

POLITECNICO DI TORINO
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Honors theses

From images to models: image-based modeling principles in architecture and their integration with infrared thermography technique

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Using digital images to create 3D models is a three-dimensional survey technique developed in the last decade from the conjunction between photogrammetry and computer vision science; the technique is named image-based modeling. Its application in architectural heritage field allows to produce 3D building models including surfaces description with texture images and, aim of this thesis, with thermal images in the infrared spectrum.



figure 1

The result is the digitalization of architectural object that is useful to know it in its shape and dimensions, in its composition and to read historical changing over time with probable degradation phenomena. Therefore it becomes the support for its study and to eventually plan a refurbishment project, or to represents a kind of cataloguing to create a huge digital archive of architectural heritage.

Integration of thermal images in the model is not a trivial operation. In fact they present distortion due to the lens that could cause their incorrect location of images on the geometry.

It is very important the perfect association of IR images on the surfaces because anomalies are in precise areas and their incorrect position could evaluate fake alteration phenomena.

The same distortion problem can be observed in images taken in visible; in this case the correction could be done by dedicated software in order to avoid both the metrical error of model reconstruction and the inaccurate association of texture to correspondent area. In fact digital images are used to extract measure information and distortion aberration lead to unreliable reconstruction of the object.

The main purpose of the research was to figure out the methodology to delete thermal images' distortion. According to this aim, it was analysed the procedure of the software used for images taken in visible that use a manual interaction of the users.

It was faced the issue due to the acquisition of thermal images using the same procedure established by the programme for images taken in visible, in order to reach internal parameters (calibration) of the camera and to get distortion values. In this way it was obtained the geometric calibration of thermographic camera; only with distortion parameters achieved it is possible to solve the correction polynomial. Results were set in the software for texture application and the final model integrated with texture of materials descriptions and of temperature difference analysis was obtained.

The innovation of the integrated model are: possibility to locate and measure anomalies on the object and to read the thermal matrix related to thermal images. In fact traditional procedure of thermal images assembling, conducted until now, not allows to establish the precise metric position of anomalies and it cannot recover the original relation between thermal image and its temperature matrix.

Method experimentation was applied in two cases study: *The Fleur-de-lis Room* in Valentine Castle and in *S. Eldrado's Chapel* located in Novalesa Abbey (Italy).

