



## Application of Infrared Thermography to investigate the 14<sup>th</sup> century wall paintings at Germolles

**Reference:** Short Term Scientific Mission, COST TD1201

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### Short description

The 14<sup>th</sup> century wall paintings at Germolles' palace are a unique example of medieval decoration created in a transition time in France between the end of Middle Ages and the start of French Renaissance. They were covered by modern plaster at the beginning of the 19<sup>th</sup> century, rediscovered during the 2<sup>nd</sup> world war, partly uncovered in the 1970s, undergone a first conservation treatment at the beginning of the 1980s, and a complete conservation-restoration intervention between 1989 and 1994 by conservator Hisao Takahashi.

The wall painting decoration of Countess of Nevers' apartment are locally affected by delamination. In the dressing room the 19<sup>th</sup> C. Covering plasters have been almost entirely removed to reveal the 14<sup>th</sup> C. painting. Only the upper cornice have been preserved. Significant structural cracks run from the cornice into the decorated plaster and recent investigations have shown that an important risk that some sections are detacher and at risk of separating from their support. The objective of this STSM was record with IRT delamination in these areas.

Infrared thermography (IRT) is a technique widely used to document the structures and their condition. IRT reveals the infrared radiations (between 8 – 14  $\mu\text{m}$ ) emitted by the surface of an object. The resulting thermal image of the object can be produced in a colour or grey scale with each colour associated with a temperature.. Building structure composed by different materials (such as historic masonry or ceiling systems), when there is a natural or artificial temperature gradient, will present a different distribution of temperatures due to the different capacity in transmitting and holding heat. Heating and cooling processes enhance temperature differences; heating can be 'natural', by solar radiation (passive method) or 'artificial' using heating systems (active method). By heating, different surface temperatures are obtained in relation to the different thermal characteristics of the material but also because the detached zones (where plaster lacks adhesion to the support) contained air pockets between plaster and the support. Due to the presence of a pocket of air the plaster can warm up faster (during heating process) and cool down faster (during cooling process) as compared to plaster well adhered to the support.

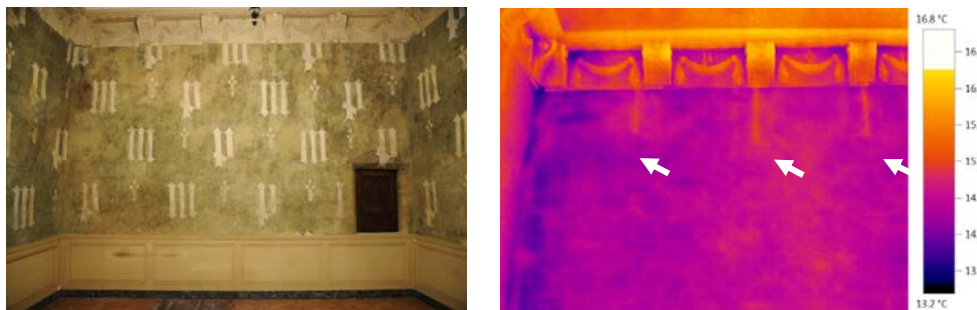


This allows to enhance differences which may not be as visible with passive thermography.

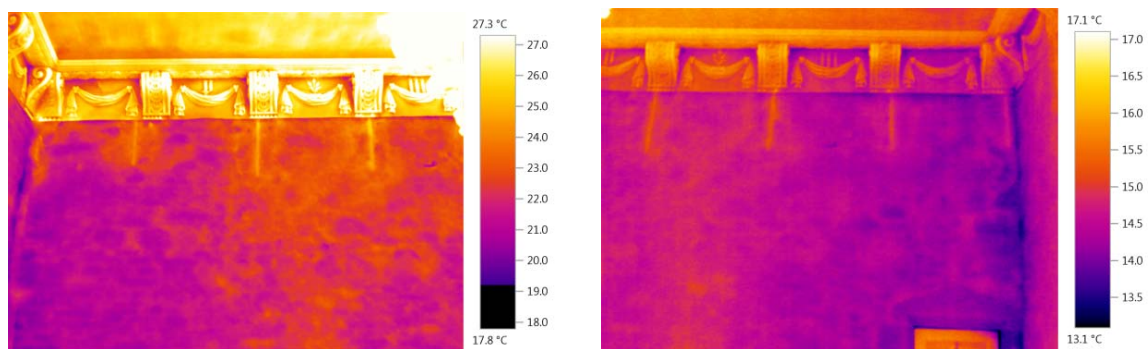
The objective for this fourth STSM at Germolles was to apply IRT (in passive / active modes and with dynamic recording), to identify and document the thermal response of the paintings and their supporting structures.

Images were collected with camera IRsoft (Testo) software. The post-processing of the images was made by IRsoft (Testo) software using an application developed by the authors using LabView® platform as a programming system.

Examination started on the western wall where more detachments were detected. The IRT pictures show the masonry texture and some constructive details such as the wooden slats (white arrows) in the upper parts of the walls.



Preliminary observation of the walls with passive IR thermography carried out on upper portion of dn west wall



Observation of the walls with active IR thermography of the south corner of the upper portions of dn west wall. The thermal images are more complete and show texture details.

IR thermography used in passive mode gave some preliminary information on masonry texture and construction details of the walls, but active IRT gives more clear results. Dynamic IRT enabled us to appreciate the level of detachment of the decorative plasters from the walls (the mainly west and north walls of Countess of Nevers' dressing-room) which were concentrated on the upper part of the walls.

To obtain more information on the wall structure, after heating, IRT images were recorded at regular time intervals (every 20 seconds) during the cooling phase. In post processing the cooling process of each pixel is analysed by FFT to obtain details not evident with the active IRT. Figures show that it is possible to recognize the brick texture in non-detached areas.



a

b

Fourier analysis applied to dynamic IRT on the west wall of dn (b) compared to detached zone identified on dn\_w. (a).

Dynamic IRT data analysed with FFT showed that internal walls in the château are made of bricks while external walls contain both stones and bricks. The walls were systematically assessed to detect delamination with the knocking method, the results were graphically mapped by Nutsa Papiashvili to show in Figure where detachment (identified by an hollow low frequency sound) was perceived. Mapping was done over an IR-reflected image of the wall (obtained with technical photography in a previous STSM) to allow to assess if the adhesion problems are somehow associated with reconstructed areas. Tactile assessment (knocking test) fully confirmed the results obtained by IRT, but no relationship was found with reconstructed areas.



a

b

Comparison between the graphical representation of the mapping result obtained by knocking method (a) and detached zones identified by IRT on the west wall of dn (b). There is a good correspondence with the results of the manual knocking tests, especially in the upper part.

If most of the work has been carried out in the Countess of Nevers' dressing-room, we have shown through preliminary tests that it could be extended to provide information on structure and condition of walls in other rooms of Château de Germolles.

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