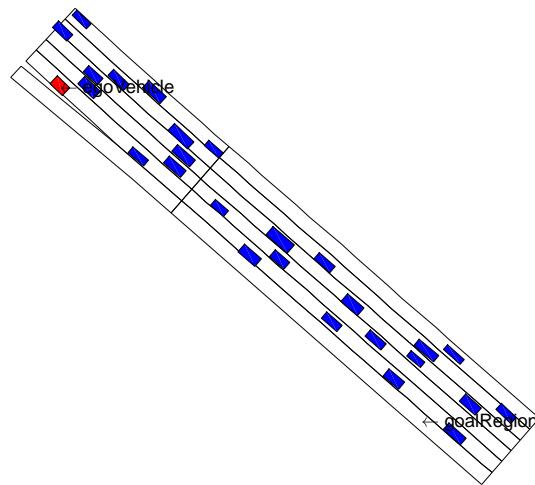


Figure 22: Scenario: S=NGSIM_US101_20.

2.1.22 NGSIM_US101_21

Table 23: Scenario: S=NGSIM_US101_21.

Characteristic	Value
features	4 lane changes
time interval	176.4 s - 193.0 s
number of obstacles	66

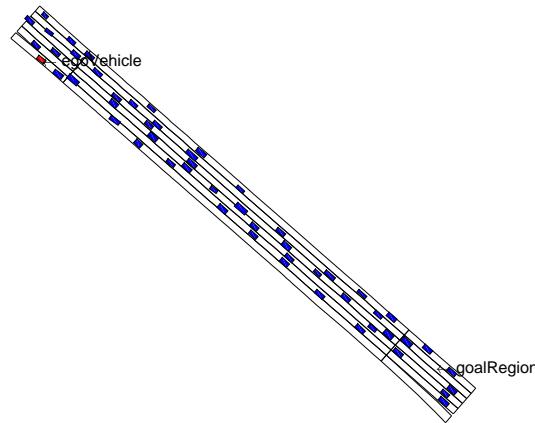


Figure 23: Scenario: S=NGSIM_US101_21.

2.1.23 NGSIM_US101_22

Table 24: Scenario: S=NGSIM_US101_22.

Characteristic	Value
features	3 lane changes
time interval	39.0 s - 53.0 s
number of obstacles	90

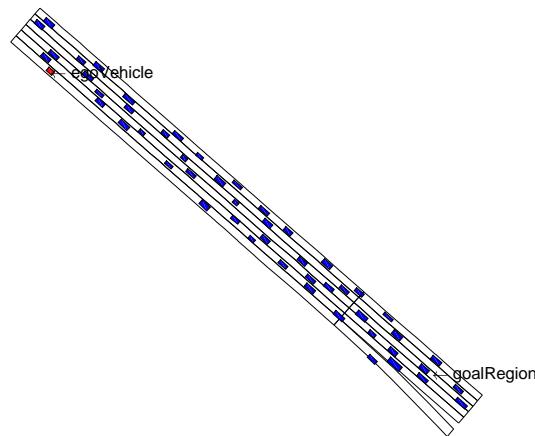


Figure 24: Scenario: S=NGSIM_US101_22.

2.1.24 NGSIM_US101_23

Table 25: Scenario: S=NGSIM_US101_23.

Characteristic	Value
features	2 lane changes
time interval	30.3 s - 43.2 s
number of obstacles	84

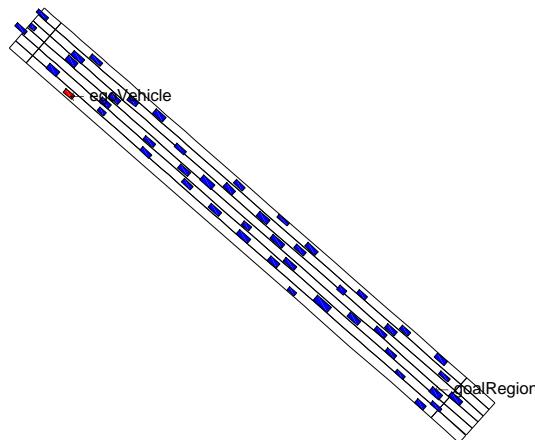


Figure 25: Scenario: S=NGSIM_US101_23.

2.1.25 NGSIM_US101_24

Table 26: Scenario: S=NGSIM_US101_24.

Characteristic	Value
features	2 lane changes
time interval	123.8 s - 130.5 s
number of obstacles	45

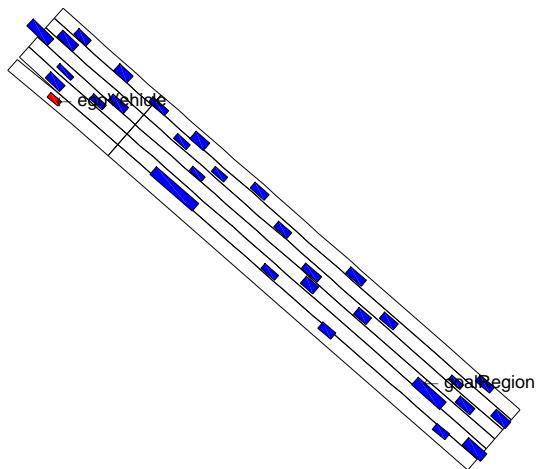


Figure 26: Scenario: S=NGSIM_US101_24.

2.1.26 NGSIM_US101_25

Table 27: Scenario: S=NGSIM_US101_25.

Characteristic	Value
features	1 lane change
time interval	20.1 s - 28.1 s
number of obstacles	45

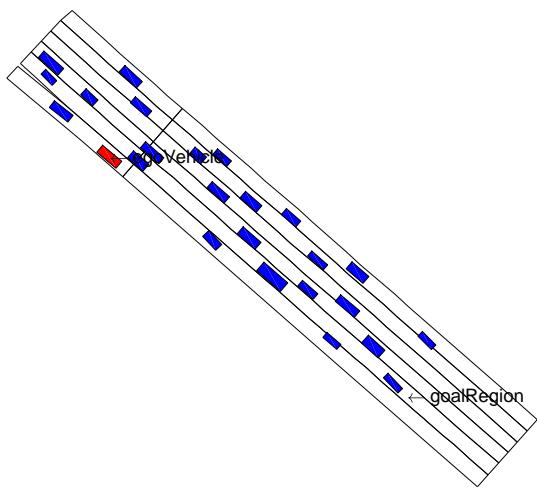


Figure 27: Scenario: S=NGSIM_US101_25.

