Scenario Factory: Creating Traffic Scenarios For Automated Vehicles

Advanced seminar: Simulation-based Testing of Autonomous Cars

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Overview

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- Test Results
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Introduction

- Virtual testing is an important tool for validating the safety of automated vehicles.
- Even though the number of publicly-available datasets has increased, they usually feature only a small number of maps and require much effort to record.
- The framework generates a set of database, safety-critical scenarios for testing of motion planning algorithms for automated vehicles (AV).

Introduction

- The safety validity of motion planning algorithm for AV´s need large amount of data for Virtual Testing(VT), so they have collected data from real test drivers which is **costly and in-efficient**, also they considered the minority of traffic scenarios posing challenges to motion planners.

- To overcome all this critical issues, In the paper they have introduced 3 major studies as follows:

1) Open Street Map (OSM).
2) Traffic SUMO Simulator.
3) Non-Linear Optimization.

Architecture

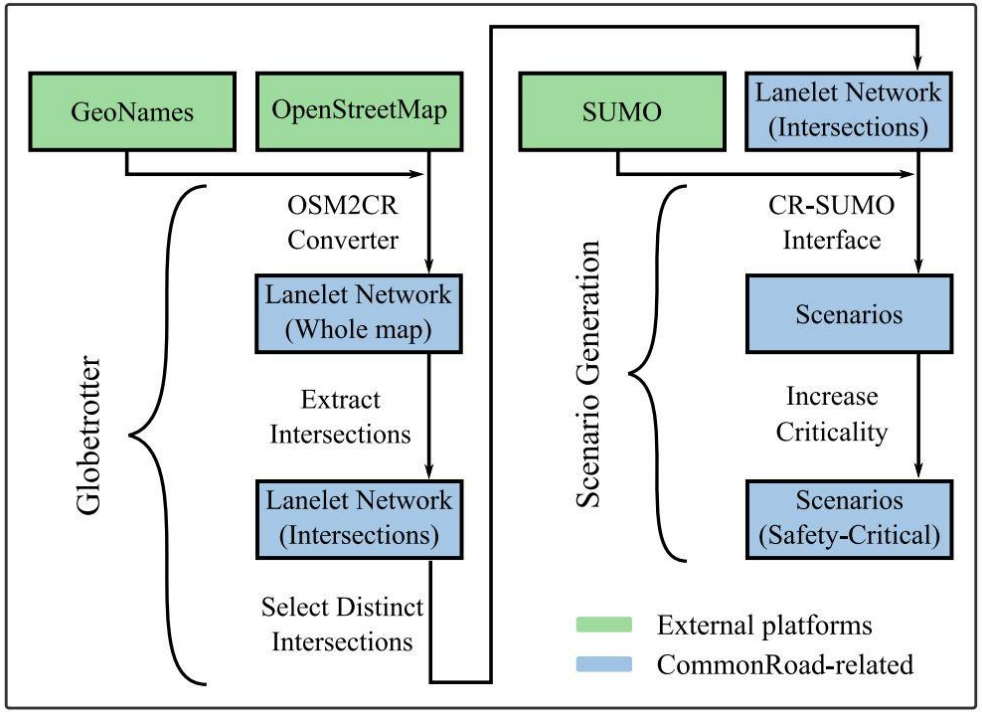


Figure 1. Architecture Process [1].

Inputs

```
{
   "base-path": "./scenarios/interactive/NGSIM/US101",
   "scenario-name":"USA/US101-27-4-1-1-1",
   "base-path":"./scenarios/interactive/SUMO/",
   “scenario-name":"USA/US101-27-47I-1-1",
   "output-path“ :"./outputs",
   "gui":true,
     "ego-vehs":{
      "veh0":{
         "wid": 1.6,
         "length": 4.3,
         "departSpeed":0,
         "pos":[0, 0, -0.68]
      }
  }
  }
```

