



## **Aerial multispectral surveys - from the analysis of architectural monuments to the identification of archaeological sites**

Bottoni Mario (1), Giuseppe Fabretti (1), and Maurizio Fabretti (2)

(1) Ministero per i Beni ed Attività Culturali, Istituto Superiore per la Conservazione e Restauro, Roma, Italia, (2) "C.D.A" Centro di Diagnostica Multispettrale, Roma, Italia

Combined non destructive and extensive multispectral analysis (thermography, photographic infrared and air photogrammetry) can be used, as aerial surveys, to verify and integrate hypotheses based upon investigations conducted on the spot and in the archives, about the location of archaeological sites in a certain area.

These techniques using specified sensors (photographic emulsions, semi conductors) enable one to record and visualize different optical phenomena, related to the wavelength of the radiations and to the thermal exchange between structures lying underground and the soil.

The information obtained has an extensive characteristic that can be transferred on maps.

The results are in practice continuous in the spatial dimension in a non destructive way, leaving the site perfectly undisturbed.

Relating to this first survey, it may be possible to locate the most significant areas and to proceed with more punctual multispectral surveys and local excavations.

The next step is to compare these results and to extend them to wider areas, establishing the significance of irregularities found with the aerial surveys and creating conclusive thematic maps.

These maps will give useful indications to define the archaeological excavation or the course of highways, water mains and other structures on the terrain.

This work presents the application of the method to the archaeological site of Fondo Marco Terenzio Varrone Cassino (Frosinone) under the control of the Archaeological Soprintendency of Lazio. The survey made it possible to determine the course of the water main of the town of Cassino through the archaeological area in a few months and with great reliability.

Actually use of aerial thermovision demonstrated itself very useful since nineties in the analysis of the micro-climatic behaviour of architectonic structures of significant dimensions, such as the dome of Santa Maria del Fiore in Florence. In this situation a mathematical model had been developed aimed to define the theoretical relationship existing between solar dynamics and the monument. Yet the information deduced from such a model, that could be easily examined by a user system realised on computer, had to be compared with real data obtained by thermographic surveys. This comparison was aimed to evaluate the contribution that other climatic phenomena and/or the dishomogeneities in the constituent materials could give to the recorded thermal distribution and then to the global thermal system. In other words, it was necessary to accomplish seasonal campaigns on field aimed to evaluate the significance of the theoretically computed data and then the reliability of the model as a way to foretell the actual behaviour of the monument from a thermodynamic point of view. The operative problem was to find locations that could be useful to accomplish significant recordings of the thermal behaviour of the various elements that constitute the Dome. A useful place was Giotto's bell-tower but it allowed a partial vision of the structure, it was instead necessary to obtain recordings, that could be considered practically instantaneous, of the whole dome. It was therefore necessary to flank the seasonal campaigns accomplished from the bell-tower with a survey accomplished by air recordings from an helicopter. Security reasons and the high costs (in terms of resources and persons) of such an investigation compelled to optimise times and methods of air recordings. To this purpose the user system was used with the aim of defining a period that could conciliate the operative needs with the necessity of evaluating the significance of the mathematical model.

A short description of this case will be exposed to underline both the differences and the similarities between these two different ways to accomplish aerial multispectral analysis.