Topic Field

Modeling of Indoor and Enclosed Environments from 3D Point Clouds

With the rising urban population and the growing complexity of cities as conglomerates of enclosed spaces, modeling of indoor and enclosed environments gained increased attention in the last couple of years. The models are needed for various purposes, such as navigation, facility management, security, preservation and documentation, etc. By considering that recent investigations have shown that 75% of the population lives in cities and about 87% of the time is indoors, there is a great demand for spatial and semantic information of indoor environments.

The technological development of mobile laser scanners makes it possible that indoor environments can nowadays be easily captured (see Figure 1). The major challenge still remains in the process of converting dense indoor point clouds automatically into vector models.

Figure 1. 3D point cloud data captured by a mobile laser scanner (points from the ceiling have been extracted for illustrative purposes).

As a provisional step to proceed towards higher dimensional indoor models, powerful and flexible floor plans can be utilized (see Figure 2). Their automatic derivation is especially important for vital applications such as emergency planning and first respond.

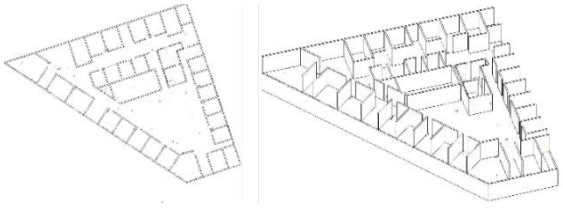

Figure 2. Automatically derived 2D and 3D floor plans from 3D point clouds.

The automatic generation of floor plans and higher dimensional indoor models becomes challenging if many objects like furniture or moving persons are present during the data capturing so that wall surfaces become (partially) occluded. In order to overcome this issue, analysis of repetitive patterns and regularities need to be included in an automatic reconstruction procedure. Additionally, not only geometric aspects but also semantic information for a deeper understanding of indoor environments need to be incorporated. To draw conclusions about the final indoor model configuration, the detection, recognition, and identification of objects in dense indoor point clouds (see Figure 3) becomes important. In conjunction with a 3D outdoor model, the resulting model can serve as a powerful information system.

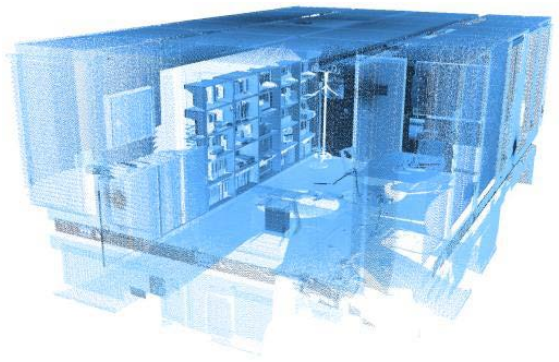

Figure 3. Dense 3D point cloud of an office room for the extraction of single objects.

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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