PhD in Architecture. History and Project

Research Title: 3D city model/digital twin

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Funded by
FULL_ Future Urban Legacy Lab and Geomatics Lab for Cultural Heritage

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Context of the research activity
The urban realm is by its nature a complex and cross-disciplinary field of researches and practices. It configures both the key source of economic growth and the place of growing inequalities where challenging demands and organized potential to elaborate answers – in terms of social innovation and applied technologies – spatially concentrate. Studying the urban realm as a space offers the unique chance of re-joining the separated paths of human sciences, hard sciences and design sciences.

FULL-The Future Urban Legacy Lab., based at Polito, aims at providing knowledge and action in the field of relevant global urban challenges and to support local decision-making processes. The acronym FULL welds legacy and future, which are intended as the socio-technical products of layering processes in space and time. For this very reason, FULL participates in the objectives and research programs of DASP PhD Programme, to highlight an interdisciplinary approach to urban studies integrating social sciences to technical ones. FULL mission is to explore, imagine and design the urban future by understanding and
activating the potential of physical and organizational forms of inherited urban settings. Transformative attitude towards urban phenomena is the ideal testing ground of FULL research work. FULL added value is to boost established research experiences at Polito in order to link analytical and empirical methods together with evidence-based action. In parallel, the aims of the Geomatics Lab of cultural heritage is to deal in the field of survey, processing, representing, managing and make available geospatial information to fit many demands of documentation and analysis concerning built heritage and urban spaces and legacies. That requests the use of spatial data and processing in the form of maps, 3D models, other geo-located data to be produced or to be retrieved from available spatial data infrastructure. Data integration and fusion need to face harmonization processing both to geometric and semantic contents, with the aim to produce interoperable spatial and non spatial databases based on standards.

Within the FULL and Geomatics Lab research framework, PhD candidates will define their specific research interests in accordance with the general themes to which FULL and Geomatics LAB devote most efforts. 3D models of cities and their buildings, including geometric and semantic information, have been largely acknowledged as a powerful tool for many research fields and application use cases (building and infrastructure design, restoration support, urban planning, assets management, etc.). Besides the BIM (building information models), the development of HBIM (historical BIM) is also of topical relevance, when historical architectural assets are involved. The great development (in number and functionalities) of BIM systems and tools, leads to relevant questions about how to actually enhance their flexibility, in order to make their exchange, maintenance and re-usability effective (e.g. to integrate the urban mapping products, in which buildings play a major role).

The use of open standards is almost mandatory, but many issues are currently critical. Industry Foundation Classes (IFC) by building SMART is the affirmed open standard for buildings managing through BIMs, while many other standards exist for the same objects, concerning the buildings and their urabn and territorial contexts (OGC CityGML, gbXML, the INSPIRE data model, national standards). Their effective integration has been the topic of many researches, using different approaches (manual,
mapping approaches, ontologies, and many more), but there is no final solution yet.

DASP PhD candidates working in FULL should hold a Master Degree in Architecture, Urban Planning or buildings Engineering. Competences of candidates are requested in the field of urban studies, in particular: Geospatial data modelling using interoperable data and tools based on standards. A selection of themes on which good competence are requested are the following:

**Skills and competencies for the development of the activity**

Instruments and methods for spatial data collection:
- terrestrial laser scanning
- photogrammetry SfM based
- Topography and GNSS
- SLAM based techniques
- Multi-scale data fusion

Method and tools for spatial data store
- BIM /HBIM models derived from points clouds,
  - Data acquisition and processing in BIM and HBIM,
  - rapid digitalization, model accuracy,
  - informative contents: Level of Details (LOD), Level of Delvelopment,
  - models inventories,
  - semantics for BIM/HBIM,
  - openBIM, GeoDB BIM,

We welcome candidates with a strong independent and critical thinking, skills in the use of the various sources of urban research. DASP PhD candidates working in FULL and Geomatics Lab are requested to work in a multidisciplinary team. Knowledge of another European language and previous international experiences will be appreciated.