2.1.27 NGSIM_US101_26

Table 28: Scenario: S=NGSIM_US101_26.

Characteristic	Value
features	1 lane change
time interval	95.7 s - 103.7 s
number of obstacles	62

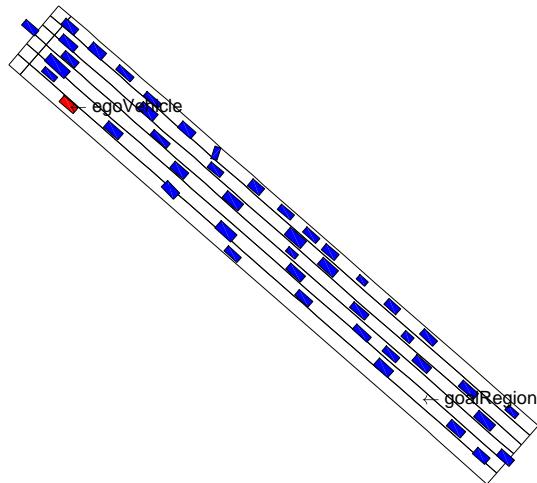


Figure 28: Scenario: S=NGSIM_US101_26.

2.1.28 NGSIM_US101_27

Table 29: Scenario: S=NGSIM_US101_27.

Characteristic	Value
features	1 lane change
time interval	121.9 s - 129.9 s
number of obstacles	44

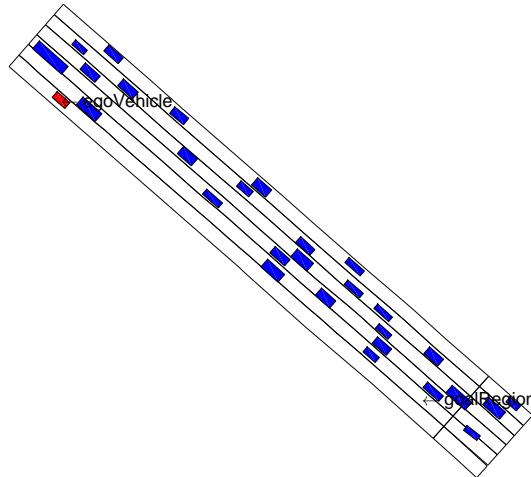


Figure 29: Scenario: S=NGSIM_US101_27.

2.1.29 NGSIM_US101_28

Table 30: Scenario: S=NGSIM_US101_28.

Characteristic	Value
features	1 lane change
time interval	163.6 s - 168.4 s
number of obstacles	30

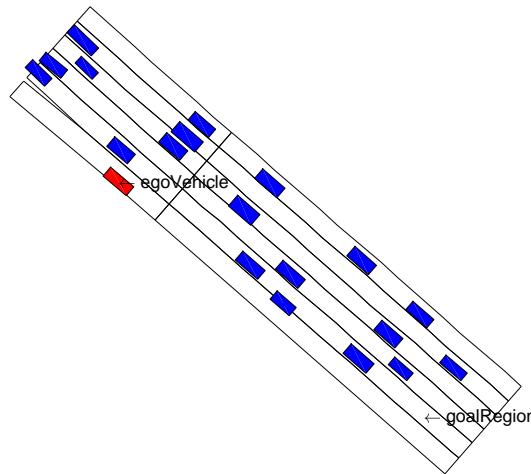


Figure 30: Scenario: S=NGSIM_US101_28.

3 Hand-crafted Scenarios

We have created hand-crafted scenarios to provide a large variety of traffic scenes and to offer dangerous situations. These scenarios were created with the free editor *JavaOpenStreetMap*² (JOSM) based on the open-source map *OpenStreetMap*³. The states of the traffic participants

²josm.openstreetmap.de

³openstreetmap.org

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were defined based on static aerial images or on typical road scenes.

3.1 GER_Muc_1a

Scenario S=GER_Muc_1a (Tab. 31, Fig. 31) represent a complex intersection in the Munich inner city near Karlsplatz (Stachus). The traffic participants coming from the very left have to wait for the traffic lights, while the traffic participants coming from the top right corner currently cross the junction. The setting of this scenario is based on the satellite image in JOSM.

Table 31: Scenario: S=GER_Muc.1a.

Characteristic	Value
GPS coordinates	48.1394991°N, 11.5654588° E
type of road	urban
features	tram rails
number of obstacles	12

