Search Based Software Engineering for Testing Autonomous Cars

Test Generator:

Automatic generation of DriveBuild test case scenarios from CommonRoad Benchmark

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The Idea

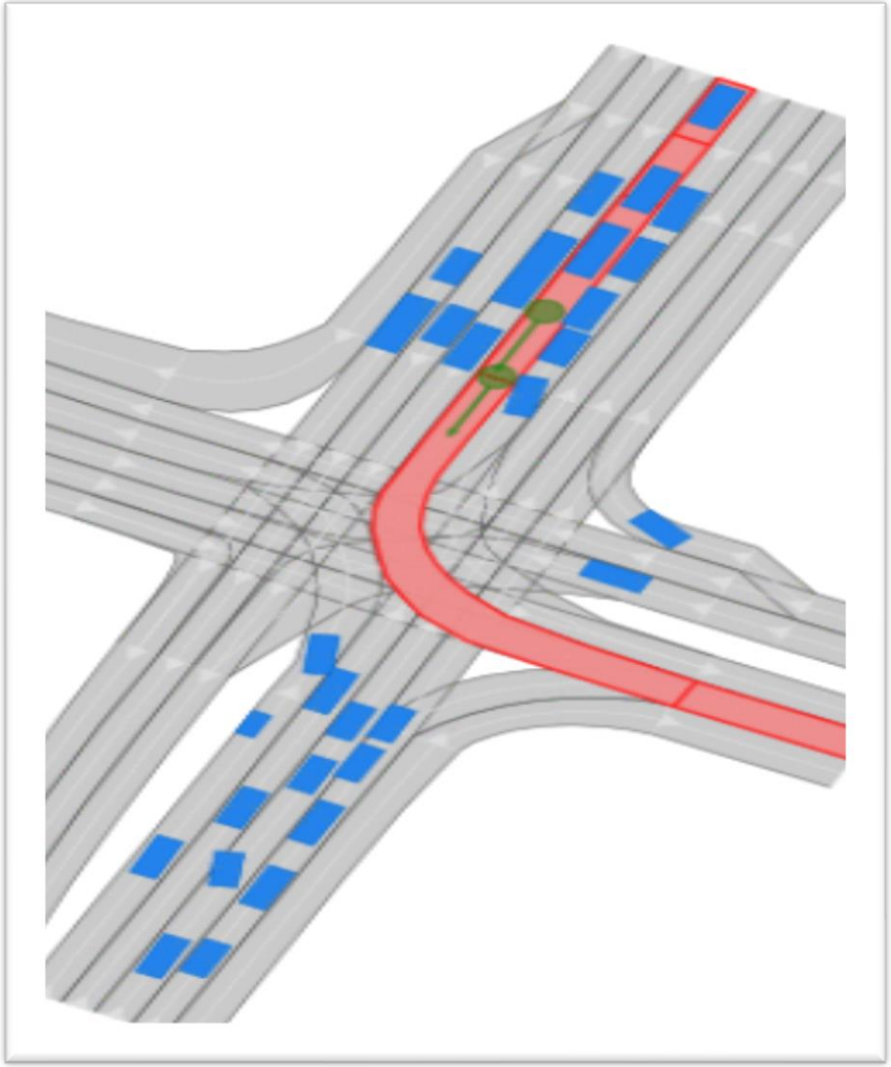
https://www.youtube.com/watch?v=7tPrj1e04gw

CommonRoad Benchmark provide diverse and complex scenarios for testing.

Extract all the scenarios from CommonRoad in XML

Reproduce them automatically in DriveBuild with multiple test criteria.

CommonRoad Benchmark



Complex road intersections and scenarios from real traffic data.

The road networks are defined in a 2D coordinate system and stored in XML format.

Provides dynamic obstacles, motion planning for ego vehicle, cost function and multiple traffic participants.

