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BOOK OF ABSTRACT

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elemental and molecular data, providing pigment identification with a high degree of confidence. Moreover, XRF spectra can allow the mapping of the sub-layer distribution of elements complementing data regarding the presence of hidden painted layers provided by NIR-reflectography. In the proposed approach, visible multispectral imaging, combined with novel methods of cluster analysis of multivariate spectral data makes it possible to map areas of paintings with similar spectral features and color properties, which correlate with the presence of the same pigment or mixture of pigments. Examples of applications on model paintings and in situ case studies will be discussed. In particular in-situ analysis on two 15-16th C illuminated manuscripts highlight the approach in the characterization of the color palette thedetection of hidden paint layers and anachronistic pigments, which yielded valuable information for identifying the original owners and the history and trade of the artworks. Advantages of this image-based multi-analytical approach will be discussed, thus informing future analysis on other heterogeneous works of art.

#011 - LIBS analysis for a stratigraphic study on Cultural Heritage materials

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Among the possible analytical approaches for Cultural Heritage studies, the Laser-Induced Breakdown Spectroscopy (LIBS) allows deep profile analysis with high spatial resolution enough to discriminate different layers in the typical complex structures [1, 2].
LIBS, based on the principles of laser ablation, allows a detailed stratigraphic analysis on the basis of spectra recorded from successive laser pulses delivered onto the same sample point. This technique has significant advantages, even if the assessment of potentialities in the quantitative analyses are object of several works. It is well-known that performance of LIBS in qualitative and quantitative analysis is affected by many factors related to plasma formation and evolution, still now under investigation.
The aim of this work is to show the importance of finding the optimum parameters for different material typologies in order to acquire the maximum information with the least damage to the works of art.
The results concern mainly the comparison between the identification of the chemical elements by using the more traditional X-Ray fluorescence technique and the study of their distribution along the thicknesses of the layers from the Laser-Induced Breakdown Spectroscopy analyses.
The collected data have demonstrated the usefulness of the Laser-Induced Breakdown Spectroscopy investigation, through which it has been possible to reveal chemical elements undetectable by X-ray Fluorescence spectroscopy [3, 4], and to analyse the stratigraphic sequence of archaeological corroded bronzes, salt efflorescence on mural paintings and paint layers from the surface up to the bulk.
This methodological approach through the LIBS analysis, although micro - destructive, avoids the sampling, allowing a stratigraphic analysis with high spatial resolution and accuracy of the sample point localization.

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#012 - XRF and LIBS integrated analysis to identify the chemical composition and the conservation state of photographic and paper materials

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In the early period, even though professional photographers worked with similar techniques and products, their artistic and commercial aims determined different choices and lead them to follow different, often personal, recipes. For this reason, identification of the techniques through date and name of the photographer or some visual features like colour, tonality and

surface of the image layer, often needs further investigation to be proved. Chemical characterization, carried out in a non o micro invasive way, can be crucial to provide useful information about original composition, degradation process, realisation technique and conservative treatments. In this case, X Ray Fluorescence (XRF) analysis was used to confirm the chemical composition of eleven historical photographs (nine silver gelatine prints and two albumen prints) dated between the end of the 19th century and the beginning of the 20th, shot in Palermo (Sicily) by a popular photographer of the time, and pasted on their original cardboards. The elemental identification showing important information on different photographic realization techniques in terms of distribution of main chemical elements in the photographic film. Inappropriate storage caused severe degradation on both the prints and the backing boards that show physical, biological and chemical damages. An integrated approach based on XRF and Laser Breakdown Spectroscopy (LIBS) allowed to verify the spatial distribution of constituting chemical element on a typical chromatic alteration of paper, the so called *foxing*, a quite complex phenomenon, not yet well understood, which deserves further investigation. In particular, the variation of calcium and iron peak intensity signal from not degraded paper to *foxing* stains center has been monitored.

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#013 - Use of holographic projections for the fruition and valorisation of cultural heritage

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In recent years is growing the interest in using multimedia supports to enhance the communication and educational aspect in the museums. The unique feature of Digital Holography in creating real 3D images, pave a way towards the future. Applications of holography to museum practice seem to be rather promising. Holographic methods may be a means capable of appreciably raising and improving the state of technical equipment of present-day museums, being able to create “real 3D” images. Nowadays, in a number of museums, are presented projections incorrectly labeled as “holographic”, being instead 2D images displayed onto special semitransparent screens. To achieve real 3D-display, the emerging digital holography techniques offer new perspectives for future museum applications, in combination with multimedia systems.

The Istituto di Scienze Applicate e Sistemi Intelligenti has been active obtaining valuable results in registration, numerical elaboration and optical reconstruction of digital holograms, as well as in developing a new method for Infrared Digital Holography. The latter allows for very noticeable results in recording holographic images of large sized objects (up to human height) thus overcoming the previous limits. The holograms are recorded by a CCD camera, stored by a PC and sent to a Spatial Light Modulator (SLM), a special micro-device capable to display holograms at high frame rate allowing for holographic dynamic scene. In this case, a sequence of holograms was acquired, by using Infrared light. The SLM performs a fast sequence of optical reconstructions of them, with visible light.

The possibility of numerical handling holograms allows for any type of image elaboration on single holograms: changes in size and/or position in the space of the holographic reconstructed images, changes of focus plane, etc. The ability to merge distinct holograms of individual objects, each numerically elaborated, allows for optical projection of 3D holographic dynamic sequences. Modern museum tasks include not only conservation and preservation of material items, but also educational activities, implemented by using a number of multimedia systems. We showed how digital holography, for display use, could play an important role in this field, thanks to its unique ability in generating “Real 3D” scenes. Some results of current researches at Istituto di Scienze Applicate e Sistemi Intelligenti They will be presented.

#014 - RADIOCARBON DATING OF MORTAR

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The carbon dioxide contributing to binder formation during the set of a lime mortar reflects the atmospheric ^{14}C content at the time of construction of a building. For this reason, the ^{14}C dating of mortars is used with increasing frequencies in archaeological and architectural research. Mortars, however, may also contain carbonaceous contaminants potentially affecting radiocarbon dating.

Recently has been obtained some promising results in mortar radiocarbon dating, thanks to the development of a procedure (i.e. CryoSoniC/Cryo2SoniC) aiming to eliminate exogenous C contamination that may occur in a mortar. In particular a novel physical pre-treatment for the isolation of the atmospheric $^{14}CO_2$ signal absorbed by the mortars during their setting, has been proposed. The protocol allows suppression of the fossil carbon (C) contamination originating from the incomplete burning of the limestone during the quick lime (CaO) production, providing unbiased dating for the mortar or lime lumps contained in the mortar. Moreover, a detailed petrographic characterization of mortars was used both as a preliminary tool for the choice of samples and to infer about the lack of accuracy (when verified) of the applied mortar 14C dating procedure.

In the present talk, we present AMS Radiocarbon dates performed on lime lumps with the aim to:

i) verify procedure accuracy by a comparison of the results obtainable from lime lumps dated after different treatments (i.e. bulk lime lumps vs CryoSoniC purified lime lumps);