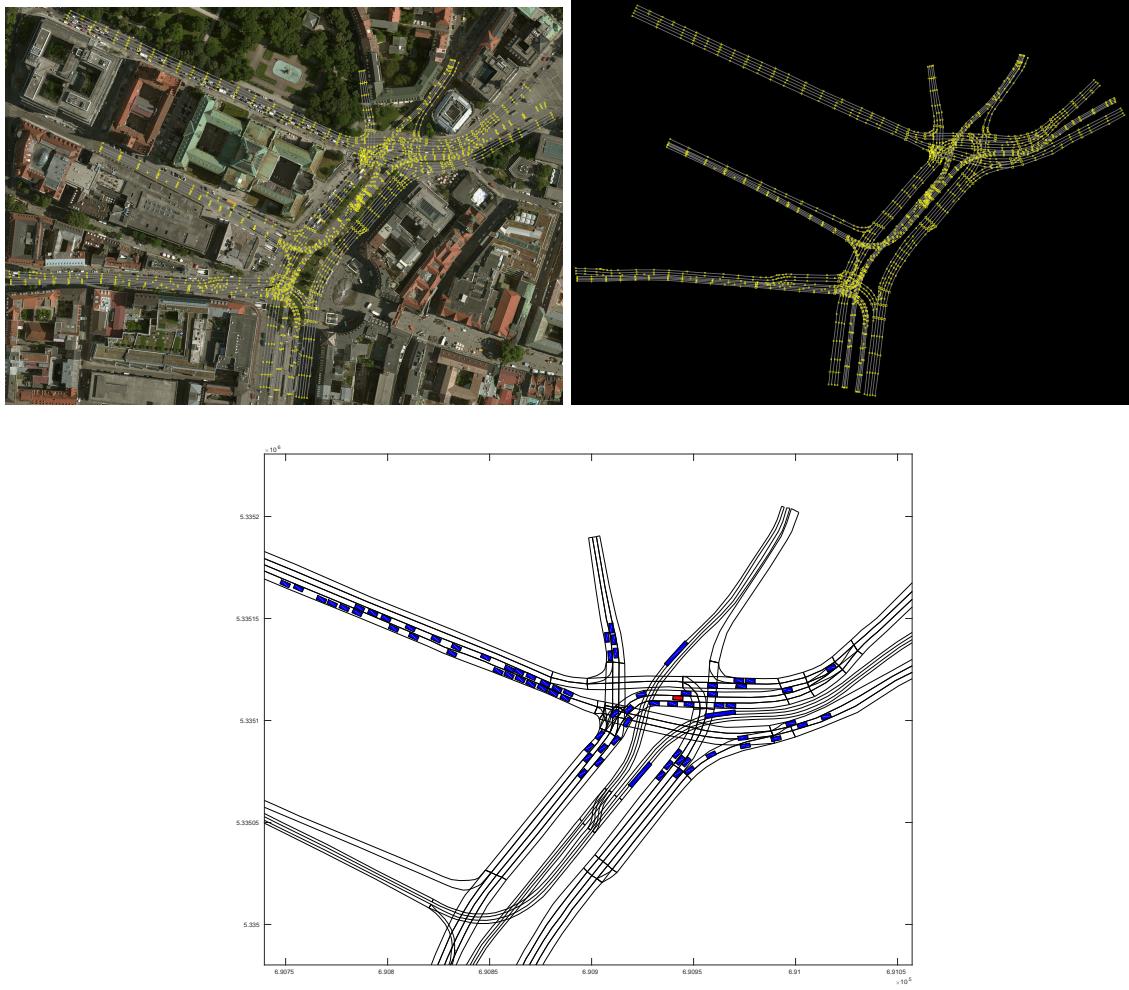


Figure 31: Scenario: S=GER_Muc_1a.

3.2 GER_Muc_2

Scenario S=GER_Muc_2 (Tab. 32, Fig. 32), features a road with two lanes per driving direction. (The lanes opposite of the ego vehicle are omitted since they are separated by a median strip.) The ego vehicle is surrounded by other traffic participants and has to perform a lane change to avoid the static obstacle ahead (the black area illustrates the goal region).

Table 32: Scenario: S=GER_Muc_2.

Characteristic	Value
GPS coordinates	48.2003383°N, 11.6078061°E
type of road	urban
features	none
number of obstacles	5

