BUILDING MODELING USING AERIAL AND TERRESTRIAL DATA

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Abstract

This poster presents researches dealing with the 3D building modeling. In the last decade, the mapping field has strongly evolved due to the needs of industrial and institutional applications, as well at civil level as military. At the French National Mapping Agency, approaches have been developed in order to model building facades and/or roofs using laser and image data acquired by terrestrial and aerial mobile mapping systems. The objective is a full building modeling.

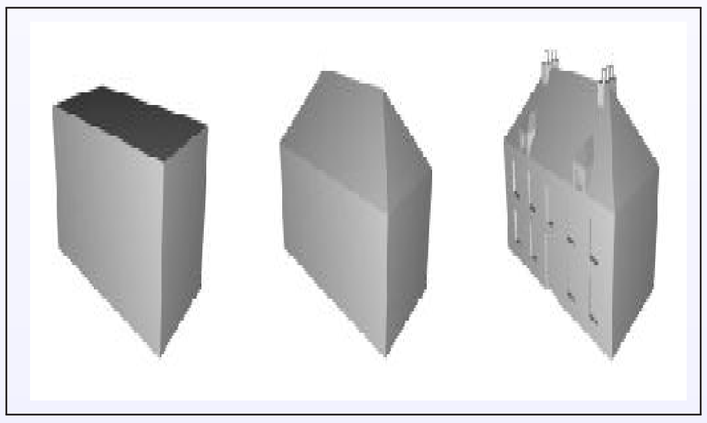
1. Fields of application

- Generating virtual scenes for navigation (tourism)
- Increasing the realism of models for simulators (aeronautic)
- Object recognition for machine guidance (military applications)
- The conservation of architectural works (cultural heritage)

2. Problems

Complexity in reconstruction

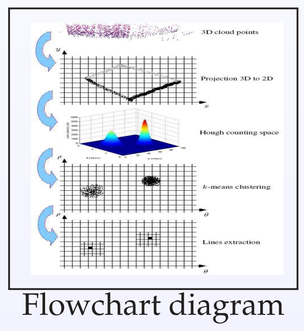
- Diversity of shapes
- Dense urban areas (Occlusions)
- Data resolution
- Angle and scale of view
- Mobile and real acquisition
- Required level of details



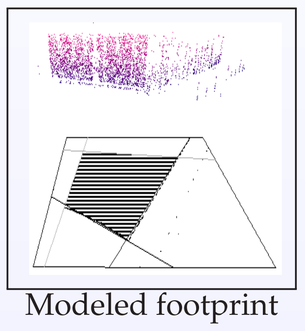
Various types of detailed building according with targeted applications

3. Footprint extraction

The generation of building footprints (individual or in block) using terrestrial laser scanning from a Mobile Mapping System (MMS) has been addressed in [1]. The MMS constitutes a fast and adapted tool to extract accurate data at street level. Urban environments evolve over time due to human activities. The structures of the cities are constantly modified. Currently, building footprints can be generated using aerial or cadastral data. However, aerial-based or cadastral-based building footprints lack precision due to the nature of the data and to the associated extraction methods.



Flowchart diagram

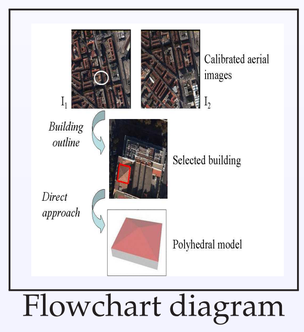


Modeled footprint

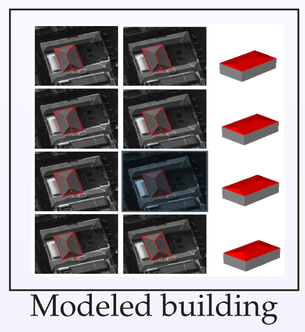
The proposed approach employs georeferenced terrestrial laser rawdata in order to extract accurate and georeferenced polygonal building footprints having simple shapes.

4. Building modeling

A model driven approach is proposed in [2] for extracting simple 3D polyhedral building models from georeferenced aerial images. The novelty of the approach lies in the use of featureless and direct optimization based on image rawbrightness. The 3D polyhedral model is estimated using a stochastic and genetic optimizer that minimizes a global dissimilarity measure. The proposed approach gives more accurate 3D reconstruction than feature-based approaches since it does not involve intermediate noisy data (e.g., the 3D points of a noisy Digital Elevation Maps).



Flowchart diagram

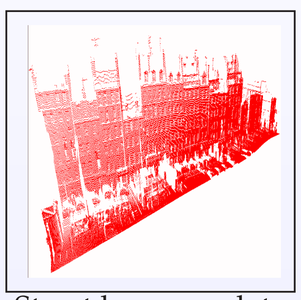


Modeled building

A building footprint is initially selected as reference in at least one image. The modeling process estimates the building parameters registering implicitly the unselected footprints in the remaining images.

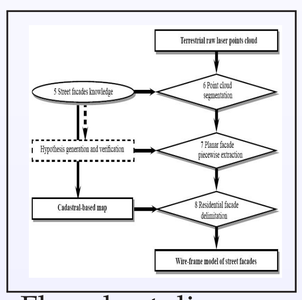
5. Facade modeling

An approach for extracting rectangular wire-frame models of street facades has been developed (extension of [3]). Georeferenced terrestrial laser rawdata are acquired by (MMS). The MMS allows to massively collect data at street level. After a filtering step of the 3D raw point cloud of street, the street point cloud is segmented into a cloud of dominant facade walls. Quasi-planar facade clusters are then extracted using an adapted Progressive Probabilistic Hough Transform (PPHT). At the planimetric level, a cadastral map (building footprints) issue from an urban database is employed to segment the planar clusters into residential facade portions. Finally, each portion is vertically delimited using heuristic approaches. The adapted PPHT allows the automatic modeling of facade boundaries with a fine facade line detection and a low computation time. The adapted approach has been tested on a set of point cloud acquired in the city of Paris under real conditions.

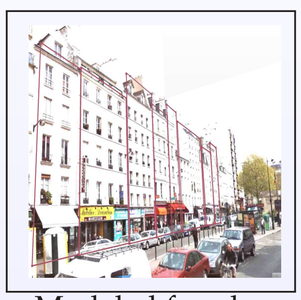


Street laser rawdata

Cadastral map



Flowchart diagram



Modeled facades

6. Conclusion

This poster presents a brief description of the developed approaches for 3D building modeling. The approaches using aerial images usually provide a satisfying reconstruction at roof level. Besides, approaches using terrestrial image and laser data are developed in order to complete the aerial-based building model. On the one hand, a fine facade model could be merged (full detailed building model); on the other hand, the building model could be registred to a georeferenced terrestrial global map more accurately. For these reasons, a registration process between the extracted aerial-based and terrestrial-based models will be envisaged in the future.

References

[1] K., Hammoudi, F., Dornaika, N., Paparoditis, Extracting Building Footprints from 3D Point Clouds using a Terrestrial Laser Scanning at Street Level, *In ISPRS/CMRT - International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences*, Paris, France, 2009.

[2] F., Dornaika, K., Hammoudi, Extracting 3D Polyhedral Building Models from Aerial Images using a Featureless and Direct Approach, *In IAPR/MVA Machine Vision Applications*, Tokyo, Japan, 2009.

[3] K., Hammoudi, F., Dornaika, B., Soheilian, N., Paparoditis, Extracting Outlined Planar Clusters of Street Facades from 3D Point Clouds, *In IEEE/CRV - Seventh Canadian Conference on Computer and Robot Vision*, Ottawa, Canada, 2010.