Proposed Approach

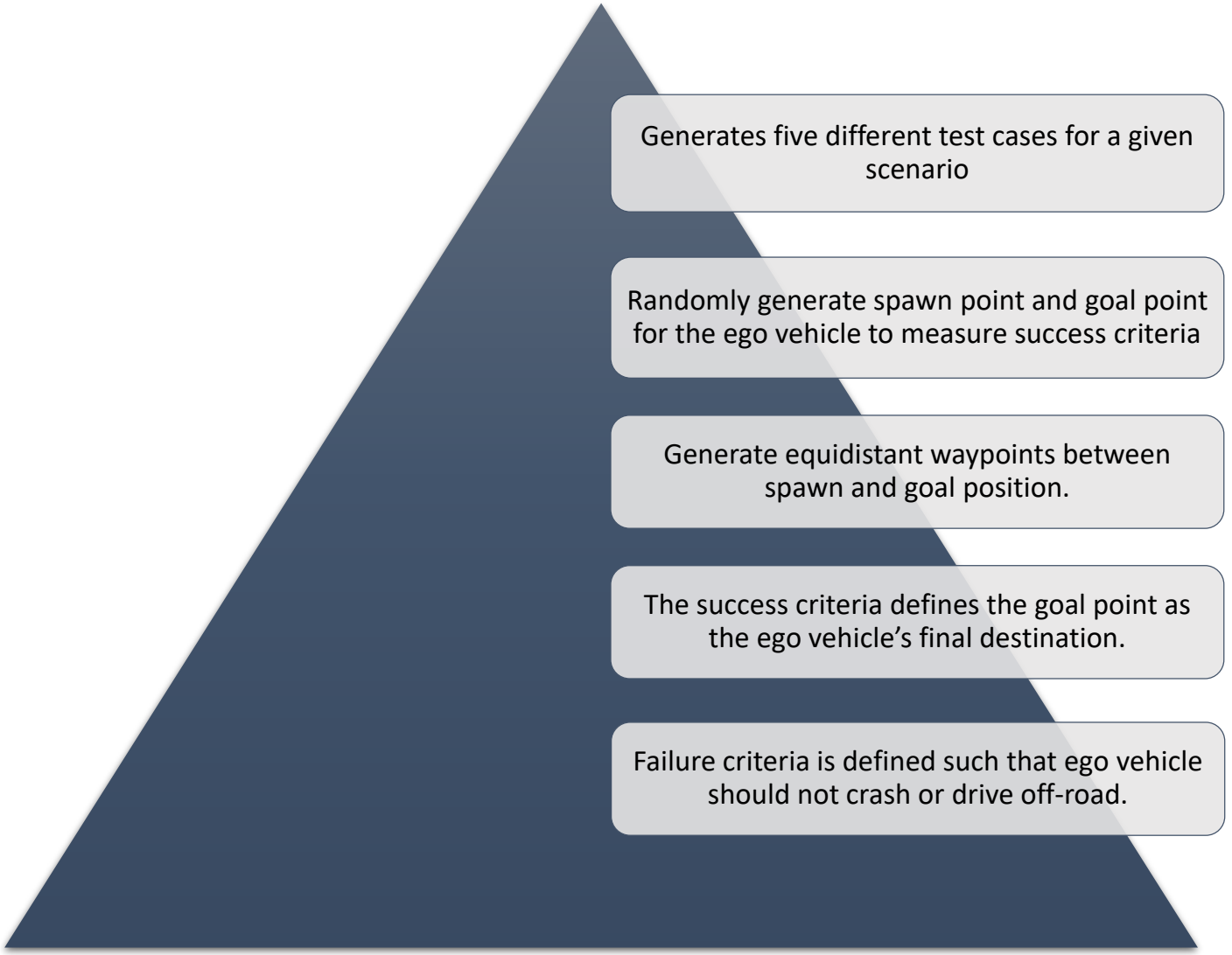
01 Download all the relevant XML scenarios from CommonRoad Benchmark.

