Preventive Conservation in Historic Houses and Palace Museums: Assessment Methodologies and Applications

SilvanaEditoriale

Preventive Conservation in Historic Houses and Palace Museums: Assessment Methodologies and Applications

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and the Research Centre
of the Palace of Versailles (CRCV)

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With the patronage of

Experimental "Patrimex" Workshop at the Château de Fontainebleau

Abstract
The Foundation for Heritage Sciences ensures the scientific management of the Equipex Patrimex, it is a financed project within the framework of the investments for the future which constitutes a socio-technical network for the characterisation, the conservation and the restoration of material heritage in all its forms (monuments, statues, paintings, manuscripts, archives, old instruments). It brings together study tools using wave-matter interactions, distributed around four poles. The "mobile platform" pole has enabled the development and the acquisition of a certain number of analytical tools during the years 2013 to 2016. The project has arrived at the end of a first development phase, an experimental workshop was set up from April 24th to 28th, 2017. Its purpose was to bring to the site, in this case, the Château de Fontainebleau, the various mobile analyses techniques from the mobile platform to implement them on the same support. This made it possible to establish comparisons between the produced data, to show their complementarity in order to allow future users to better understand the use of these tools.

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The Foundation of Heritage Sciences (FSP) is a partnership foundation created by the universities of Cergy-Pontoise and Versailles-Saint-Quentin en Yvelines, the Louvre museum, the Palace of Versailles and the Bibliothèque Nationale de France.

Placed under the patronage of the ministry of Culture and Communication, it also includes several cultural institutions (National Archives, the Quai de Branly Museum, Pompidou Centre), training institutions (Institut National du Patrimoine) or research structures (Laboratoire de Recherche des Monuments Historiques – LRMH, the Museums of France Research and Restoration Centre – C2RMF, the Research Centre on Conservation – CRC...).

The FSP's ambition is to structure and finance research around tangible cultural heritage, in several fields: knowledge, improvement of conservation and restoration methods, finally, dissemination and sharing of knowledge.

The Foundation ensures the scientific management of the Patrimex Equipment of Excellence, a project financed under the investments for

the future, which constitutes a socio-technical network for the characterisation, conservation and restoration of tangible heritage in all its forms (monuments, statues, paintings, manuscripts, archives, old instruments). It brings together study tools using wave-matter interactions, distributed around four poles.

On the Neuville site of the University of Cergy-Pontoise, new laser tools are developed to meet the challenges of characterisation and restoration of material heritage. The results obtained will promote a much detailed knowledge of tangible heritage, suggesting, for example, new restoration techniques.

Embedded versions in a mobile platform supervised by the LRMH (Laboratoire de Recherche des Monuments Historiques) allows on-site analysis, for all historical monuments and heritage works that cannot be moved.

As part of IPANEMA, a new light line of (PUMA) dedicated to the study of heritage materials is located within the prestigious SOLEIL synchrotron. This instrument makes it possible to explore in a non-destructive way the heart of the matter thanks to the radiation produced by the circulation of electrons at a speed close to that of light.

All information collected will be digitally preserved and accessible to the involved laboratories through the creation of an innovative database, a real information system dedicated to the study of tangible heritage and the transmission of the associated knowledge.

Having reached the end of the first phase of development (acquisition, adjustment and installation of equipment), the continuation of the project required the organisation of an event to put in the situation of various techniques present in Patrimex. Thus was born the idea of setting up an experimental workshop.

The Château de Fontainebleau conservation team has agreed to host the event held from April 24th to 28th, 2017. Various study supports were discussed. The final choice fell on two of the castle's spaces:

– The Saint-Louis vestibule: not open to the public, this room is located in the dungeon, the oldest part of the castle. Under Louis-Philippe, this space benefited from a painted neo-Gothic style decor. Today attacked by the presence of salt and capillary rise, this decor requires an analysis to prepare for its eventual restoration, especially for the "Louis-Philippe in Fontainebleau" exhibition which is in preparation.