Inputs

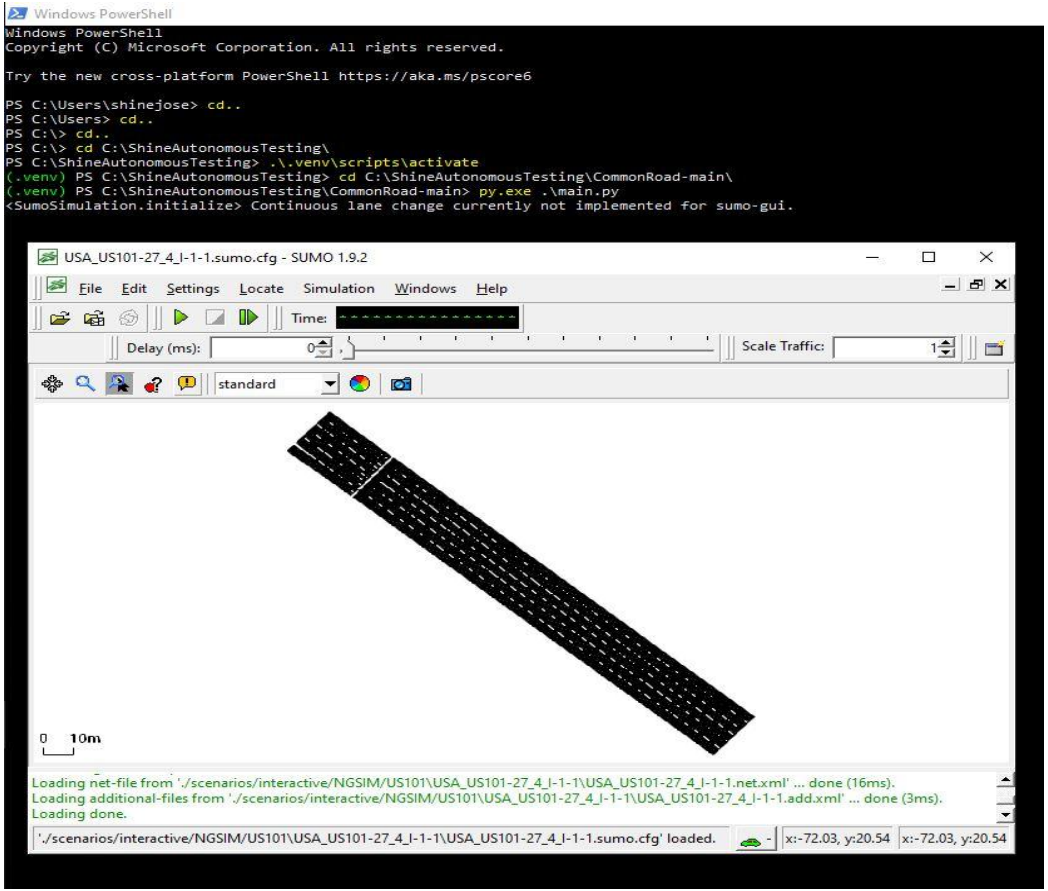


Figure 2. SUMO Inputing [2].

