

Integrating multispectral and thermographic imaging techniques to recover hidden details in deteriorated parchment manuscripts.

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Nowadays, multispectral imaging analyses are routinely employed to study several details in paintings and manuscripts [1] and, in some cases, to characterize their materials [2]. In particular, ultraviolet (UV) fluorescence analysis (UVF) allows locating latest restoration treatments in artworks and rescuing the eldest writings in palimpsest, as for the case of the Archimedes one [3]. Differently, the deeper penetration capabilities of infrared (IR) techniques make possible to recover the drawing lines of preparatory sketches and pentimenti, below the painted layers. In addition, the IR reflectography (IRR) is a useful method to obtain information about the nature of the employed inks, analysing their transparency or opacity properties in the investigated spectral region [4]. However, artefacts are not always in good conservation conditions, especially parchment manuscripts are usually affected by different kinds of damages. Indeed, after the manufacturing processes, parchment is characterized by highly hygroscopic proprieties and it can be exposed to many damaging factors, mainly due to thermal and hygrometric changes, which in turn could induced physical, biological and chemical alterations, such as microbial attack, brown stains etc. [5]. Furthermore, human manipulations could cause lacerations, tears or loss of visibility of textual sections or decorations on parchment artefacts [6]. All these different reasons of deterioration could generally prevent the original readability of graphic elements of written texts and painted details, with the consequent loss of the manuscript or document contents. Therefore, to solve this issue, in this work, multispectral imaging analyses are compared with the thermographic results, in order to evaluate the capability of each technique to recover lost areas. Indeed, the pulsed IR thermography (IRT) is able to record both the thermal and the optical contributions arising from a heated sample and is proved to be an advantageous tool to reconstruct the complex structure of illuminations and to discover inner defects [7]. The combined use of the above mentioned techniques allows analysing several spectral ranges from UV to MWIR (Medium Wavelength Infrared) and recovering the readability of lost details, in specific deteriorated situations. For this reason, four parchment artefacts of different ages were selected, which were characterized by typical damages that commonly affect books and documents, such as water stains, biological alterations and the ones caused by manipulation and non-adequate restoration treatments. The chosen books and documents are united by the prevention of the original visibility of written texts and painted decorations, due to different causes by both wrong environmental conditions and human handlings. Finally, it must be pointed out that the presented results show how an integrated use of the above-mentioned techniques allows obtaining an exhaustive recovery of the superficial and sub-superficial lost details with a greater effectiveness as compared to the use of a single one of them, particularly in the case of damaged parchment artefacts.

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