

## **Open PhD position at IMAGINE starting in 2018:**

### **Generation of urban models with building and district typification from low-cost data**

#### **Context**

The challenges of sustainable development and the transformation of the construction sector are pushing the stakeholders to rethink the methods of design / construction / management of buildings and urban spaces. However, the development of new methodologies and services (such as simulations and optimizations) based on virtual clones of buildings can only address the very limited fragment of the stock for which a BIM model exists.

At building scale, BIM generation is more and more mature. Several fast and economical methodologies exist or are under research to reconstruct BIM models of existing individual buildings adapted to different uses.

At the urban scale however, BIM generation has not yet reached its maturity. A high-level assessment of existing urban districts – for example evaluating energetic needs, impact of refurbishments, amount of embedded construction materials, etc. – requires up-to-date digital models. But building scale methodologies are not scalable to a city or territory without a high amount of manual labor, and other economical reconstructions – based on photogrammetry for example – address only the geometric reconstruction of buildings, with no rich associated semantics allowing to address such urban scale uses.

#### **Objective**

The objective of this thesis will be to define a methodology and prototype allowing to generate a simplified geometric and semantic urban model suitable for relevant urban scale simulations such as energetic simulations and life cycle management.

The methodology should rely on data easy to acquire. While for the French territory a larger amount of data exists – e.g. cadaster, fiscal information per household or estimated energy consumption – this information is not always available on foreign territory, may be outdated or be acquired to different standards. Relying on available or easy to acquire data like street level photography guarantees a universal applicable method.

The output expected is not an accurate representation of the city or territory, but a typification of buildings and districts according to construction type, urban layout and other relevant parameters to define, and including some useful semantics such as usage (residential, office, ...).

#### **Expected results**

During this thesis, we will determine which relevant parameters can be derived from photographic input data to address urban scale use cases. These parameters will then be used to classify and typify buildings and districts into classes, which would allow for statistically relevant semantic enrichment of missing parameters using other available databases or expert knowledge.

#### **The lab**

This thesis is a collaboration between CSTB (the French Scientific and Technical Center for Building) and Ecole des Ponts, also called ENPC (one of the top scientific school in France). More precisely, the work will take place in the IMAGINE group of the LIGM lab at Champs-sur-Marne (20 min from Paris by RER A), with a few possible trips to the CSTB at Sophia Antipolis.

IMAGINE is a research group on computer vision and machine learning. It has a long record of excellency for developing techniques for 3D reconstruction (e.g., technology transfer in the Acute3D startup in 2011) and semantic analysis (e.g., with CNNs or shape grammars).

The thesis will be co-supervised by Pascal MONASSE and Renaud MARLET (ENPC).

### **Profile of applicants**

- very strong academic record with an excellent degree (M.Sc., M.Eng. or equivalent) in Computer Science, Mathematics, or a related field (e.g. Electrical Engineering),
- excellent knowledge in computer vision (including 3D vision), good knowledge in machine learning and computational geometry,
- very good programming skills.

### **Application**

To apply, please email

- your CV,
- a transcript of your MSc grades/marks (even if incomplete),
- a report you wrote for your MSc thesis or for a previous internship,
- reference letters of previous supervisors or professors, or names of references,
- a brief description of your research interests highlighting the links between your education/training/experience and the thesis topic,

to:

- [pascal.monasse@enpc.fr](mailto:pascal.monasse@enpc.fr),
- [renaud.marlet@enpc.fr](mailto:renaud.marlet@enpc.fr)