Output Generated

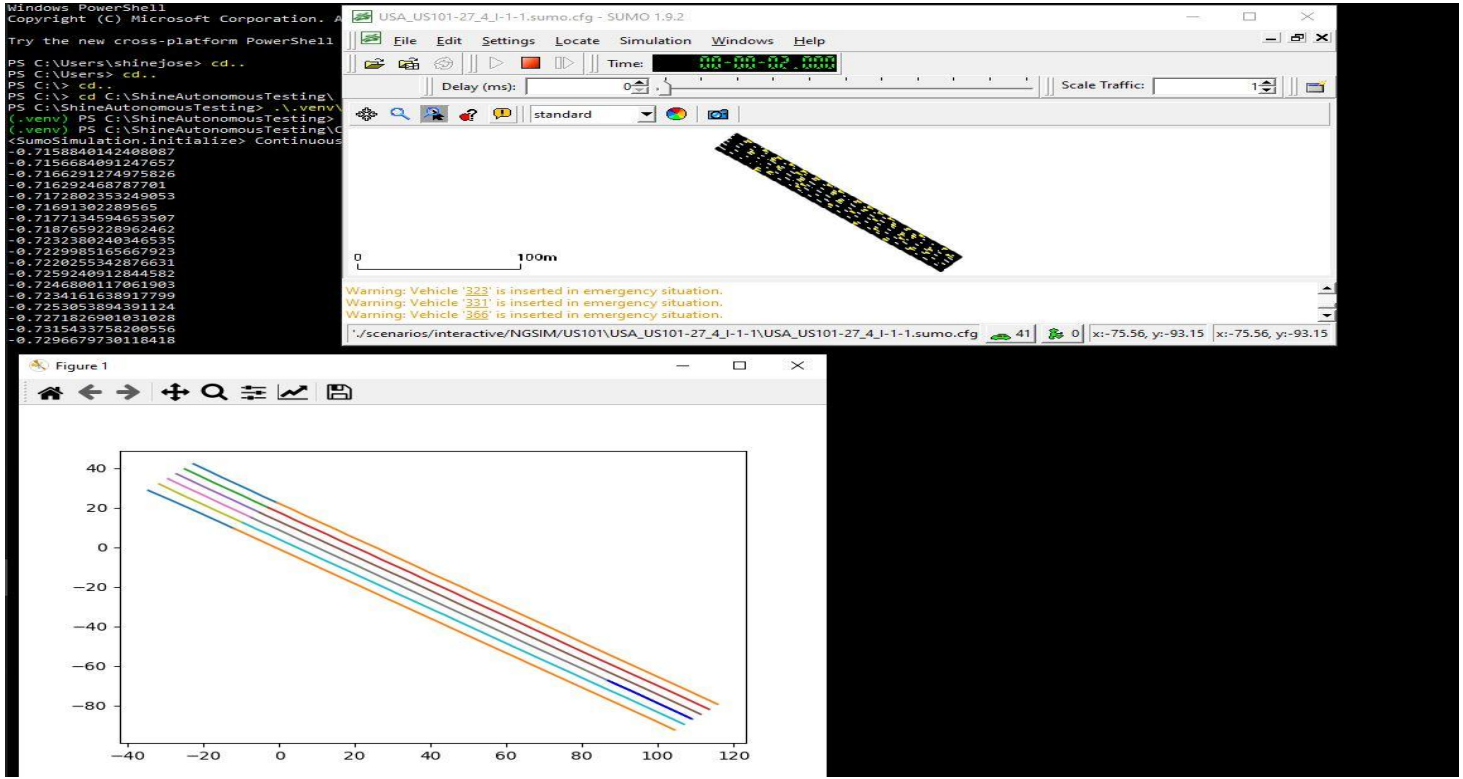


Figure 3. SUMO Simulation Of Given Map Inserted [3].

