How to support the conservation of garden sculptures: A case study in Romania

The Centre of Restoration through Optoelectronic Techniques CERTO, from the National Institute of Research and Development for Optoelectronics (Magurele, Romania), puts into practice valuable scientific results of physico-chemical investigations, documentation-digitization, applied archaeometry, and imagistic laboratories

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The strongest challenge for research is to validate results by offering solutions to societal problems and implicitly by offering the information needed for optimal intervention. Researchers' responsibility is all the higher when the field of application involves valuable materials and objects, when there is no question of sampling the materials for analysis, or the analysis cannot be repeated, when the method sensitivity and superior resolution are mandatory. Restoration of cultural heritage objects is such a domain. Be it either for preventive or curative conservation, questioning the mobile or immobile cultural heritage objects in order to characterize or diagnose an incipient and often subtle degradation represents an entire project and implies choosing the non-contact, non- or micro-invasive techniques with maximum priority, revealing data from surface but also from hidden layers. Involving advanced research is needed, especially in the case of highly valuable items, even masterpieces, objects and monuments, which require maximum care and responsibility even for restorers. Exploitation of research means, in practice, can only be based on the results of extensive laboratory research, often over many years and through experience built on a vast casuistry.

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tigations, documentation-digitization, applied archaeometry, and imagistic laboratories. Undoubtedly, numerous fields of natural sciences and engineering are involved in the cultural legacy domain. The field of optoelectronics holds some major advantages: it proposes ecological methods and techniques, develops methods that always respect the original material by applying principles which do not entail sampling or that are micro-invasive. There are even techniques that can be versatile, operated remotely, and most equipment are transportable if not even portable. All these features are indisputably those that offer functionality both in field and laboratory operations. Interrogation of the object without moving it, without taking it out from its storage or display environment is the biggest relief for gallerists, curators, restorers, etc. Likewise, the possibility to extract useful information until recently considered the appanage of laboratory work, in direct connection to the immobile patrimony, is a technical performance, which radically changes the quality of research services. The experience gained through direct collaboration with restoration-preservation practitioners has shown that optoelectronics is not only functional but it also respects the most severe rules in this field.

Since 2007, ART4ART - Advanced Research Techniques for Art and Archaeology – a mobile laboratory, which carries out research, measurements and services – functions as an ambulance. It distinguishes itself from the other few mobile

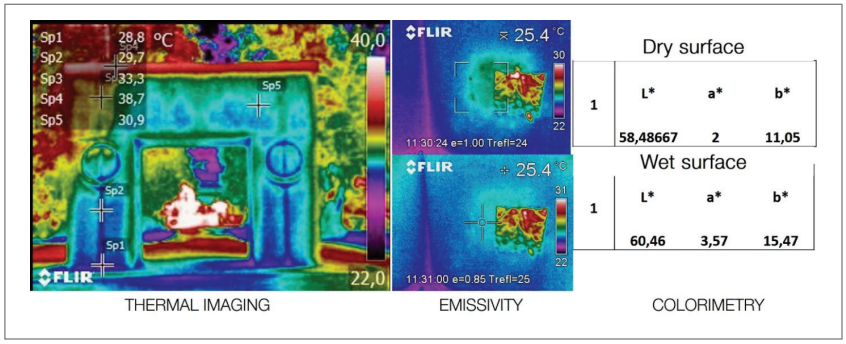

Fig. 1 Thermogram indicating the influence of the unseen metal part over the transversal stone block – under known environmental conditions

laboratories since it was conceived to ensure the needed information on field and as just a collection of techniques. The auto-laboratory project itself has aimed to close the circle of truly useful information in the field for decision-making. It follows major interdependent stages: monitoring, physico-chemical investigations, diagnosis, intervention, post-intervention monitoring. It is worth mentioning that knowing the vulnerabilities of a work of art also leads to establishing a correct and efficient intervention program, which is extremely useful for conservators.

Another major advantage of opto-electronic techniques is that they have allowed to transform the auto-laboratory into an "installation" accessible on-line [1].

The first "broadcasts" were achieved in March 2010 from the Roman Mosaic Edifice in Constanta, Romania. If there is still skepticism regarding its usefulness, advantages such as long-distance assistance to a team for educational and training purposes, ensuring on-line mandatory training programs (laboratories and/or seminaries), soliciting the best on-line guidance for difficult situations, extending the duration of the work season, or reception of works, etc., are arguments which support the continuation of the project.

Since 2015, the ART4ART auto-laboratory is the main instrument in a wide project aimed at characterizing and monitoring an exceptional monument – the Heroes' Path Ensemble from Tg. Jiu, Romania. The project is exceptional from at least 2 points of view – the ensemble, the only public forum work of Constantin Brancusi, extends over a city, and its monitoring must be understood in an extended way.