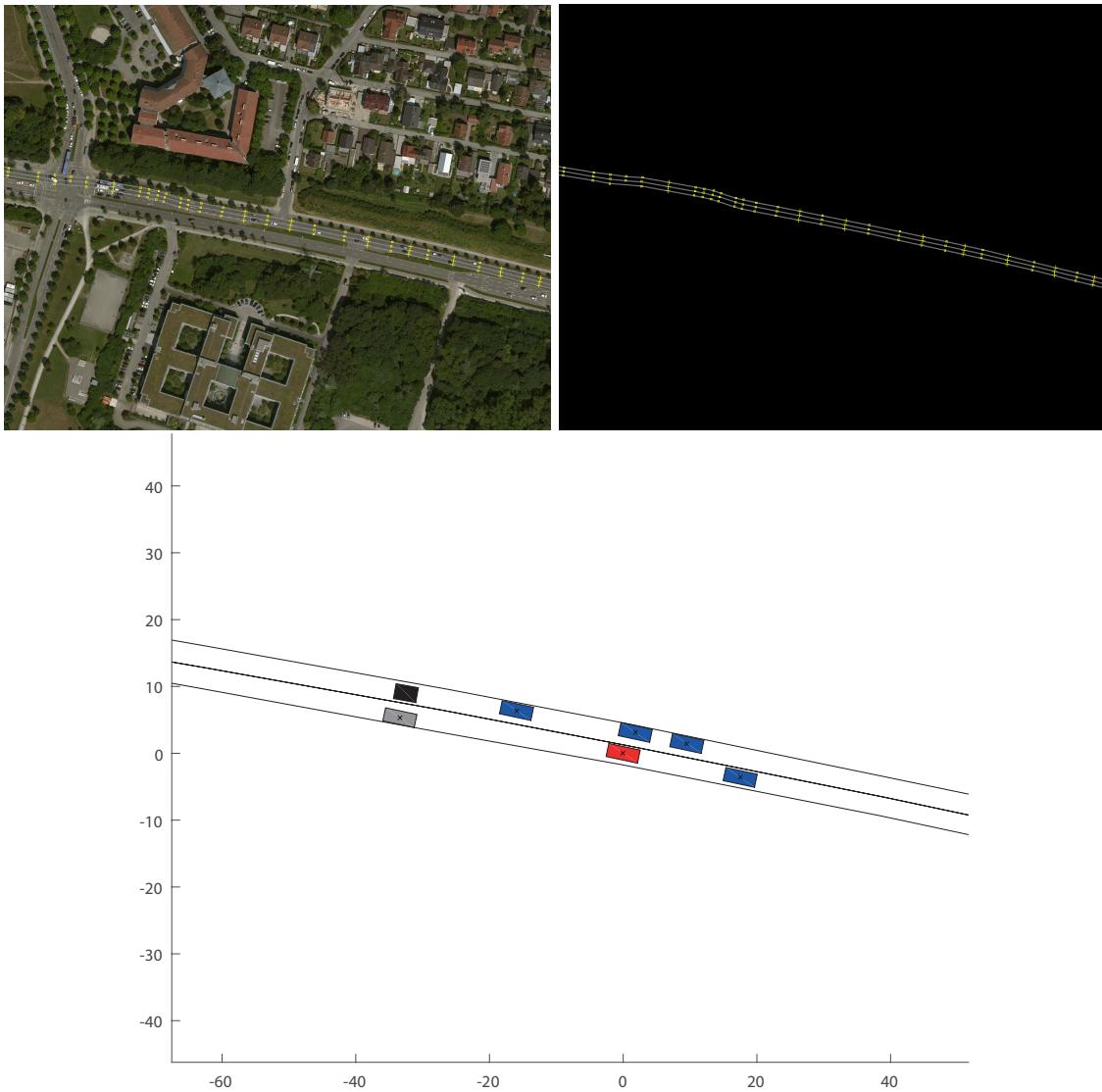


Figure 32: Scenario: S=GER_Muc_2.

3.3 GER_Muc_3a

Scenario S=GER_Muc_3a (Tab. 33, Fig. 33) presents an intersection in Munich's inner city: The north-south street Leopoldstraße (5 lanes) is crossed by Hohenzollernstraße (2 lanes) and Nikolaistraße (2 lanes). The intersection is modeled as an uncontrolled intersection.

Table 33: Scenario: S=GER_Muc_3a.

Characteristic	Value
GPS coordinates	48.1595678°N, 11.5855009°E
type of road	urban
features	intersection
number of obstacles	3

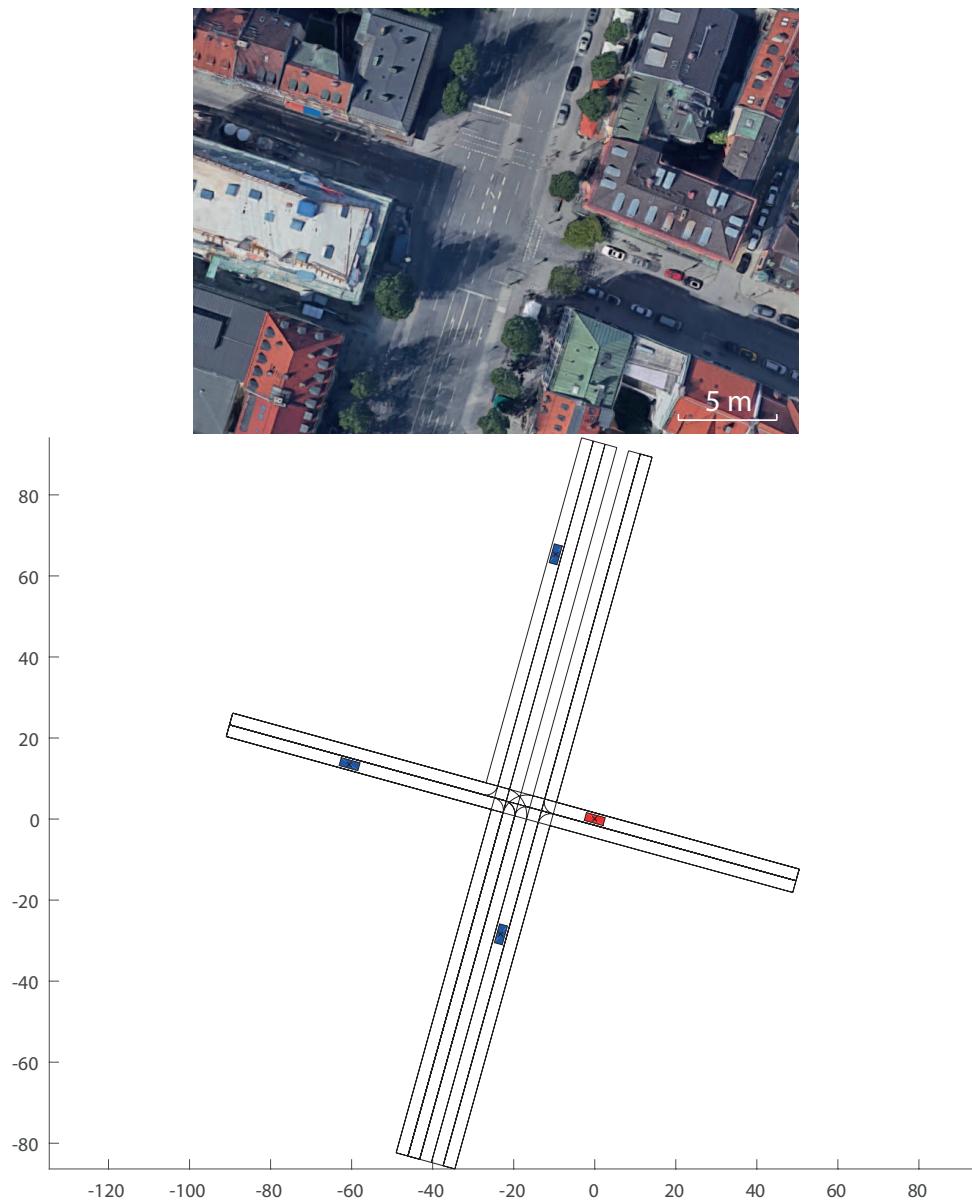


Figure 33: Scenario: S=GER_Muc_3a.

3.4 GER_A9_1a

A four-lane highway (one driving direction) North of Munich is presented in scenario S=GER_A9_1a (Tab. 34, Fig. 34). There is a slip road which merges in the right-most lane.

Table 34: Scenario: S=GER_A9_1a.