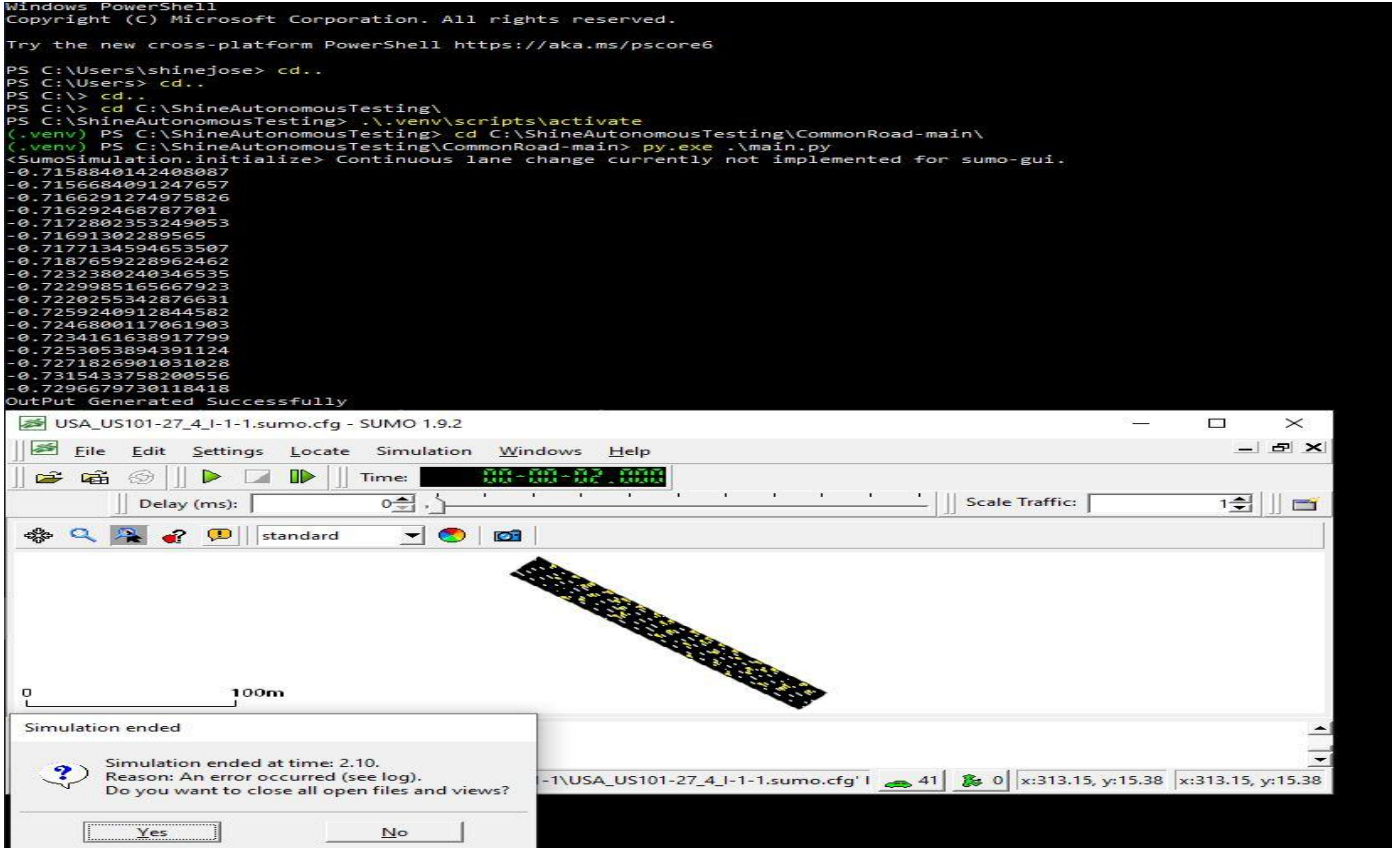


Figure 4. To add a new map [4].