– The salon known as the King of Rome: This space is located at the end of the gallery of Diana. This gallery built under Henri IV included a wooden ceiling with wooden framed walls whose plaster was painted with scenes from the history of Diana and Apollo. The walls included panelled woodwork surmounted by battles of the king and

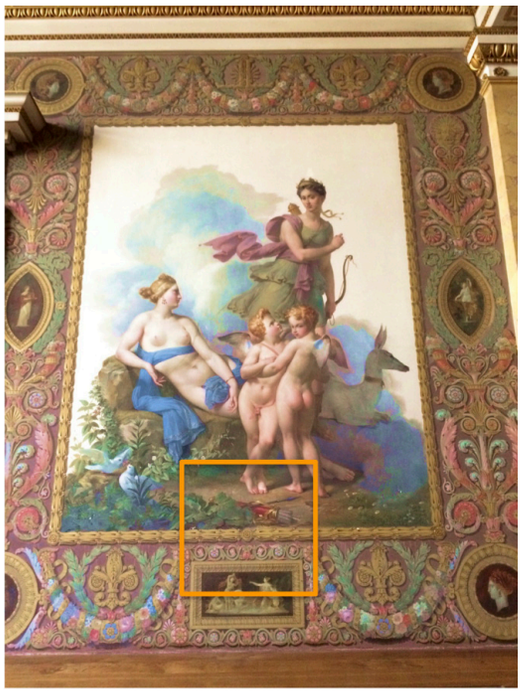

Fig. 1
Wall painting concerned by the analysis, the salon of the King of Rome, Château de Fontainebleau.

Fig. 2
Visualisation of the analysed area in the bands corresponding to wavelengths 1200 nm.

Fig. 3
Visualisation of the analysed zone in the bands corresponding to the wavelengths 2000 nm.

deities. Very ruined at the end of the Ancien Régime, the gallery underwent a general restoration in 1810. Napoleon then projected a new decor evoking the actions of his reign. The Restoration completed the project, which was replaced by a set of paintings representing the history of the monarchy. Under the Second Empire, the gallery was transformed into a library. The space that hosted the experimental workshop has retained its decor of the First Empire. Currently very under-studied, this set of plaster and painted stucco raises questions about its composition.

The defined objectives were the following: to bring on the same site different analysis techniques in order to implement them on the same medium, to make comparisons between the produced data and

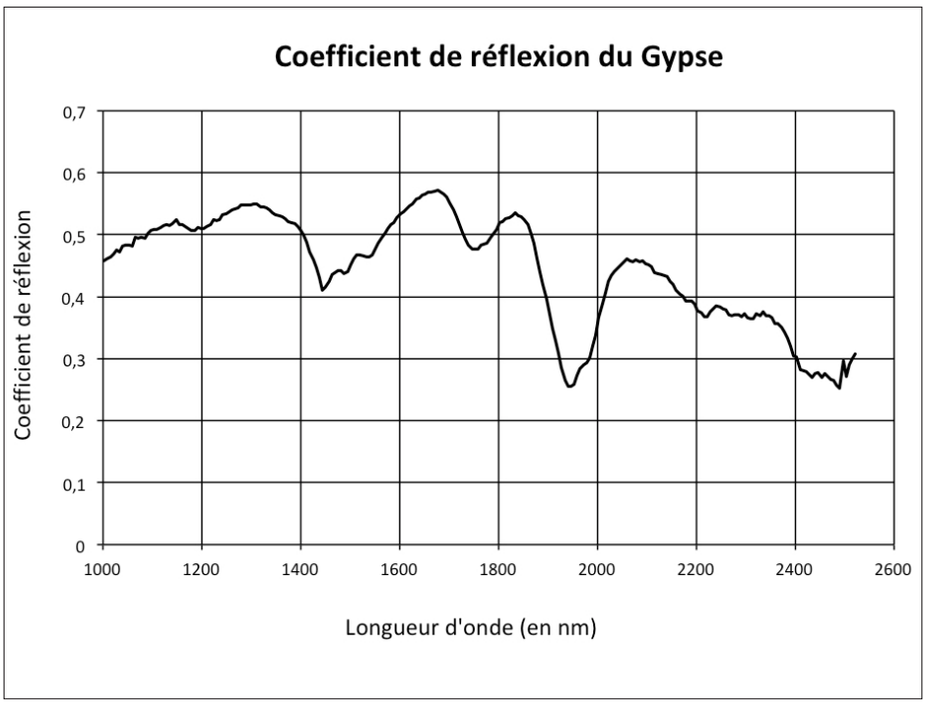

Fig. 4
Spectrum of reflection highlighting the uniform presence of gypsum.

especially to allow future users to better understand their use. The duration and the constraints related to the setting up of such an operation within fragile spaces did not make it possible to proceed to the delivery of data directly exploitable by the conservation team and the restorers of the site. Only reflections and information on the relevance of certain techniques in relation to certain mediums could be presented.