Characteristic	Value
GPS coordinates	48.2429326° N, 11.6404244° E
type of road	highway
features	slip road
number of obstacles	4

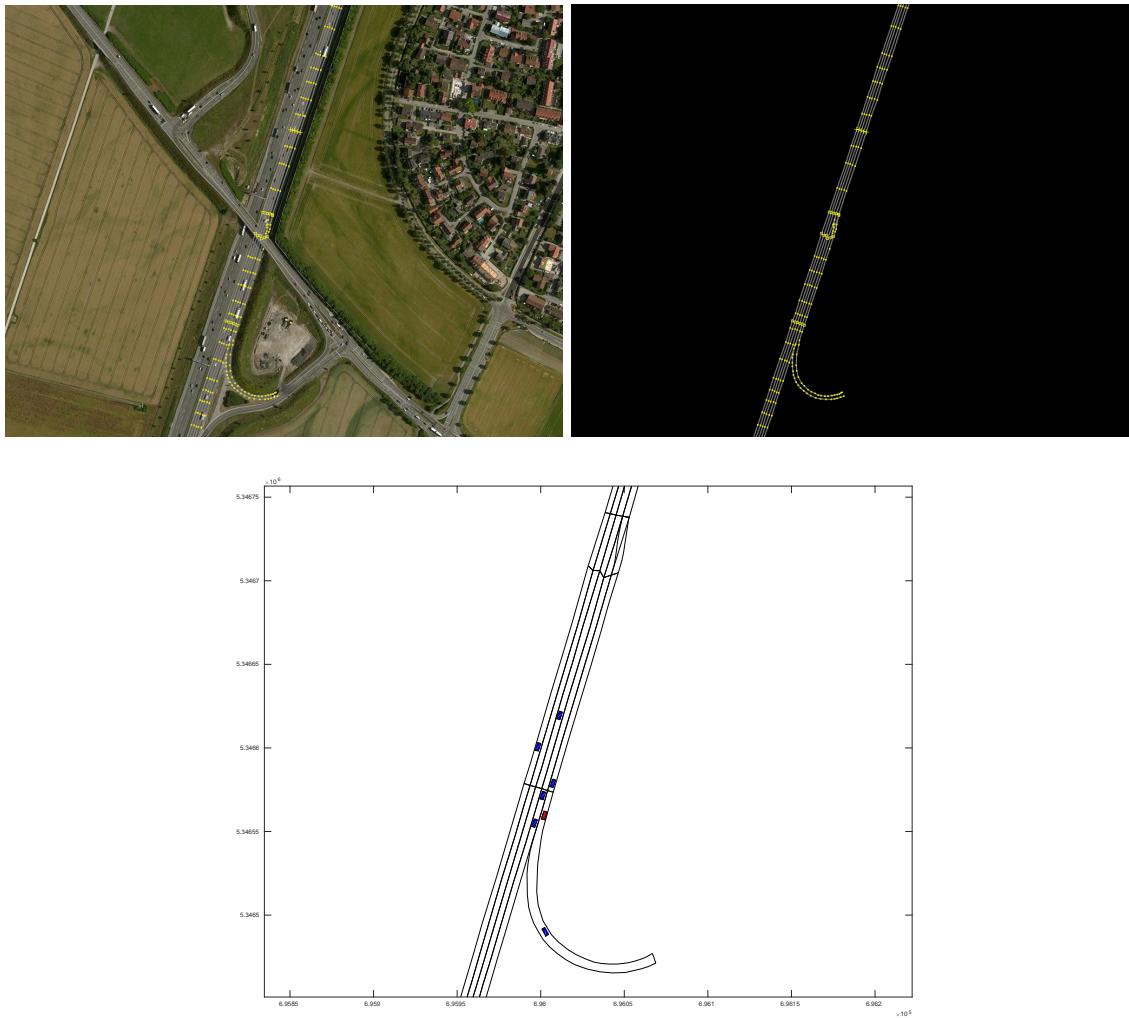


Figure 34: Scenario: S=GER_A9_1a

3.5 GER_A9_2a

Scenario S=GER_A9_2a features a section of the A9 north of Munich, which is a three lane highway, where the ego vehicle is located in the middle lane and has to change to the right lane

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(Tab. 35, Fig. 35).

Table 35: Scenario: S=GER_A9_2a.

Characteristic	Value
GPS coordinates	48.1899272° N, 11.6137145° E
type of road	highway
features	none
number of obstacles	2

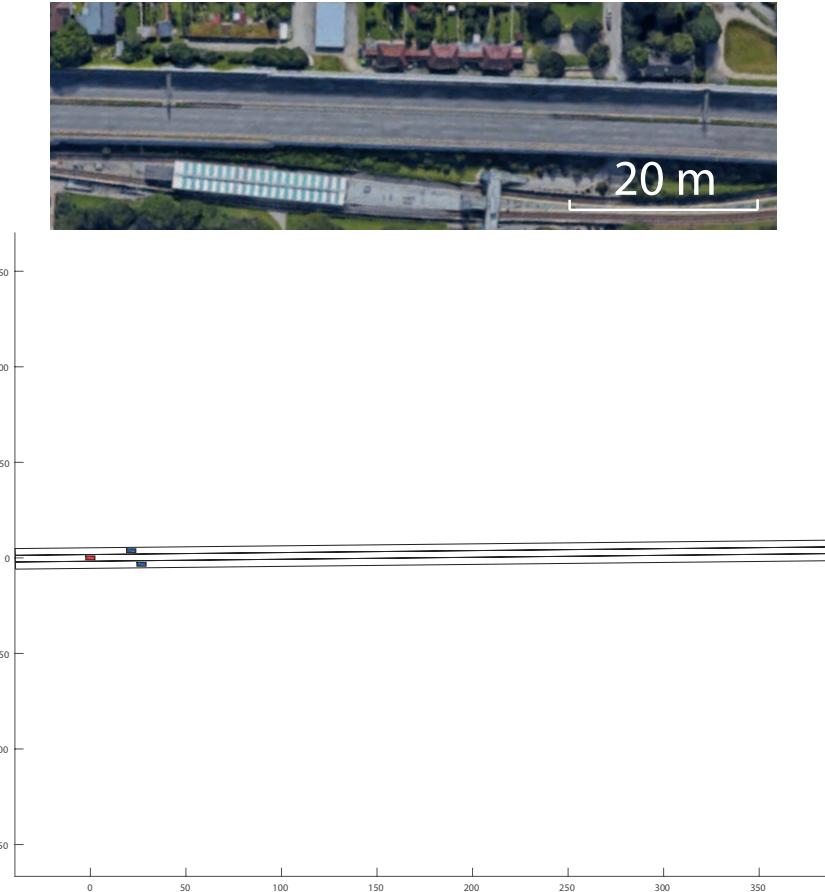


Figure 35: Scenario: S=GER_A9_2a

3.6 GER_A99_1

In scenario S=GER_A99_1 (Tab. 36, Fig. 36), the driving direction is equal for all three lanes. The ego vehicle is surrounded by other traffic participants.

