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Metrological validation of a photogrammetry-based technique

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***Abstract*—Photogrammetry is a technique that allows one to extract three-dimensional measurements and information about an object from two-dimensional digital images. This techniques finds many applications, and it is particular useful for the documentation of artifacts in the field of cultural heritage. To this purpose, the validation of the dimensional accuracy of the 3D models obtained through photogrammetry is necessary and must be investigated. This paper presents the validation of a photogrammetry-based technique, using a Coordinate Measuring Machine (CMM). The validation employs a reference object manufactured by using a 3D printing machine and designed to be employed in multi-spectral characterizations. The reference is a dodecahedron with the twelve faces coated with several pictorial materials, which are representative of a wide historical period. Thus, the reference can be used also for the integration of multi-spectral imaging data that are not detectable in the visible spectrum. The image acquisition process is fully automated. The quality of such acquisitions is quite good, as it is proved by the presented experimental validation. Some acquisitions both with visible light and with UV light are presented in the paper as well.**

***Index Terms*—photogrammetry, multispectral imaging, reference object, metrology, cultural heritage, Coordinate Measuring Machine, CMM**

I. Introduction

Several works appeared in the literature [1] regarding different types of digitalization techniques. These techniques include both active range-based techniques, such as laser scanners [2] or structured light projection instruments, or passive image-based systems, such as photogrammetry [3], [4]. Photogrammetry has the great advantage of being low-cost, of covering a wide range of applications [5], [6], and it allows one to extract information about both the geometry and the appearance of an artifact. On the other hand, laser scanner based techniques can be quite accurate from a dimensional point of view, but they often do not acquire information regarding the object texture and color. In addition, such techniques usually lack the possibility of collecting data outside the visible spectrum.

As a matter of fact, besides the three dimensional digitalization, Multi-Spectral Imaging (MSI) is another image-based technique widely diffused in the Cultural Heritage field. Indeed, this non-invasive technique is extremely successful in the identification and mapping of the different types of materials, such as pigments, dyes, binders and varnishes, which were used in the past to coat the different objects and that have different reflection levels under different wavelengths [7], [8].

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