Constantin Brancusi (1876- 1957) is a Romanian sculptor [2], with an intense activity in France, considered to be the patriarch of modern sculpture with works of stone, metal, wood, who has been appreciated throughout his lifetime and has drawn the attention of collectors. In his workshop, permanently open at the Pompidou Centre, he has emphasized that the works of art are bound and not sheltered, it is a space which must be *read* as a work of art itself.

The only monumental art Brancusi has created, the Heroes' Path Ensemble from Tg. Jiu, is in Romania and is composed as a path, with specific elements, which unfold along 1.2 km [3]. The ensemble has been created between 1937-1938 and is the first in Romania to benefit, starting from 2015, from complex monitoring through a multiannual program. The monitoring program must be coherent and must ensure information useful for both characterizing and establishing the intervention protocol, and also to complete the gaps in the information databases regarding the construction and history of interventions.

As the ensemble is in the middle of a city, monitoring of air quality, wind speed, type and level of precipitations must be performed continuously and followed on-line, aiming to establish the pre-signaling scheme of the risk factors levels. The importance of this activity has been emphasized especially by cor-

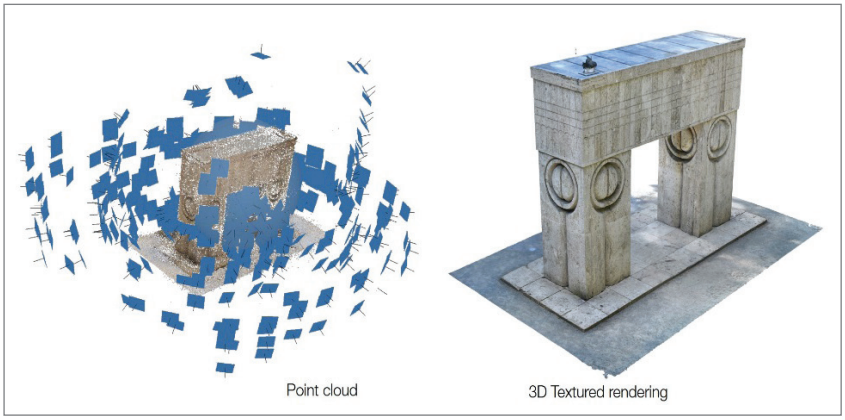

Fig. 2 Digital backbone – detailed photogrammetry model

roborating it with the thermal distribution, which reveals the thermal stress (Figure 1).

Meanwhile, measuring environmental factors and the immediate impact on the ensemble's pieces, the physico-chemical analyses of the base materials, the degradation products, and the eventual contaminations compose the comparative data package reported every 6 months.

To serve his artistic message, the sculptor has created *The Gate Kiss* out of Banpotoc travertine – a material known to be not a porous sedimentary rock, not a very resistant one, yellowish to brown in color. This material can raise great issues for restorers when it comes to the technique and degree of cleaning, realizing and integrating the esthetic of restoration materials (mortars, grouts). Also, the natural „leopard" aspect is accentuated when the surface humidity changes or when there are fine pollutants on the surface. Research has created an evaluation method of the color parameters based on which pertinent primary comparison can be done. As such, measuring the CIELab coefficients is associated with determination of thermic emissivity at the moment of measuring, and the punctual chromatic values can be compared if they are collected in similar thermic emissivity conditions.

The degree of adherence of sealants and mortars used in different restoration stages is controlled through laser Doppler vibrometry and has not indicated major detachments so far between filler and support materials, but has drawn attention on the areas in which the filler has superficial cracks.

As there were doubts regarding the structure of The Kiss Gate – part of the ensemble –from the very first campaign the ground penetrating radar control has been performed, applied in an innovative manner on the vertical plane.

It is very important for the results that have been mentioned and those obtained through FTIR and XRF to be rigorously positioned in order to correctly evaluate the whole information package. The digital model has been partially created in the first stage through laser scanning, which also requires rigorous photographic texturing, that is why we have opted for the periodic detailed photogrammetry model for all elements. As such, we have not only the volumetric description, but also the backbone to which all measurements report to [4], as well as information to be used as reference for any intervention, or for an unwanted deterioration (Figure 2).

Of course, we have not gone into the scientific details of the project, but we must draw attention on the way in which research can be validated. Moreover, as in most states, the budget for cultural projects is never comprehensive but, as partnership, is perfectly functional, generating added value to the scientific research and efficiency growth of the investment in scientific infrastructure.

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