Topic Field

Model driven 3D Reconstruction of Urban Objects from Sparse 3D Point Clouds based on Roof Shape Libraries

Because of recent developments in dense image matching methods for optical remote sensing data, more and more 3D point clouds become available originating from very high-resolution satellite images. Compared to aerial sensor platforms, the sensor setup in orbit yields a lower number of overlapping images and many (partial) occlusions. Consequently, the derived 3D point clouds are sparse, heavily filtered and smoothed, and contain many gaps (cp. Figure 1). But they are potentially available for all around the world on short notice, which makes then perfect for applications w.r.t. situational awareness, e.g. during crisis situations after natural disasters.

Figure 1. 3D point cloud of Munich (Germany) derived from WorldView-2 stereo images.

For the 3D reconstruction of urban objects like buildings, vegetation, transportation networks, and city furniture, current data driven methods that have been developed for (dense) 3D point clouds are not able to capture the typical characteristics of the real-world counterparts from the above-mentioned data. Therefore, model driven methods need to be developed or existing ones adapted for these purposes.

Model driven approaches typically use a library of configurable shape templates to describe the general shape of buildings (see Figure 2). For a given extract of the 3D point cloud, these methods select and estimate the parameters of the roof shape template that best fits the given data. As, e.g., buildings with complex footprints and roof shapes cannot be described by a single roof template alone, they need to be built by a combination of several simple shapes. Often, model based reconstruction methods also make heavy use of additional vector data like footprints or tree cadasters.

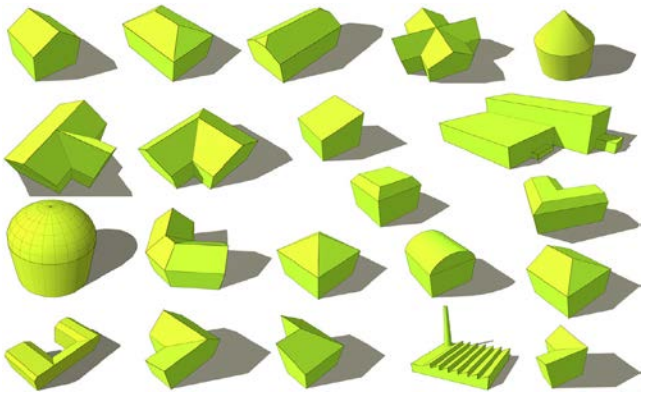

Figure 2. Example library of 3D roof shape primitives and their combinations to more complex 3D building models.

Because the model templates explicitly feature the typical characteristics of the real-world counterparts, the resulting 3D models are always valid and well-formed (cp. Figure 3).

Figure 3. 3D city model of Berlin.

Exemplary topics for master thesis:

- ☐ For more details about exemplary topics, please refer to the display case of the chair “Methods of Geoinformation Science” at room H5121 (main building of Technische Universität Berlin).

Recommended skills:

- ☐ 3D modelling, geometric computations, programming (C++).

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