Evaluation and selection of 3D city modelling techniques

IGN - MATIS lab.
Saint Mandé - France

PhD thesis proposal

We aim to individually evaluate each building reconstructed in 3D using Very High Resolution (VHR) optical images. Detected errors will be ranked, and a human operator will then validate or invalidate such errors. It will help us (1) robustifying the learning process of acceptable 3D reconstructions, given a level of details, and (2) upscaling the process with a direct labeling of new areas. Various 3D modeling techniques will be compared in order to assess which one(s) is(are) the most suited for which urban environment.

Context

Accurate 3D topographic modeling is a invaluable input for many applications such as weather and ecological simulations, telecommunications, urban planning, virtual tourism, ... This is all the more true in urban environments where very high geometric accuracies are expected. In particular, building roofs and individual roof facets should be correctly reconstructed. However, the generation of such 3D databases with the significant help of human operators is highly expensive and remains tedious, even when semi-automatic tools are inserted. The results may also be unsatisfactory in terms of topology.

Consequently, many automatic approaches were developed in the last twenty years in many private and public companies, and in particular in the MATIS and TITANE labs of IGN and INRIA, respectively. Proposed methods depend on the level of details that is expected and the spatial resolution of the input dataset (0.1-1 m for multi-view optical images and 5-100 pts/m² for 3D point clouds). Nevertheless, various important issues still exist, related to computing times, geometric quality, upscaling, or environment-specific analysis etc.

No fully satisfactory method has been developed so far and can even be designed. Furthermore, even in case of reliable building reconstruction for a given environment and level of details, no method has been designed to evaluate such outputs.

In this PhD work, we aim to develop a semi-automatic building modeling evaluation method using VHR multi-view optical images (0.1 m). We target to take benefit from human operator inputs to validate, refine, and upscale the diagnosis process, based on a supervised classification of each building roof. The proposed evaluation approach, in its most automatic version, will also be used to select the most appropriate approach(es) for reconstructing a given environment (dense urban centers, residential areas etc.)

Workflow

The PhD work will be divided into three main tasks:

i) 3D city model evaluation using supervised classification techniques with robust 3D geometric feature extraction;

ii) Statistical improvement and upscaling using a semi-automatic error labeling process;

...
iii) Comparison of various reconstruction techniques, more-or-less constrained and more-or-less adapted to various levels-of-details.

Application requirements

— The candidate should belong to one of the country of the European Union or to Switzerland;
— Strong knowledge in image processing, computer vision/computer graphics, and remote sensing;
— Good knowledge of programming language (C++) is mandatory.

Supervision

— Clément MALLET - IGN/MATIS lab. (Saint-Mandé, France) – Personal webpage;
— Florent LAFARGE - INRIA/TITANE (Sophia-Antipolis, France) – Personal webpage.

PhD location

The PhD work will be carried in the MATIS lab. of IGN, which is the French Mapping Agency. Saint-Mandé is located near to Paris with direct access with the subway.
The MATIS laboratory of IGN is specialised in photogrammetric computer vision, image analysis and remote sensing from both geospatial imagery of and ground based imagery (e.g., provided by mobile mapping systems). It is composed of 35 researchers, including 16 permanent researchers.

Contact

Contact Clément MALLET – clement.mallet@ign.fr – for more information about any aspect of the position and research topic.

Application

Application should include:

— a CV;
— a motivation letter, linked to the PhD thesis topic;
— the recommendation letter of the responsible of the Master thesis (or equivalent) and any other relevant support letter;
— In a single PDF file.

We remind you that the applicant should come from one of the country of the European Union or Switzerland.
Every application that does not fullfil all elements required above will be silently ignored.