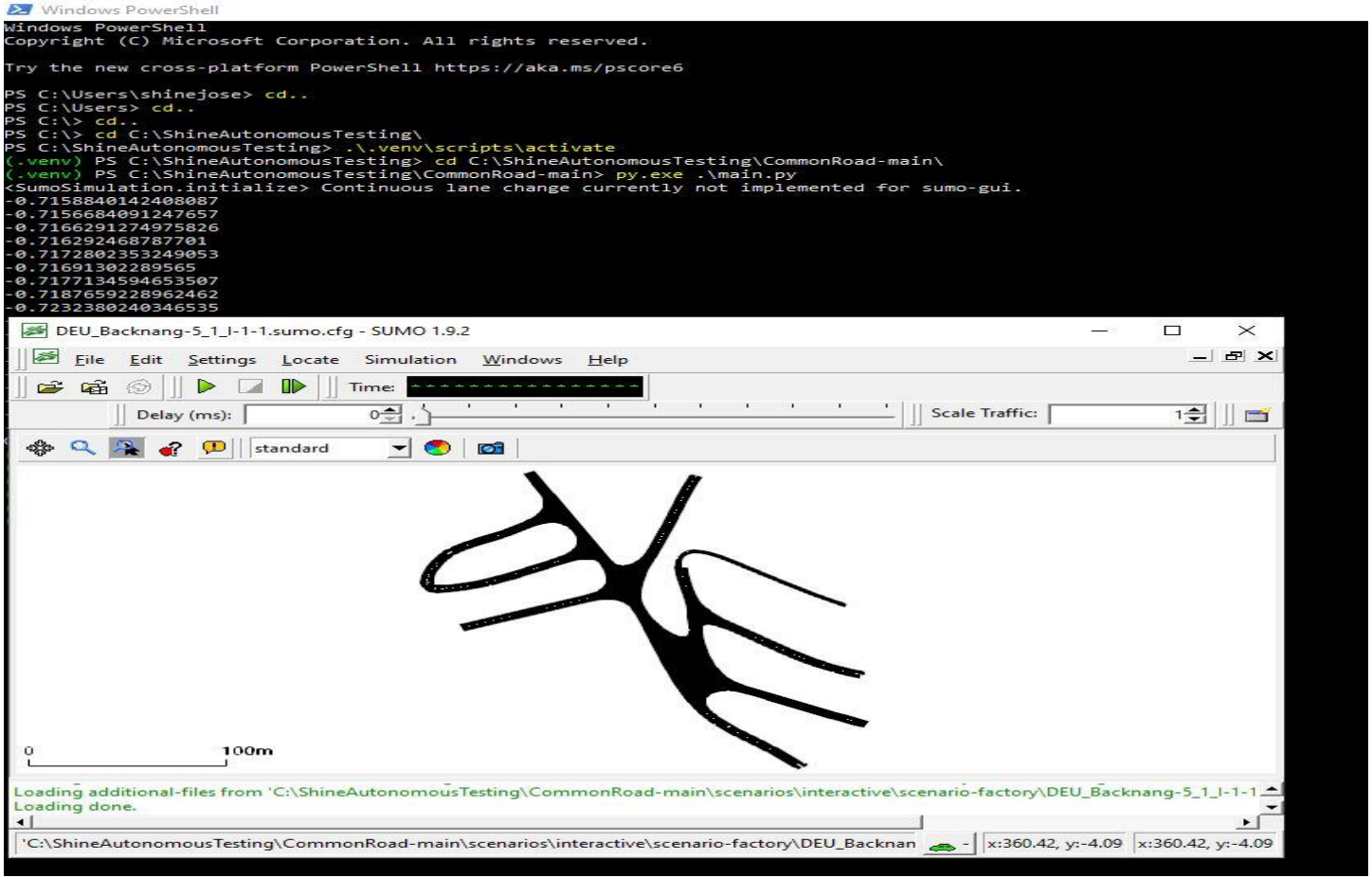


Figure 5. New Map & Features Added [5].

Output Generated

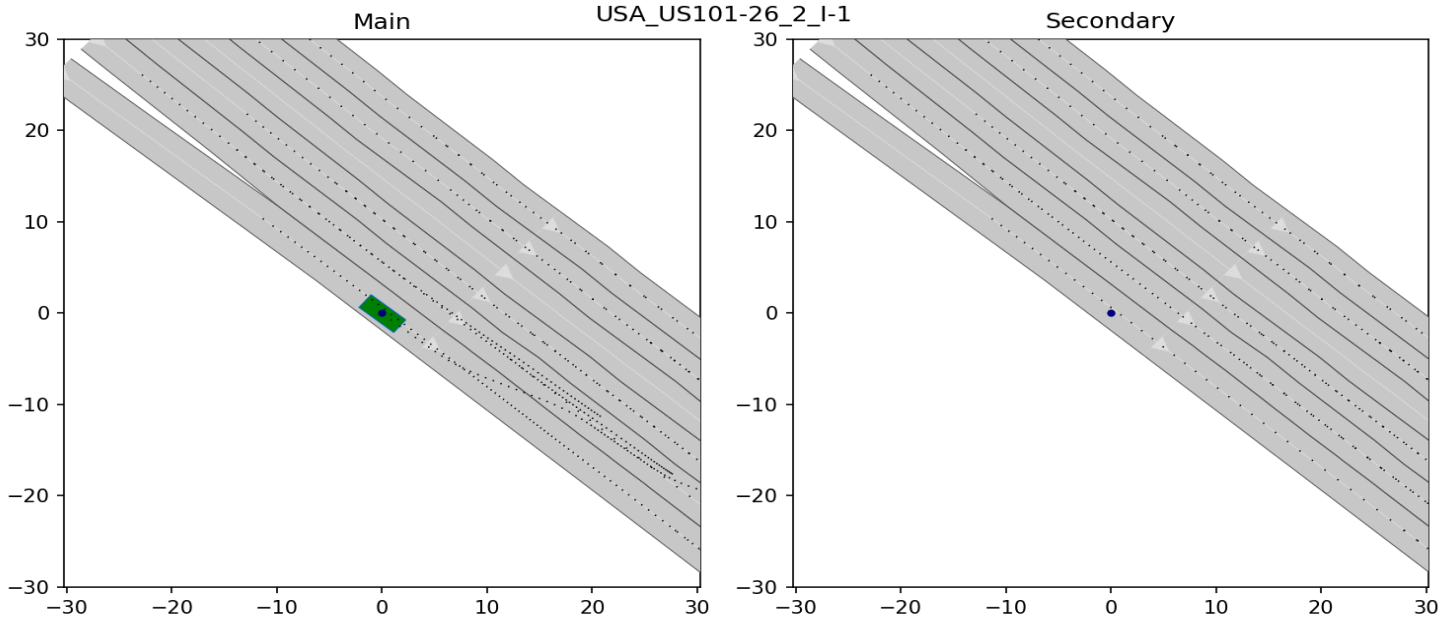


Figure 6. SUMO Simulation Of Given Map Inserted [6].

