PhD position

Indoor reconstruction from a smartphone

Context

The automatic 3D-modeling of indoor scenes from imagery and laser scanning is a topic of growing interest in computer vision and geometry processing [1]. Reconstructing indoor scenes is a difficult task because the urban objects composing such scenes may significantly differ in term of complexity, diversity, scale and density. Moreover, optical data have usually a poor visibility and reflectance effects which make 3D information difficult to extract.

Several methods have been developed for reconstructing indoor scenes by piecewise planar models from 3D point clouds [2] (see Fig. 1), from single images [3] and RGBD images [4,5]. Other methods (e.g. [6]) try recognizing the various urban objects composing a scene without modeling them in 3D.

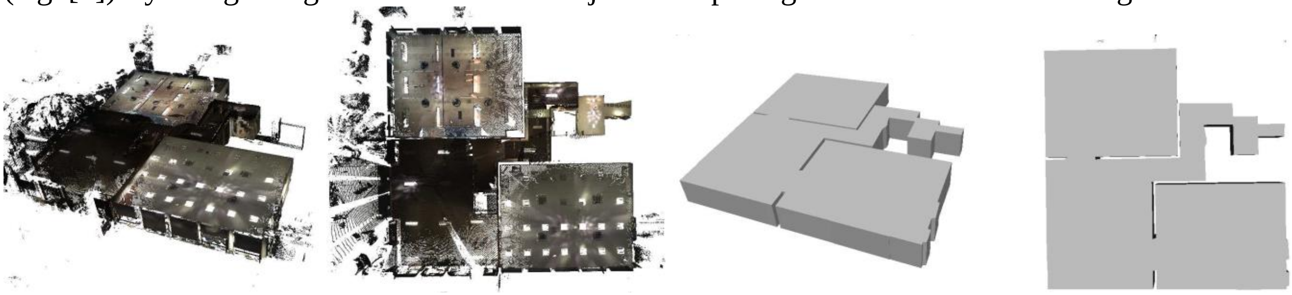

Fig.1 – Laser point cloud of an indoor scene and the associated 3D model reconstructed by [2].

Objectives

The objective of this PhD is to study the automatic 3D reconstruction of indoor environments from low cost devices, typically photos from a smartphone. In particular, we aim at modelling in 3D structural components of indoor scenes such as walls, floors, ceilings, windows and staircases. The input data will be composed of (i) a picture of building floor maps (e.g., fire exit plans) and (ii) multiple photos of each rooms. The floor maps will be used to produce a coarse 2D planimetric model that captures structural and non-structural walls as well as doors, staircases and lifts, whereas the multiple photos of each room will serve for (i) lifting the 2D model into 3D and (ii) texturing the coarse 3D model

The project will explore the following research directions:

- *Semantic segmentation of floor maps* – It will consist in segmenting the floor plan into semantic classes for locating and extracting the vertical structural components (walls, doors, staircases and lifts). Instead of labeling the floor plan image at the pixel level, one interesting research direction to explore will be rather to rely on a geometric partition of the images by efficient 2D geometric data structures as Voronoi diagrams (see Fig. 2) obtained using [8] for instance. With such polygonal cells as atomic surface elements, one may be able to capture high order geometric clues from the image without ad-hoc processes, and obtain a clean vectorization of the 2D model.
- *Camera calibration of the multiple photos* – We will investigate on the efficient registration of photos for each room from the output of the previous step. Simultaneously, one will try to estimate the ceiling height of the room from geometric clues. In particular, considering information on room corners will be an interesting idea to explore.
- *Texturing of the 3D model* – Once the photos will be registered on the coarse 3D model, we will investigate on the optimal way of texturing the 3D model, with a correction of intensity variation between image transitions. We aim at developing a robust algorithm that produces

visually consistent texturing even in presence of inaccurate surface geometry and noisy camera poses. One possible solution to explore will be to formulate such a texturing problem as a labeling energy minimization by assigning to each surface component of the mesh one image index specifying which image should be used to texture the surface component. As indoor lighting conditions can be inconsistent within the same room, we will also investigate on a global approach for rectifying radiometry over the whole 3D model assuming neighboring rooms with similar shapes are likely to have partially identical textures.

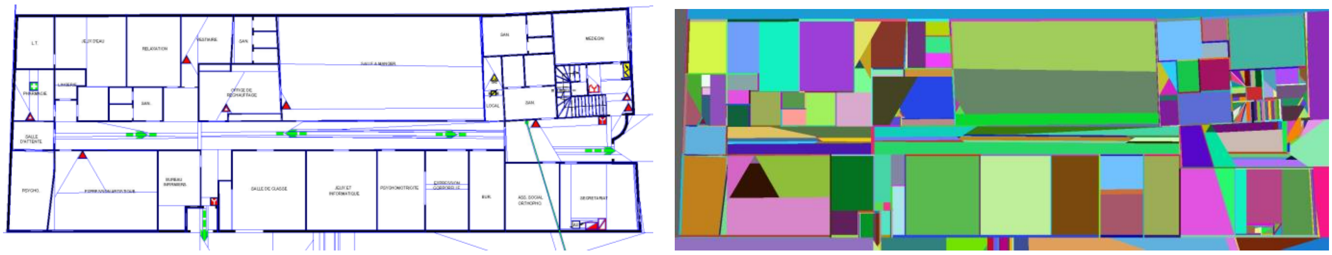

Fig.2 – Decomposition of a floor plan (left) into polygons (right) by using [8]

Keywords

Computer vision, geometry processing, surface reconstruction, 3D modeling, urban scenes, point clouds

Candidate profile

The ideal candidate should have good knowledge in computer vision, 3D geometry and applied mathematics, be able to program in C/C++, be fluent in English, and be creative and rigorous.

Location

The PhD will take place at Inria Sophia Antipolis, on the beautiful French riviera. The research will be conducted in the Titane group (https://team.inria.fr/titane/). The group does research on geometric modeling of complex environments.

Application deadline: 9th of October 2017

Contact

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References

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