Doctoral Dissertation
Doctoral Program in Architectural and Landscape Heritage (31th Cycle)

Geomatics support to the metric documentation of the archaeological heritage. Tests and validations on the use of low-cost, rapid, image-based sensors and systems.

Abstract

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Abstract

The research that will be presented in this thesis work is dedicated to the geomatic support to the metric documentation of Cultural Heritage (CH) and in particular of the archaeological heritage. Several aspects connected with this topic will be addressed during the development of this contribute, especially related with the sustainability of the employed techniques, their main characteristics and the implications connected with their deployment. The concept of sustainability of an approach to the documentation of a CH artefact can present several facets and was thus treated considering different aspects in the course of this dissertation. The first element connected with the concept of sustainability is related with the time component: this element has become a crucial point in the last years and for this reason the concept and the issues related with the definition of rapid mapping and its fields of application have first been defined in this contribute. A second element is the economical sustainability of the instruments and techniques deployed to solve the task of CH documentation: for several reasons, especially in the field of archaeological documentation, the available resources faced a constant decrease in the last years, leading to the attempt of different researchers to stress all the available technological and methodological solutions in order to reach the best optimised balance between costs and performances in the deployment of different techniques. Connected with these issues, is the optimisation of the employed resources: both in terms of the works of people involved in the process of documentation, both in terms of the technological solutions adopted and in the overall process of treatment of the collected data. Finally, the solutions adopted must also be sustainable in terms of response to the need of documentation of the users, i.e. the community of archaeologists, and the products derivable from these processes need to respond to the requirements of the different branches of archaeology and to support the research activities of this community.

Among the different instruments and techniques that the geomatics community can deploy to respond to these needs it was decided to focus on the image-based solutions, i.e. photogrammetry. These approaches are able to perfectly support these research issues, due their main characteristics: they are flexible, low-cost, adaptable to several situations and most of the times able to respond to differentiated needs of several research areas of archaeology. The methodology behind these approaches was thus reported and revised in this thesis and the main last research addresses were identified. This framework was ulteriorly restrict to two main categories of sensors: Unmanned Aerial Vehicle (UAVs) and spherical camera systems. Concerning UAVs systems, which are by now a consolidated field of research of geomatic with their own methodologies, the focus was set on operative issues connected to the optimisation of their use in context of CH documentation. Different tests were performed on CH site to set up the adopted methodological framework and more extensive analyses were achieved on two selected archaeological sites. Several aspects have been tackled, starting from the enhancement of the flight planning and camera orientation phases, through the different georeferencing strategies and finally till the use of the products generated in a photogrammetric approach. In this sense their use for multi-temporal monitoring of archaeological areas was an approach particularly researched.

On the other hand, the use of spherical system in a photogrammetric approach is a relative new field of research and the methodological validation of this approaches for task of CH documentation from the community of researchers is still ongoing. In this thesis work the aim was thus to test and validate the deployment on the field of such systems (and the use of the derived products), to underline the main issues that will need a further investigation in the following years and to try to define best practices and guidelines for their use in the field of archaeological documentation.

Finally, the possible integrations between the datasets acquired with these two systems were evaluated. In particular, the possibility of co-register aerial and terrestrial data derived from UAVs and spherical systems was stressed, in the direction of the future development of a multi-sensors and multi-scale approach between these two categories of sensors and techniques.