Results

- This approach can significantly decrease the drivable area, and thus it increases the criticality.

- And the second image shows the reduction of critical area.

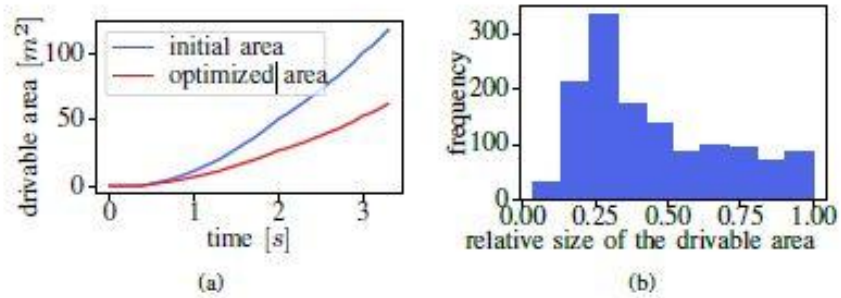


Figure 7. SUMO Simulation Of Given Map Inserted [7].

BeamNG.Tech

- The same Scenarios what we tested before are going to test in BeamNG tech simulator.
- Roads, Vehicles are created and placed using the same old files from Scenario Factory.
- We must extract the XML file format to JSON file format and to test the simulation successfully.
- Let's get into the simulator testing.

Inputs

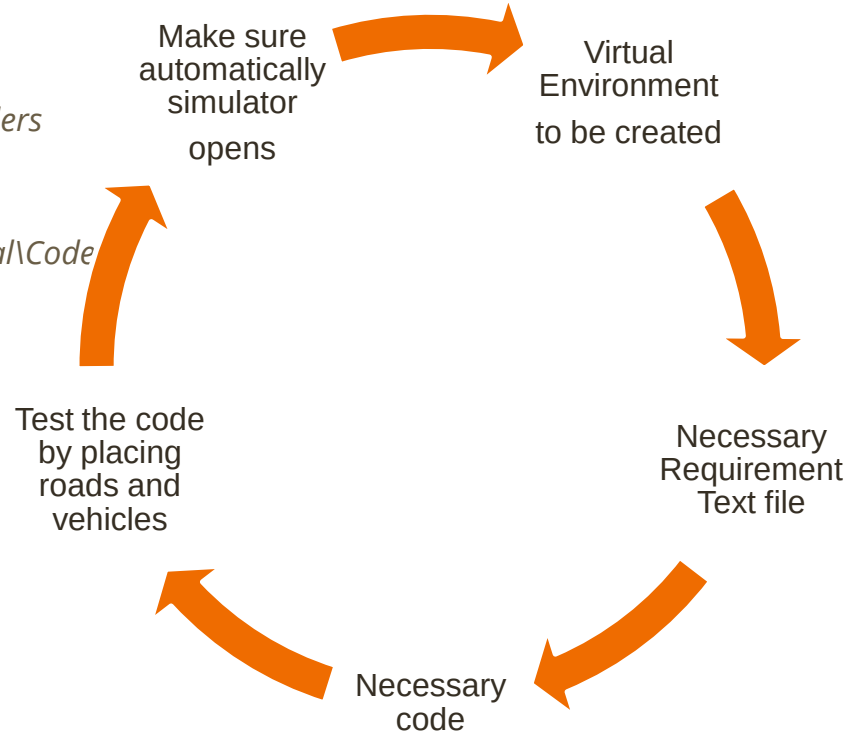
```
from beamngpy import BeamNGpy, Scenario, Road

# Specify location of BeamNG home and BeamNG user folders

BNG-HOME = "C:/ShineAutonomousTesting/BeamNG.tech"
BNG-USER = "C:/ShineAutonomousTesting/sbst-2021-tutorial\Code

beamng = BeamNGpy('localhost',
64256, home=BNG/HOME, user=BNG/USER)

# Start BeamNG by setting launch to True
bng = beamng.open(launch=True)
try:
input('Press enter when done...')
finally:
bng.close()
```



