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

Master's Thesis Proposal

Evaluation of point cloud coregistration methods with semantic city models for multiple levels of detail

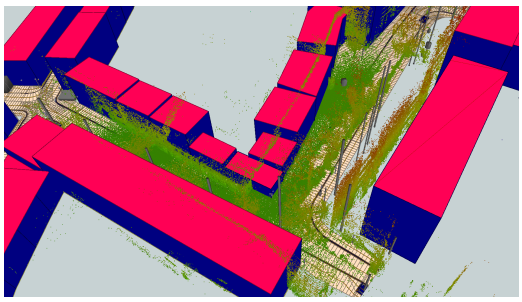

Figure 1: Source point cloud in a semantic road space model

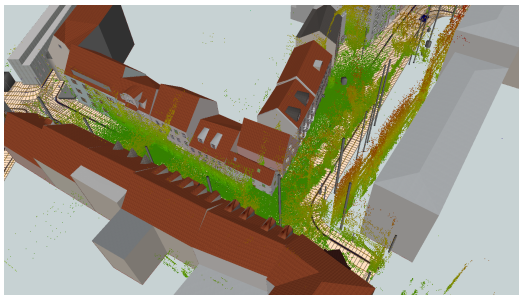

Figure 2: Source point cloud in a semantic road space model at LOD3

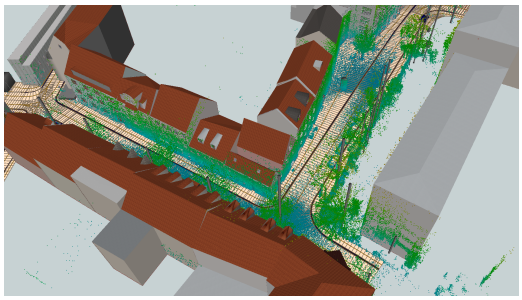

Figure 3: Coregistered point cloud with the semantic model

Description In recent years, an increasing number of semantic models of the built environment have been acquired and provided in varying degrees of detail, such as buildings and road space models in LOD2 and 3. However, before existing semantic models can be enriched with representations of new surveying campaigns and used for subsequent analyses, the point clouds typically have to be aligned with the model first [1]. Coregistration strategies can be categorized into point-based, primitive-based, and global-based approaches [2], whereby their performance depends on the characteristics of the source point cloud and the target model.

The objective of this thesis is to investigate a list of selected coarse and fine coregistration algorithms by evaluating their performance in terms of accuracy, robustness, and computational efficiency. For this purpose, the registration methods are to be applied to several source point clouds with different characteristics, such as point density and relative accuracy. Semantic street space models from Munich and Ingolstadt serve as target models, as shown in Figure 1-3. Furthermore, the influence of object types in the model, such as city furniture and windows, on the registration performance should be evaluated. The performance of the registration algorithms under varying parameters should be analyzed both quantitatively with metrics and qualitatively.

Requirements Proficiency in Python or C++ programming is essential. Additionally, experience with point cloud processing techniques and familiarity with relevant libraries, including Open3D and PCL, will be advantageous. Prior exposure to the CityGML standard and the FME tool is beneficial.

References [1] Wysocki, O., Xu, Y., and Stilla, U., "Unlocking Point Cloud Potential: Fusing MLS Point Clouds with Semantic 3D Building Models While Considering Uncertainty", ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci., VIII-4/W2-2021, 45–52, 2021.

[2] Xu, Y., and Stilla, U., "Toward Building and Civil Infrastructure Reconstruction From Point Clouds: A Review on Data and Key Techniques," in IEEE J. of Sel. Top. in Appl. Earth Obs. and Remote Sens., vol. 14, pp. 2857-2885, 2021.

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