02 Automatically parse all the XML files sequentially to transform them into DriveBuild XML scenarios.

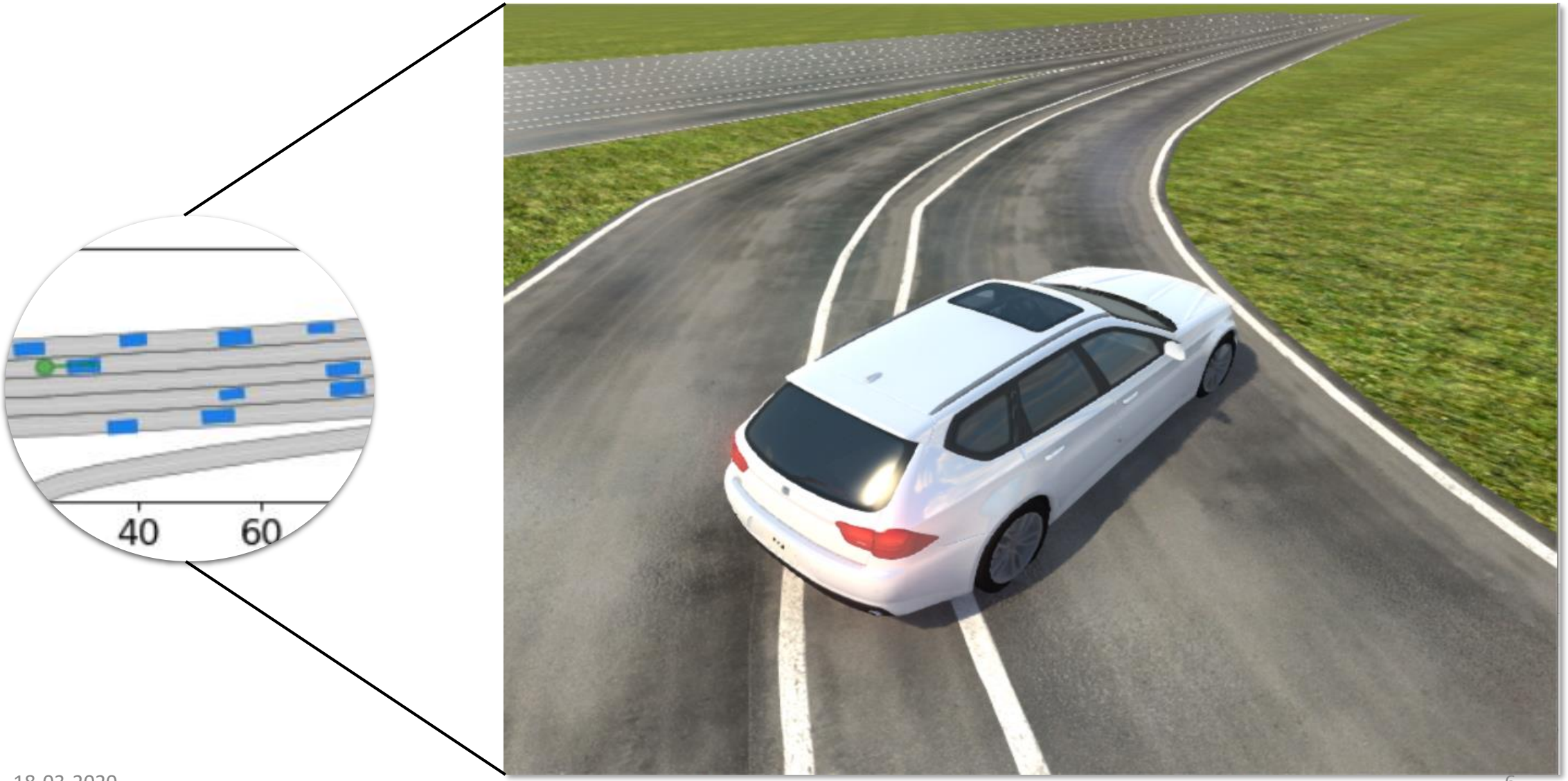
03 Automatically define the test criteria and waypoints for each scenario to test the ego vehicle.

04 Run the DriveBuild test cases for all the extracted scenarios and generate the results.

Definition of Test criteria



Transformation from CommonRoad to DriveBuild scenario



Key features

- Utilizes real traffic or partly handcrafted data to simulate road configuration.
- Each scenario is further used to generate multiple test cases.
- Provides huge and complex road network and intersections ranging up-to 10 lanes.
- Automatically run the all test cases for the ego vehicle and generate results.
- No human intervention is needed to parse and generate the test cases.

Challenges

Multi-lane road configurations

- It does not always scale well when converting complex road networks from commonroad to Drivebuild scenarios.
- The lane width of the DriveBuild needs to be calibrated in order to fit the multi-lanes since the Commonroad Benchmark does not provide a separate lane width.

Overlapping of multiple road networks

- The overlapping of the road networks lead to the lane markings intersecting each other.

Identification of parallel road networks

- The whole scenario is specified sequentially irrespective of road configuration in Commonroad.
- This pattern need to be identified and handled separately in DriveBuild.

Further improvements

- Extending the test cases by incorporating static and dynamic obstacles such as traffic participants.
- Reproducing the motion planning from the CommonRoad benchmark.
- Eliminating overlapped lane markings on the road intersections.

Test Generator Demo and References

Test Generator Demo link:

https://youtu.be/hVMZdasMWno

- https://commonroad.in.tum.de/
- https://github.com/TrackerSB/DriveBuild
- https://github.com/BeamNG/BeamNGpy