Table 36: Scenario: S=GER_A99_1.

Characteristic	Value
GPS coordinates	48.2268093° N, 11.5539866° E
type of road	highway
features	-
number of obstacles	5

3. HAND-CRAFTED SCENARIOS

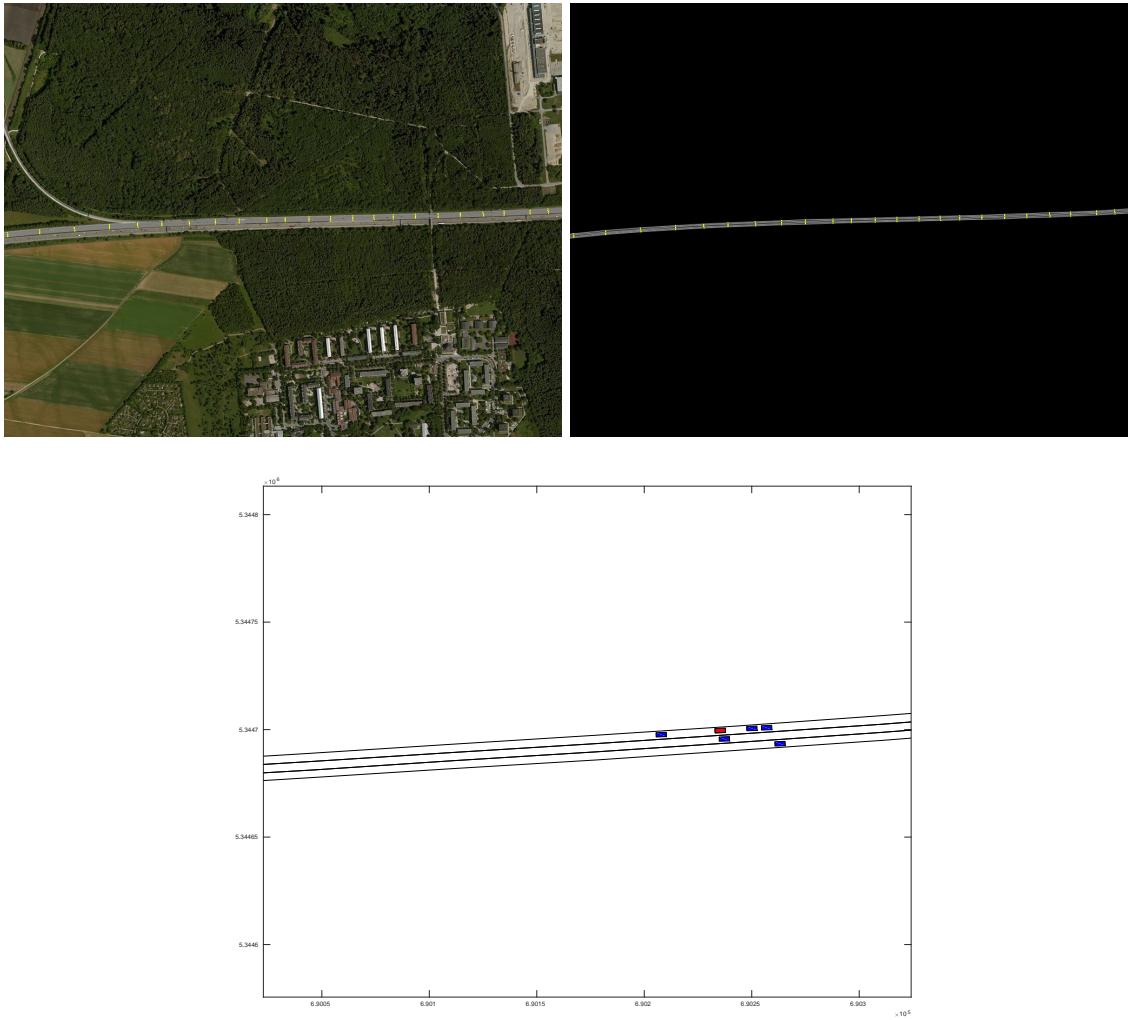


Figure 36: Scenario: S=GER_A99_1.

3.7 GER_Gar_1a

The driving direction goes to the right for both lanes in scenario S=GER_Gar_1a (Tab. 37, Fig. 37). These lanes eventually merge into only one lane.

Table 37: Scenario: S=GER_Gar_1a.