A certain number of mobile techniques have been put in place, which can provide information on the structure of the studied materials (Raman spectroscopy and mid-infrared, X-ray fluorescence, etc.). We will only detail here the techniques which gave directly exploitable results.

Hyperspectral Imaging in the Near-Infrared

Hyperspectral imaging is an optical analysis technique (non-destructive and contactless) which allows the acquisition of images containing, not three (as in conventional digital imaging – RGB) but several hundred channels covering a wide range of wavelengths, from visible to far infrared. Initially developed for teledetection (mining), these techniques are now extended to other fields of application: industrial, biomedical and more recently for the study and conservation of heritage objects. The processing of the information contained in these cubes of data can lead to the characterisation and identification of materials, and then to their mapping. The hyperspectral imager financed by Equipex Patrimex works in the near infrared, at energies just below

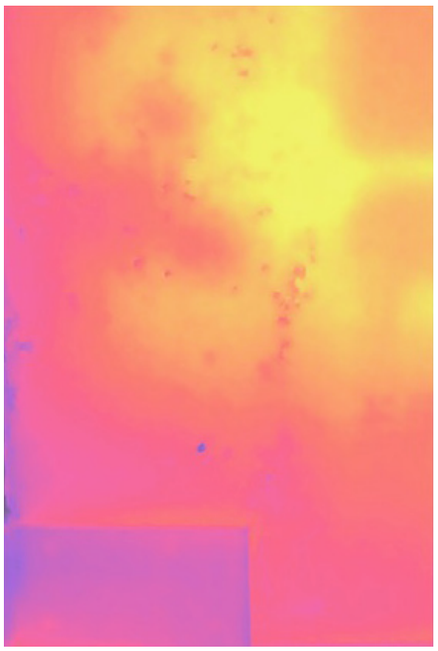

Fig. 5
West wall of the Saint-Louis vestibule, Château de Fontainebleau, detail.

Fig. 6
Infrared image of a portion of the west wall of the Saint-Louis vestibule highlighting a cold spot (blue area).

the visible energies. The measurements taken at the Château de Fontainebleau were made in the salon known as the King of Rome, located on the murals at the end of the gallery of Diana. The image area was relatively limited so as to minimise exposure and measurement time. Figure 1 illustrates the concerned wall painting and the analysed area. Figures 2 and 3 show the visualisation of the analysed area in the strips corresponding to the 1200 nm and 2000 nm wavelengths. In this area, no underlying amendment or outline could be detected. The data cube also makes it possible to extract for each of the present pixels their spectrum of reflection, it has made possible to highlight the uniform presence of gypsum, as illustrated in figure 4. The further identification of the various constituents could be considered by coupling these analyses in the near-infrared to those in the visible field, but also with an elementary identification such as X-ray fluorescence.

Stimulated Infrared Thermography

Stimulated infrared thermography is based on the analysis with a thermal camera of the temperature response of a previously excited sample using a controlled light source. The presence of defects results in the appearance over time of localised heating zones. The analysis of the kinetics of heating and cooling of these anomaly zones makes it possible to characterise these defects (depth of the defects, etc.). This technique was put in place on the West wall of the Saint Louis vestibule (fig. 5). This wall showed, following its deterioration, a visible stratigraphy with several layers, including one seeming to contain metal. The infrared image of this same wall has made it possible to highlight a cold spot (blue zone on fig. 6), showing of the presence of a conductive

material (i.e., metal). This hypothesis was subsequently corroborated by the optical microscopy study of a swab.

Conclusion

The experimental Patrimex workshop made it possible to implement a set of analysis techniques all in one place and in the presence of specialists of these techniques, which could show the complementarity of the different techniques. It also helped to understand the complexity of a multi-analysis campaign for the specialists but also for the conservators. Finally, certain research paths for conservation and restoration have been proposed. These can be considered in the framework of the next Patrimex call for projects, allowing the financing of cooperations between scientific actors and heritage institutions.[1]

Notes

[1] Patrimex's partners wish to thank Vincent Droguet, Oriane Beaufils and Jehanne Lazaj, conservators, as well as all the teams from the Château de Fontainebleau.
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