Topic Field

3D Building Reconstruction from Airborne Laser Scanning Point Clouds

For several years 3D city models assume a central role in urban and regional planning, surveying, navigation and telecommunications and enable in the environmental field precise analyses and simulations of pollutant, flood and noise propagation. The application areas are thus quite varied and lead at the present time to an increased demand.

For the reconstruction of large urban areas, airborne laser scanning (ALS) point clouds have proven to be an appropriate data source. As a necessary step towards the reconstruction of 3D building models, their points need, however, first to be classified so that building points can be distinguished from other points (see Figure 1). In this regard, new methods need to be developed that are, for example, based on stochastic graphical models (e.g., Markov/conditional random fields), random forest, machine learning techniques, or a combination thereof.

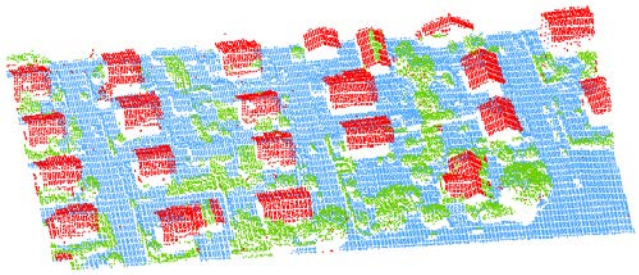

Figure 1. Classification result of an ALS point cloud (red: building, green: vegetation, blue: ground).

Based on the extracted building points, automatic approaches for 3D building reconstruction can be applied. In model-driven reconstruction approaches building templates are chosen from a predefined library and then adapted by their parameters to best fit their roof shapes to the given data. Thereby, they always generate topologically correct and well-shaped building models. In contrast, data-driven approaches are not restricted to a predefined library but they resemble very closely the input data so that buildings with individual shapes can be constructed as well. However, the building models or parts thereof can easily end up distorted and exhibit small irregularities.

Lately, model-driven and data-driven approaches have been merged towards hybrid reconstruction approaches that try to exploit the advantages of both worlds: the shape flexibility of data-driven approaches with the shape regularization capabilities of model-driven approaches. For this, semantics and regularities can be incorporated to a certain extent in data-driven reconstruction methods. The resulting building models of such a hybrid reconstruction approach are shown in Figure 2. A typical workflow of a hybrid reconstruction process can, for example, consist of the following three steps: segmentation (e.g., RANSAC, Hough transform, surface growing, etc.), derivation of topological and semantic information (e.g., based on a roof topology graph), and 3D model construction (e.g., using half-spaces, binary space partitioning, etc.).

Figure 2. Resulting building models of an automatic hybrid reconstruction approach.

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 modeling, geometric computations, programming (C++).

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