

PhD in Architectural and Landscape Heritage

Research Title: AI for Heritage

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Context of the research activity	<p>The recent scenario of the Architectural Heritage 3D documentation is supported by a wide offer of geomatic methods. Their versatility covers many fields of study characterized by multi-scale and multi-sensor approaches, but a significant amount of the necessary processing still requires very specific, subjective and time-consuming procedures.</p> <p>Although the development of automatic solutions for data acquisition and processing has been greatly pushed forward by the technological innovations of the last 20 years, some phases are still monotonous and repetitive and they require particular involvement of an operator in intelligent interventions.</p> <p>In this context, artificial intelligence (AI) algorithms can nowadays provide a valid contribution for various purposes thanks to the last developments in the field and their deployment to the metric documentation of Heritage. Many important actions can be significantly supported by machine</p>
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	<p>learning and deep learning techniques applied to images, point clouds or meshes: recognition of significant objects, semantic selection and segmentation of elements within 3D datasets, automatic classification of particular degradation materials, automatic instance segmentation of geometric elements for BIM purposes, etc. Such AI techniques, proving to be a completely innovative approach, certainly offer an increasing efficiency and effectiveness in the Heritage digitization and documentation processes.</p>
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<p>Objectives</p>	<p>The specific objective of the PhD study is to train a researcher profile that is able to recognize, in the critical and interdisciplinary approach to heritage knowledge and documentation, as for all BAP candidates, a fundamental point of any type of possible intervention. In particular, the 3-year research will aim to develop a complete framework, based on machine learning and deep learning techniques, for Heritage 3D documentation and classification at different scale. Starting from acquired 3D data, the candidate will define a processing pipeline, based on AI solutions, for data processing and interpretation, comparative analyses, feature extraction, semantic segmentation and virtual access. Among the objectives of the research, there will be to understand existing AI solutions and adapt them to heritage datasets, with the goal of extracting semantic information constituting an added value in the field.</p> <p>The specific applications will be identified in areas of common interest of the Geomatics Laboratory for Cultural Heritage of the Polytechnic University of Turin and of the 3D Optical Metrology (3DOM) Unit of FBK Trento. Application scenarios will be identified in the context of urban architectural heritage, for morphology-oriented studies, or on extensive architectural complexes, isolated or disseminated in the territory.</p>
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<p>Skills and competencies for the development of the activity</p>	<p>BAP PhD candidate work will be planned as a shared schedule: partly in the Geomatics Laboratory for Cultural Heritage of the Polytechnic of Turin (G4CH) and partly in the 3D Optical Metrology unit of FBK Trento (3DOM). The candidate should hold a Master Degree in Architecture, Buildings Engineering or Civil Engineering. Competences of candidates are requested in the field of 3D digitisation applied to cultural heritage, in particular: Geospatial data modelling using interoperable data formats and tools based</p>
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on metrically controlled 3D models (point clouds, surfaces, imagery) as well as some computer science knowledge. In particular, the following knowledge and competences are recommended:

Instruments and methods for spatial data collection:

- terrestrial laser scanning
- Terrestrial and UAV photogrammetry
- Topography and GNSS measurements
- SLAM-based techniques

Method and tools for spatial data processing and management:

- Multi-sensor multi-scale data fusion
- Reality-based 3D modeling using 3D surveying data
- BIM / HBIM
- Skills in programming and developing

We welcome candidates with a strong independent and critical thinking, with great ability to work in collaborative, interdisciplinary and international research environments, with self-motivation and ability to complete tasks systematically and autonomously, with flexibility and adaptability.