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Multi-band infrared imaging for the characterization of underlying elements in the *Santa Maria in Cosmedin* altarpiece

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Abstract **– This paper presents the integrated application of near and middle-infrared imaging techniques for the characterization of the altarpiece preserved inside *Santa Maria in Cosmedin Basilica* (Rome, Italy). The visible aspect of this polychrome wooden artefact is the result of several adjustments overlapped during the centuries. The stratigraphic analysis of the artwork has been carried out by the use of pulsed thermography and reflectographic techniques in order to detect structural elements, such as defects on the wooden support, and disclose underlying graphical/pictorial features, such as underdrawings and *pentimenti*. The results allowed the description of the conservative status of the altarpiece and a better comprehension of its realisation process.**

I. INTRODUCTION

The painted altarpiece preserved inside the *Santa Maria in Cosmedin Basilica* is an important holy artefact of the Greek orthodox community placed in Rome [1]. The painting has been retouched and restored many times during the centuries for stylistic adjustments and conservative issues, occurring in a multi-layered pictorial structure. Therefore, an exact reconstruction of its realisation process is complicated, requiring non-destructive analyses for stratigraphic investigations.

For these purposes, infrared (IR) imaging techniques are widely employed in Cultural Heritage (CH) examinations, exploiting the different optical behaviour of the infrared radiations through the pictorial layers for the detection of subsurface features, such as structural defects and underlying graphical/pictorial elements [2].

In this work, near and middle-infrared bands have been adopted through an integrated use of reflectographic and thermographic approaches. Three techniques have been employed for the *Cosmedin* altarpiece characterization: near-infrared (NIR) reflectography, working in the IR spectral range of 0.7–1.0 μm, pulsed thermography and middle-wave range (MWIR) reflectography, both operating in the middle-IR region (3-5 μm).

Specifically, near-infrared reflectography (NIRR) is the most extensively used technique for the identification of underlying features in painted artefacts by using a CCD camera and a suitable illumination source, typically a halogen lamp [3].

In the last decades, pulsed thermography (PT) and middle-infrared reflectography (MIRR) have undergone a similar applicative growth, being successfully employed for the investigation of several type of painted artefacts, i.e. wooden and canvas paintings [4, 5], frescoes [6] and illuminations on parchment/paper [7, 8]. In particular, PT is employed for the detection of subsurface inhomogeneities, such as support damages and/or pictorial elements, by evaluating the temperature variations at the sample surface generated by an external pulsed stimulus [9].

The MIRR technique is similarly applied in multi-layered artefact investigations by recording the reflected radiation in the MWIR region by an infrared camera immediately after the sample illumination with a halogen lamp [10, 11].

The different penetrative power in NIR and MWIR bands within the artefact allows the achievement of complementary results fundamental for the definition of its state of conservation and, at the same time, for the recovery of graphical and pictorial elements beneath the several overlapping layers, such as in the presented case study.