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Integrated approach for non-invasive diagnostic investigation at the Bishop's Palace of Frascati

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***Abstract* – Artistic surfaces at the Bishop's Palace of Frascati have been investigated by an integrated approach involving different non-invasive technologies. Information on previous restoration actions are reported in this paper.**

I. INTRODUCTION

In the frame of the ADAMO project (Analysis, Diagnostic and Monitoring for the Cultural heritage conservation and restoration), financed by Lazio Region for Technological Cultural District (DTC Lazio), a campaign of measurements has been developed at the Bishop's Palace of Frascati, ancient fortress of the town near Rome, in the past, and domicile of Episcopal Tuscolana Diocese nowadays. The measurements have been performed, in order to check the state of the previous restoration work. Following the requests of the holder of the Palace, particular attention has been devoted, in this study, to the investigation of the so called "*stufetta*" room at the ground floor of the Palace (Fig.1), and the "*Landscape room*", adorned with framed views of garden, at the first floor. An integrated investigation approach has been adopted involving different technologies and instruments with the common characteristic to be non-invasive at all. A LIF (Laser Induced Fluorescence) system developed at Diagnostic and Metrology Laboratory of ENEA, already applied as diagnostic tool in Cultural Heritage investigations, has been used. Thanks to its unique properties of being a non-destructive and non-invasive remote technique, with no sampling requirements, based on transportable or portable instruments that can provide first results in real time, LIF is a suitable tool also for the characterization of valuable and unmovable targets [1,2]. LIF technique has been already successfully applied in archaeological sites, making available useful information to the restorers [3,4]. The validity of the technique as diagnostic tool for artworks of different materials, like paintings, wood and stone, has been also demonstrated [5,6,7]. The LIF instrument is able to acquire fluorescence spectra and generate multispectral images for obtaining component materials maps of the investigated surface, useful for the identification and the characterization of materials of interest. This technology worked, in this study, in synergy with other non-invasive techniques, suitable for localizing the bio-deteriorated areas and the added restoration materials as well as to focus some details to support and integrate the experimental results. In particular, *SfM* (Structure from Motion) technique [8] was used to obtain the 3D photogrammetric reconstruction of the painted vault of the "stufetta" and the RGB-ITR 3D laser scanner prototype was used for digitalizing the "Landscape Room". This 3D laser scanner has been already used for remote diagnostic of cultural heritage [9,10]. The obtained results highlighted the localized presence on the surface of different materials, due to retouching or consolidating processes, also in areas where significative differences are not appreciable by naked eye. Deterioration phenomena, mainly due to environmental humidity, have been in addition localized by the systems also in some points where they were not clearly evident, suggesting the possibility of damage early detection. The combined use of the different instruments offered several advantages. In particular, the possibility to overlap the LIF spectral maps to the 3D photogrammetric model, obtained in a short medium range of distance, and to the 3D laser colored model obtained by RGB-ITR scanner, also in case of low light conditions, allowed to perfectly localize, also at great distances, the points on the surface submitted to degradation actions. The available techniques for the bio-degradation characterization and monitoring [11,12] can be supported by the presented approach. Moreover, the ability of measuring in situ, remotely, besides to assure the complete non-invasiveness, eliminates the use of scaffolds, reducing the time and the cost of the analysis. The results of the proposed integrated approach can be of great usefulness for the site conservation