Evaluation

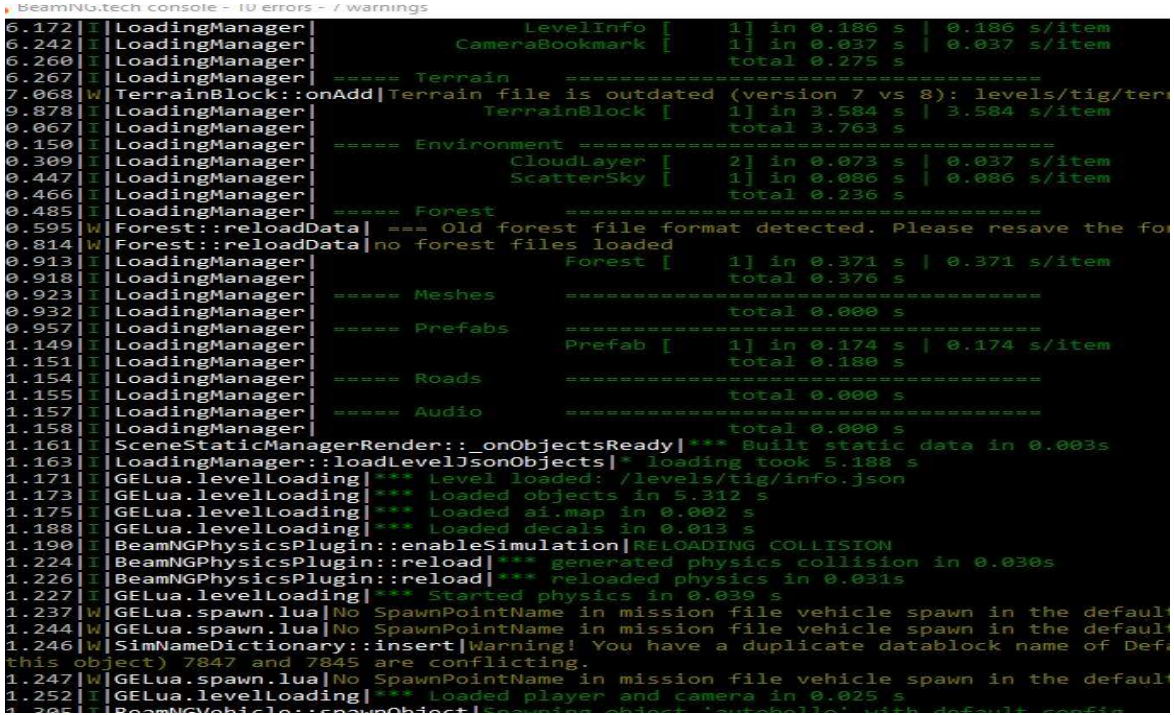


Figure 8. Given Prefabs, Meshes & Roads are Loading [8].

```
(.venv) PS C:\ShineAutonomousTesting\sbst-2021-tutorial\Code> py.exe .\xmlvisualization.py
<Element 'commonRoad' at 0x000001B1C15844A0>
commonRoad {'timeStepSize': '0.1', 'commonRoadVersion': '2020a', 'author': 'Edmond Irani Liu, Fabian Höltke, Moritz Klischat', 'affiliation': 'Technical University of Muni
ch, Germany', 'source': 'Scenario Factory (OpenStreetMaps, SUMO Traffic Simulator)', 'benchmarkID': 'ARG_Carcarana-4_1_T-1', 'date': '2020-08-23'}
location {}
scenarioTags {}
lanelet {'id': '7223'}
lanelet {'id': '6255'}
lanelet {'id': '7238'}
lanelet {'id': '6259'}
lanelet {'id': '7890'}
lanelet {'id': '7945'}
lanelet {'id': '5847'}
lanelet {'id': '7237'}
lanelet {'id': '5843'}
lanelet {'id': '7222'}
lanelet {'id': '7891'}
lanelet {'id': '7946'}
lanelet {'id': '7239'}
lanelet {'id': '7224'}
lanelet {'id': '7892'}
lanelet {'id': '7944'}
lanelet {'id': '7240'}
lanelet {'id': '7241'}
lanelet {'id': '7242'}
lanelet {'id': '5846'}
lanelet {'id': '6258'}
lanelet {'id': '7225'}
lanelet {'id': '7226'}
lanelet {'id': '7227'}
lanelet {'id': '7888'}
lanelet {'id': '7889'}
lanelet {'id': '6256'}
```

Figure 9. Features Extracted From XML File Format [9].

Figure 10. Features Extracted From XML File Format To JSON [10].

