Development of a space utilization concept for a test intersection for automated and connected mobility and implementation in traffic simulation.

Master‘s Thesis of Fuad Mustafa

Mentoring:
Dipl.-Ing. Martin Margreiter
M.Sc. Mario Ilic

Fig. 1 A visualization of MCube’s test bed for automated and connected driving (MCube Project).

The emergence of connected and automated vehicles has the potential to alter our perception of transportation. These vehicles can enhance safety, decrease traffic congestion, and improve the quality of life in cities.

This thesis aims to contribute in the ongoing efforts to develop and build a permanent testbed facility for Connected and Automated mobility in the Munich area. In this testbed facility, various automated driving experiments will be conducted, with a focus on interactions with vulnerable road users (VRU) such as cyclists and pedestrians. The testbed facility comprises a 100m × 80m asphalt area that can be used very flexible for a variety of intersection layouts since all road markings, traffic infrastructure, and other road elements can be moved easily.

The primary objective of this thesis is to develop a space utilization concept for the testbed facility with a focus on the test intersection area including all the necessary intersection-side infrastructure and then the implementation in a microscopic traffic simulation.

The thesis employs a structured process chain that begins with an examination of the testbed components and area characteristics in order to develop an initial concept of the applicable designs and measures within the testbed facility. Then, in order to evaluate the best design practices to be adopted in the testing area, a complete review of local and worldwide guidelines and standards that govern the design principles of road space elements is carried out.

Following that, a procedural methodology as shown in **Fig. 2** is developed that involves the selection and design of seven intersection layouts for the test intersection, followed by the creation of seven testbed 3D scenes based on these layouts. The testbed scenes are then exported to OpenDRIVE and integrated into a virtual microscopic simulation environment.

The thesis uses the scenario creation software RoadRunner to create the 3D testbed scenes, and the microscopic traffic simulation tool SUMO.

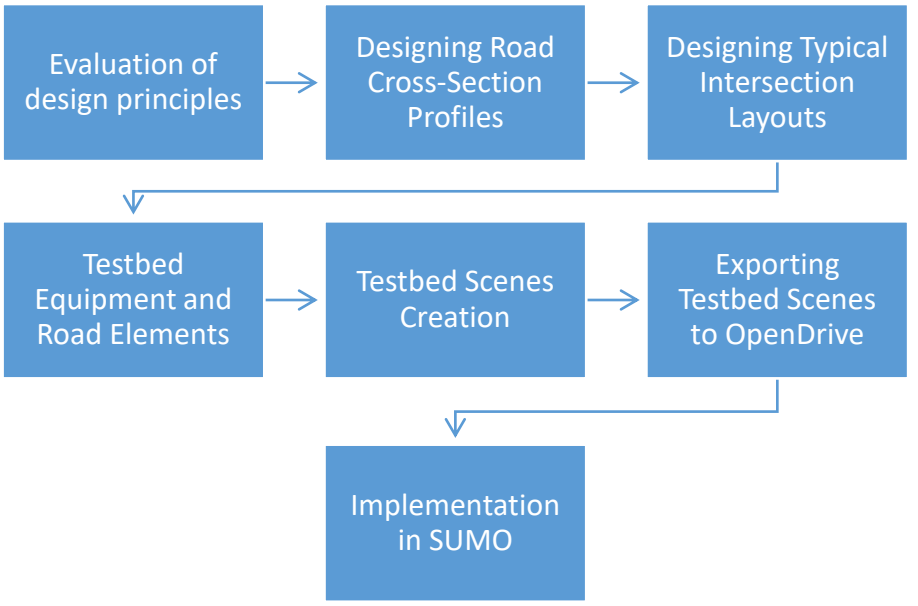

Fig. 2 Methodology flowchart.

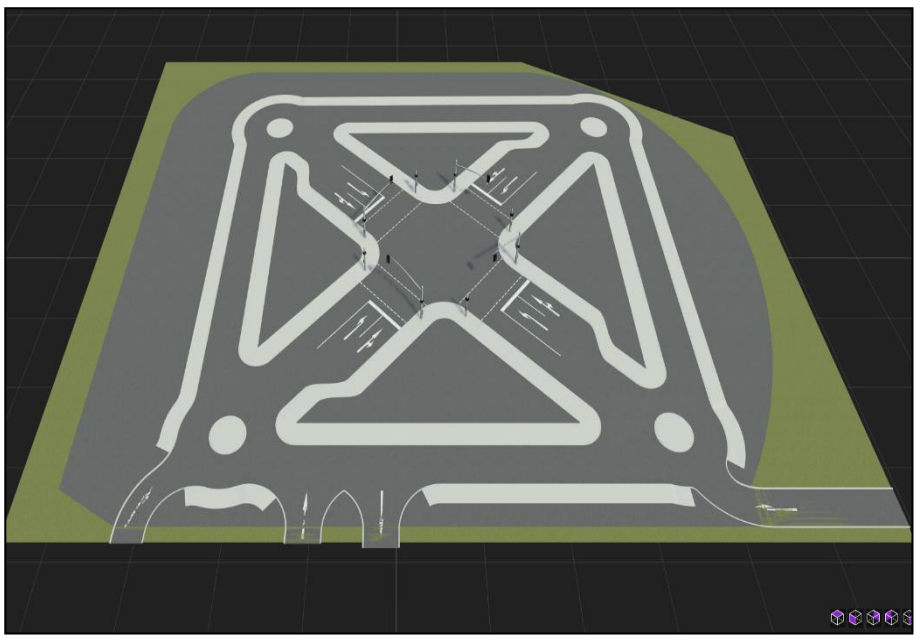

Fig. 3 MCube’s testbed scene (RoadRunner version: 2023a).

The created typical intersection layouts and RoadRunner testbed scenes as the one shown in **Fig. 3** represent intermediate results that highlight the progress made during methodology execution and are used to support the final findings of this thesis. These testbed scenes are then exported to OpenDrive and integrated in a virtual microscopic simulation environment using the microscopic traffic simulation tool SUMO. The resulting SUMO networks can be referred to as the thesis's final results. These results indicate that exporting detailed and complicated 3D scenes created by RoadRunner software to OpenDRIVE is not the best approach to integrate them in a virtual microscopic simulation environment.

This thesis sets the path for further research into the design of optimal intersection layouts for usage in the testbed facility, as well as enhanced implementation in microscopic simulation environments.