Characteristic	Value
GPS coordinates	48.2636344° N, 11.6525963° E
type of road	rural road
features	merging lanes
number of obstacles	4

3. HAND-CRAFTED SCENARIOS

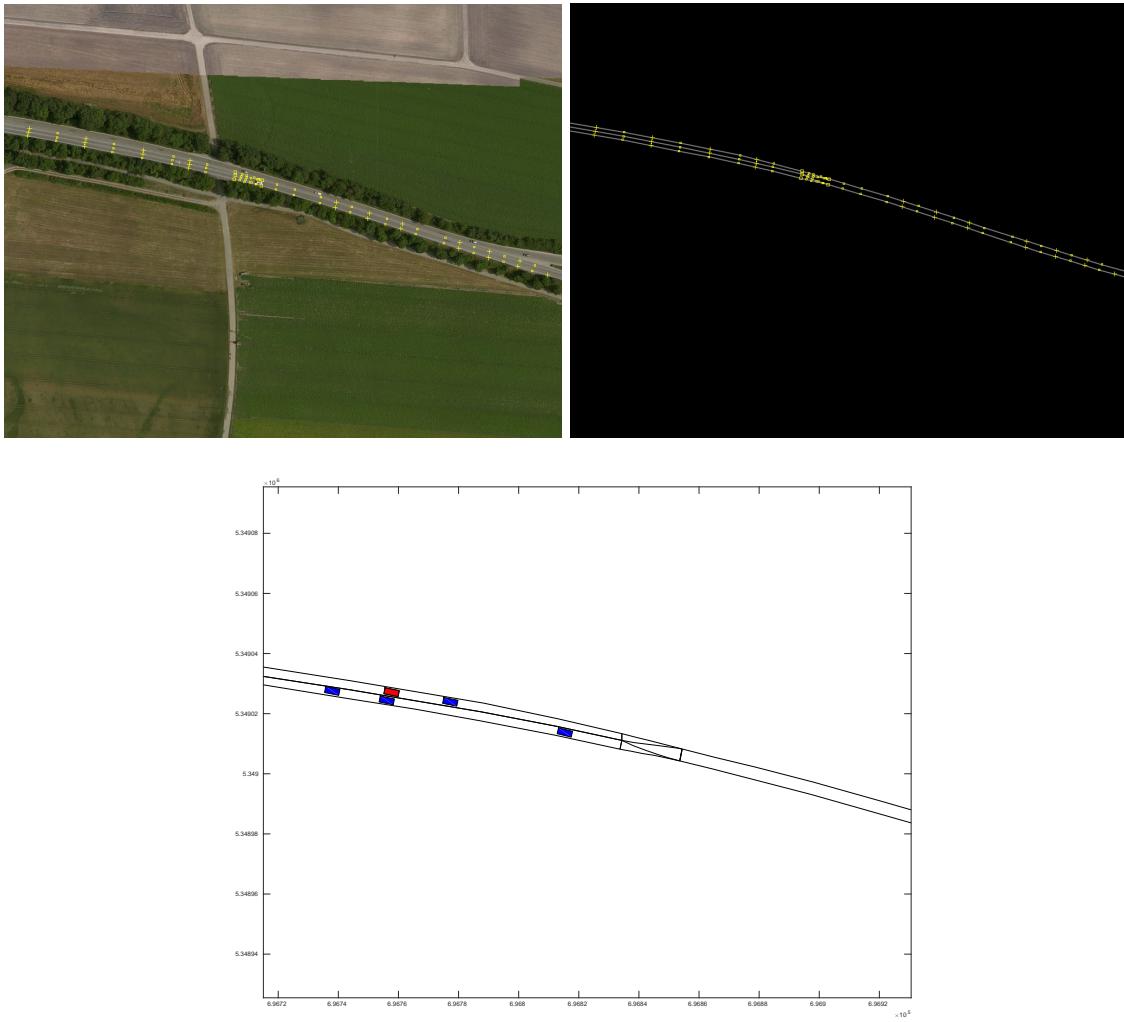


Figure 37: Scenario: S=GER_Gar_1a.

3.8 GER_Ffb_1

Scenario S=GER_Ffb_1 (Tab. 38, Fig. 38) presents a urban intersection in Fürstenfeldbruck.

Table 38: Scenario: S=GER_Ffb_1.

Characteristic	Value
GPS coordinates	48.1779103° N, 11.2475029° E
type of road	urban
features	intersection
number of obstacles	5