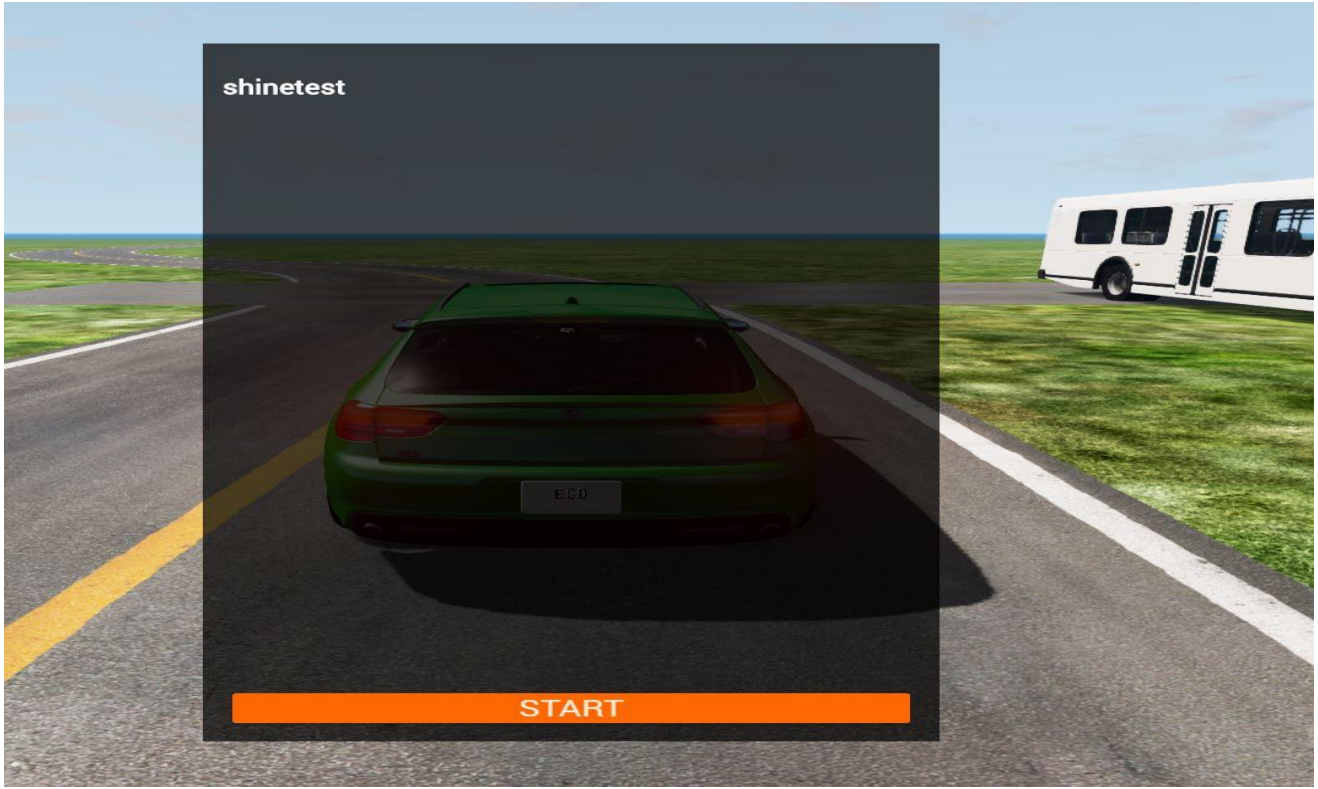


Figure 11. Simulator Loaded With ShineTest [11].

Figure 12. Simulator Loaded With ShineTest Result [12].

Conclusion

- By shinetest generator, I tried to implement the scenario factory by creating roads and placing Vehicle.
- Tracks are created using the given end points and visualized it.
- Obstacles are created as a parking bus.
- Successfully tested them in the virtual environment by the discussed paper in the meeting.

References

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5. N. Kalra and S. M. Paddock, “Driving to safety: How many miles of driving would it take to demonstrate autonomous vehicle reliability?” Transp. Res. Part A: Policy Pract., vol. 94, pp. 182–193, 2016.
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8. https://github.com/shinejose0007/AutonomousCarTesting
9. https://gitlab.lrz.de/tum-cps/commonroad-io
10. https://commonroad-io.readthedocs.io/en/latest/
11. https://github.com/se2p/sbst-2021-tutorial/

Thank You...