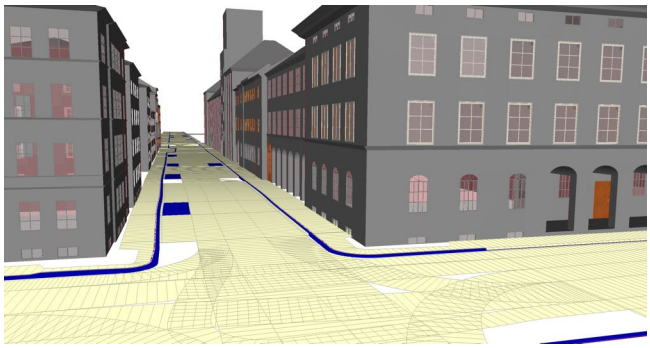
Department of Aerospace and Geodesy
TUM School of Engineering and Design
Technische Universität München

Master's Thesis Proposal

Derivation and Validation of HD Maps for Automated Driving from Semantic 3D City Models



(a) Semantic road space model in CityGML 3.0

(b) TUM EDGAR research vehicle driving

(c) Lanelet2 map with perceived objects

Description An increasing number of cities are comprehensively surveying their streets and incorporating detailed street space representations into their semantic 3D city model to enable a diverse set of interdisciplinary applications. Simultaneously, highly automated vehicles such as the TUM EDGAR [1] rely on specialized lane-level maps to plan the driving trajectories in real time. However, the detailed semantic 3D city model are not yet utilized to provide optimized environment representations to support real-time algorithms for automated driving.

The goal of this thesis is to develop an automated methodology to derive Lanelet2 map representations [2] from semantic road space models in OGC CityGML 3.0 enabling their direct use for trajectory planning of automated driving systems. To this end, a requirements analysis is performed to identify the environmental representation requirements of automated driving algorithms including trajectory planning. The data models of CityGML 3.0 and Lanelet2 need to be comprehensively investigate in order to develop a syntactic and semantic conversion methodology. The proof-of-concept conversion implementation will be assessed using the software stack of the TUM EDGAR research vehicles and further trajectory planning algorithms across a range of different urban environments. To detect requirement violations or inconsistencies early, validation strategies for the derived map should be explored.

Requirements Proficiency in Python, C++ or Rust programming is essential. Familiarity with the CityGML standard and the Robot Operating System (ROS2) is considered beneficial.

References

[1] Phillip Karle et al. *EDGAR: An Autonomous Driving Research Platform – From Feature Development to Real-World Application*. 2024. arXiv: 2309.15492 [cs.RO].

[2] Fabian Poggenhans et al. "Lanelet2: A high-definition map framework for the future of automated driving". In: *2018 21st International Conference on Intelligent Transportation Systems (ITSC)*. 2018, pp. 1672–1679.

Organization:	TUM Chair of Geoinformatics	Organization:	TUM Chair of Automotive Technology
Supervisor:	Benedikt Schwab	Second Supervisor:	Jan Bergmann
Room:	0501.EG.126	Room:	MW 3508
Tel.:	+49.89.289.22973	Tel.:	+49.89.289.10497
Email:	benedikt.schwab@tum.de	Email:	jan.bergmann@tum.de