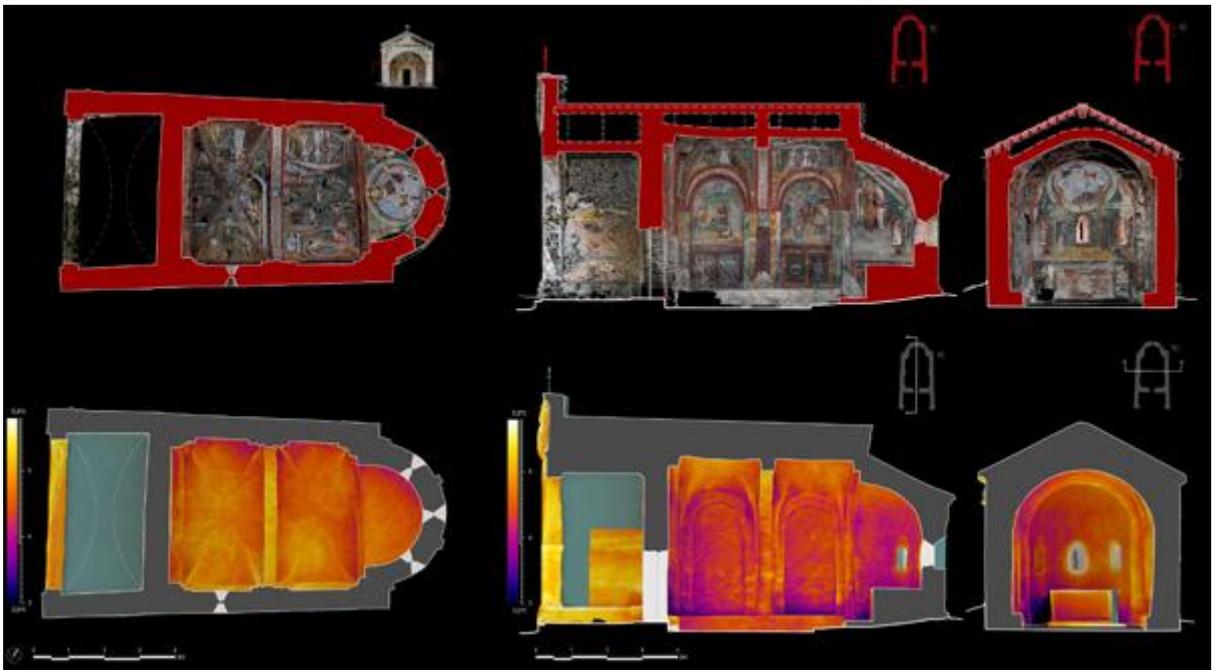
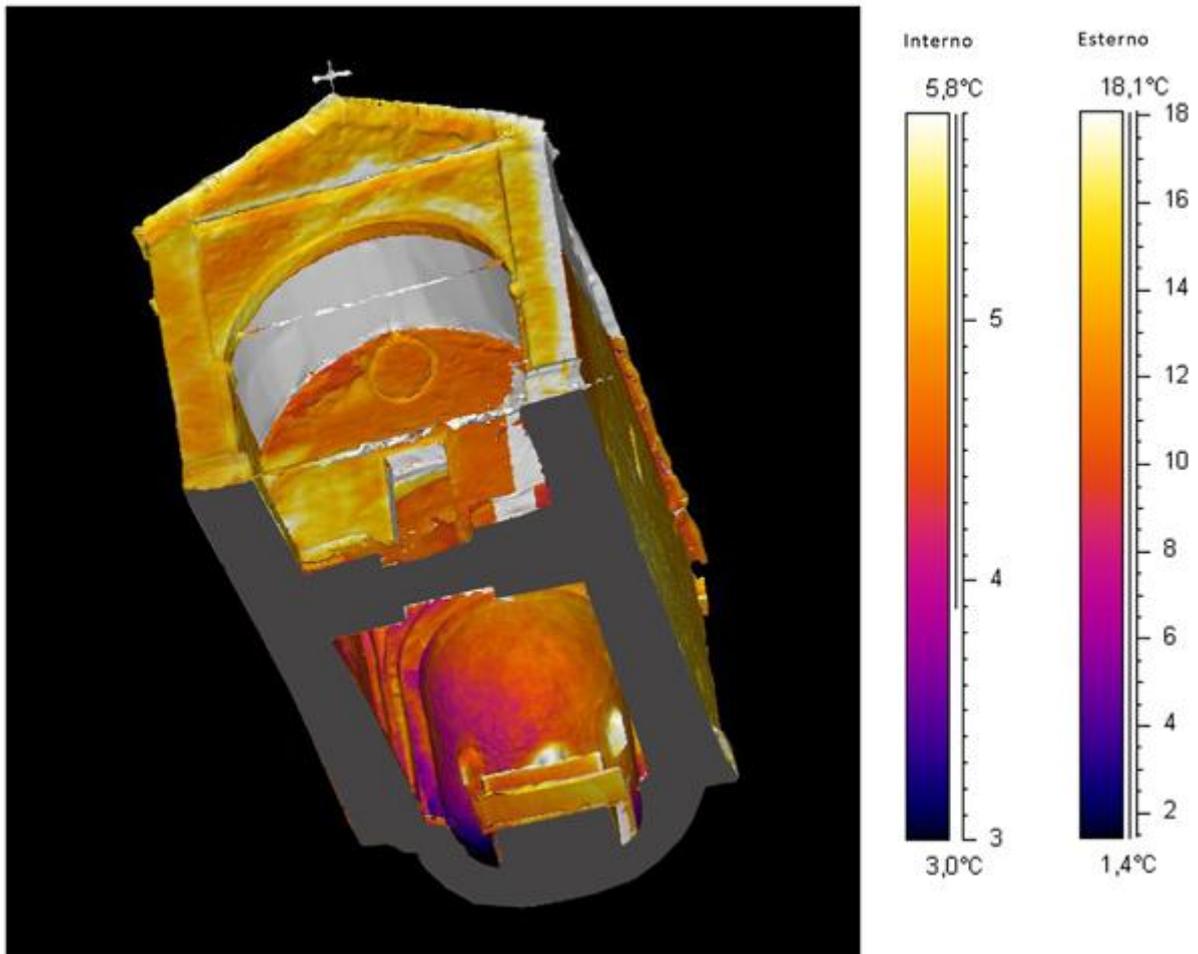


figure 2-3. Integrated model

In conclusion it was established a comparison between the more economical image-based modelling technique based on the use of photographic cameras and laser scanning approach which produces very accurate survey results but with high cost of instrumentation.

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