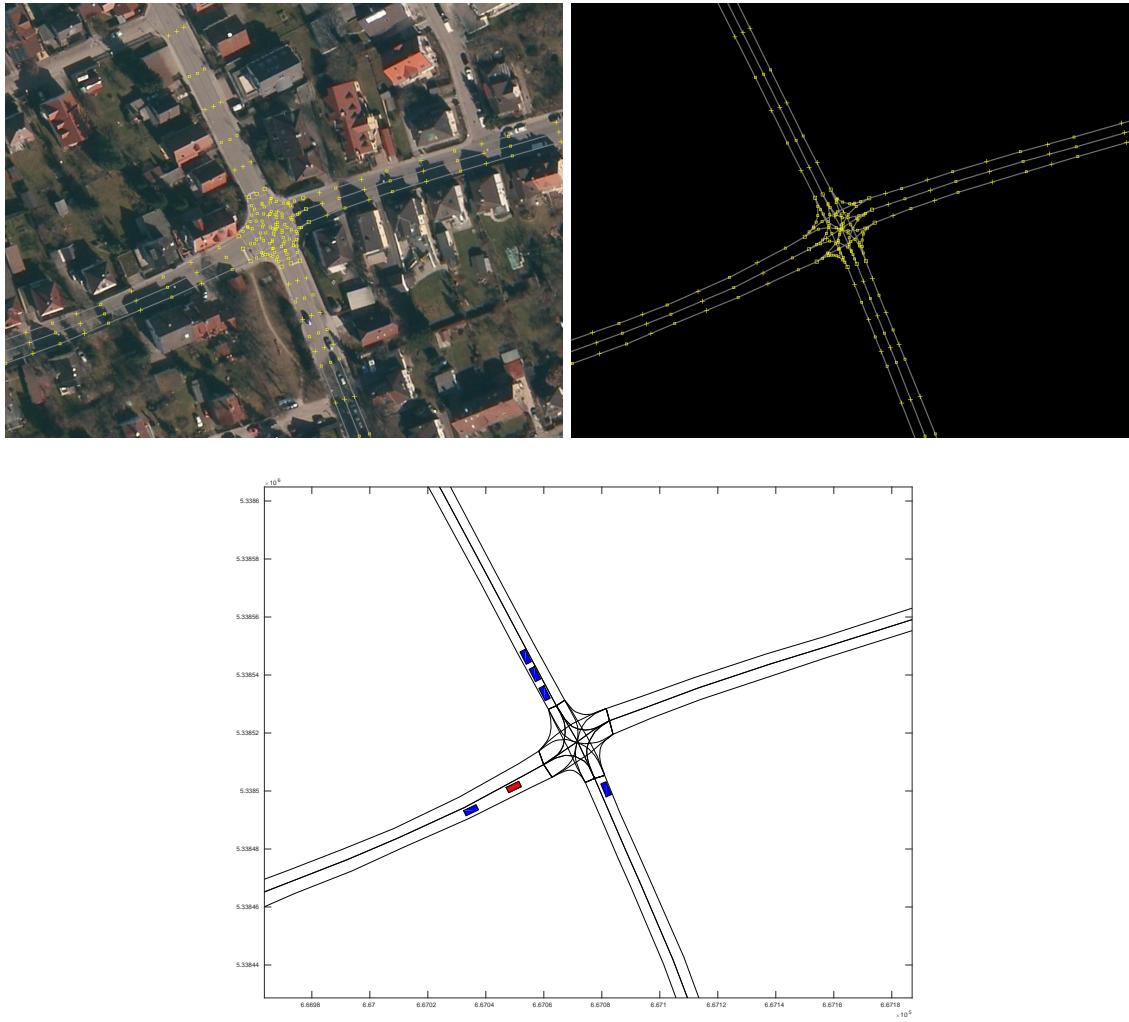


Figure 38: Scenario: S=GER_Ffb_1.

3.9 GER_Ffb_2

A T-junction is modeled in scenario S=GER_Ffb_2 (Tab. 39, Fig. 39). One traffic participant is already in the junction.

Table 39: Scenario: S=GER_Ffb_2.

Characteristic	Value
GPS coordinates	48.1761832° N, 11.2483497° E
type of road	urban
features	T-junction
number of obstacles	3

4. CONCLUSIONS

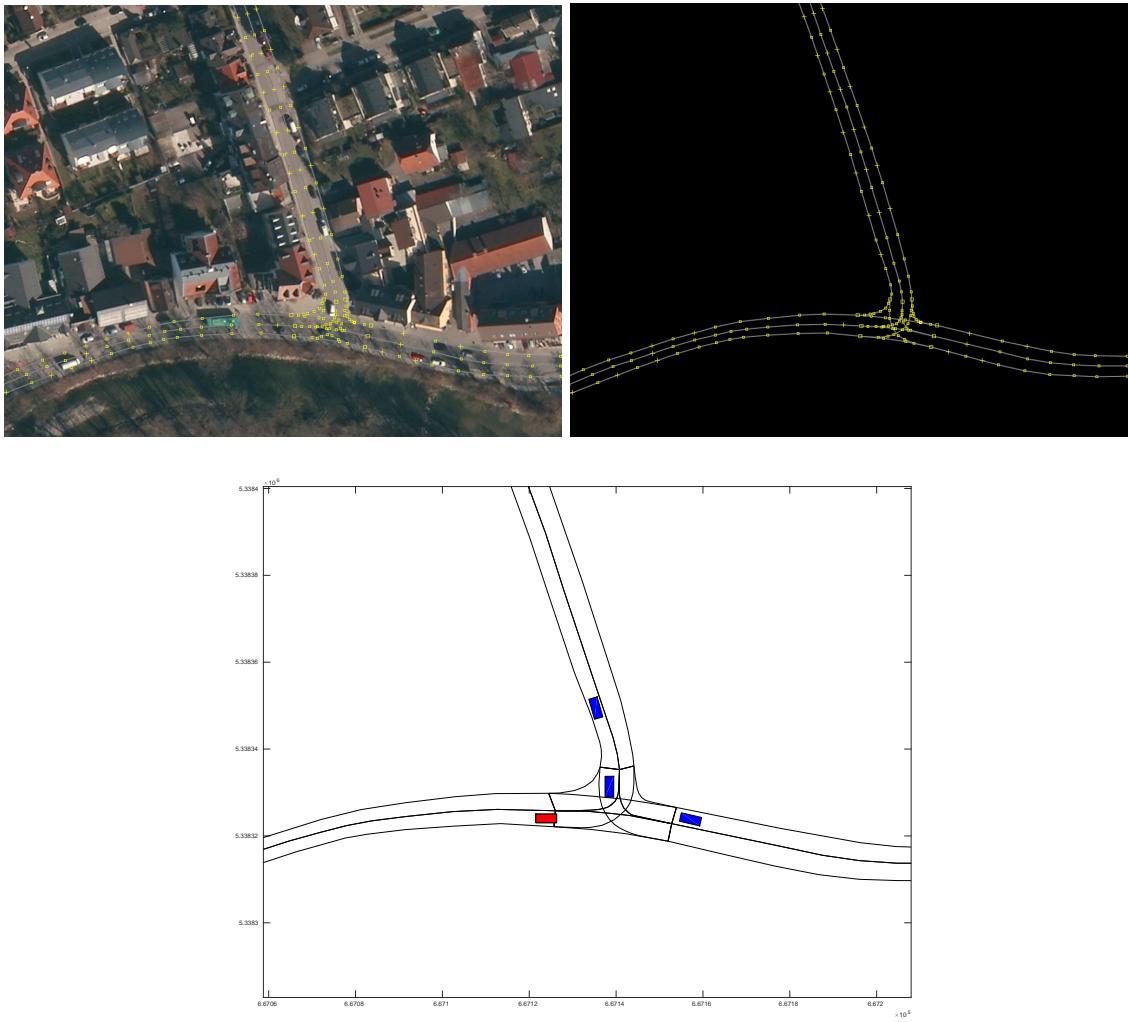


Figure 39: Scenario: S=GER_Ffb_2.

4 Conclusions

This document describes all scenarios available to compose a benchmark that fits one's needs. The *CommonRoad* scenarios feature different traffic situations on urban intersections, rural roads, and highways.

If you have any comments, please contact us through our website⁴.

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⁴commonroad.in.tum.de

References

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