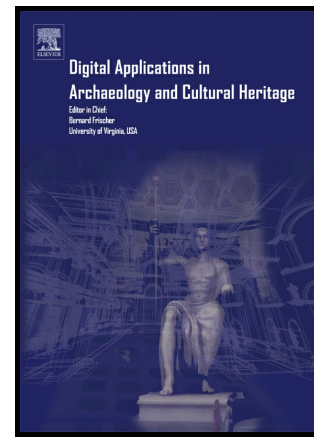


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## COLOR DEFINITION OF OPEN-AIR ARCHITECTURAL HERITAGE AND ARCHAEOLOGY ARTWORKS WITH THE AIM OF CONSERVATION

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# COLOR DEFINITION OF OPEN-AIR ARCHITECTURAL HERITAGE AND ARCHAEOLOGY ARTWORKS WITH THE AIM OF CONSERVATION

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## ABSTRACT

The color survey of Architectural and open-air Archaeological artefacts represents a difficult operation due to a lot of factors such as subjective aspects of visual perception, objective characteristics relating to sources of lighting and the way one watches something. The paper describes a method for 3D reality-based color managed modeling, aimed to render reflectance properties of artifacts with perceptual fidelity on many type of display. The method is based on an accurate color management system, from acquisition to visualization, in order to be used within a 3D acquisition pipeline, allowing simultaneous processing of color and shape data. The developed techniques are easy, low-cost, fast and could produce visually accurate images and 3D model, and, in order to avoid inaccuracies, a systematic quality control on the images acquired and 3D models rendered has been introduced. Results are presented about both processing accuracy and final 3D models visualization.

The color survey, usually, refers to three methods, which are not able to ensure the correct perception of color on an RGB monitor or its faithful reproduction on a print support, and to assure a right color checking on a wide surface, and with a non-uniform color. The presented workflow and specific solutions appear today a good compromise between fidelity of reproduced data and ease of use of the developed tools.

## KEYWORDS

3D reality-based modeling, Architectural Heritage, Archaeological Heritage, Color calibration, Pipeline color management, Color quality assessment, Color reproduction accuracy

## HIGHLIGHT

- Color definition using 3D reality-based models, starting from RGB images
- Fidelity of color reproduction, using automatic pipeline
- Reuse of old (previous) images data set to compare actual state and previous state
- Color quality assessment, using color metric standards

## 1. Introduction

In the field of analysis, conservation and management of Architectural Heritage (AH) and Archaeological open-air artefacts (Fig. 1), the color definition and reproduction is a key step, as demonstrated by the outstanding Henri Labrousse and Louis Duc drawings representing Roman monuments, built during the years 1825-1830 (Gaiani, 2012) and as shown by numerous recent attempts to faithfully reproduce the color in urban planning documentation (Falzone, 2008).

However, color detection of plastered painted façades, monumental-historical buildings and Archaeological or historical artifacts represents a difficult operation due to many factors, such as subjective aspects of visual perception and objective characteristics relating to sources of lighting and surface reflectance properties, the way and the angle how the monument or site is observed. Furthermore, the geometric conformation of certain types of buildings could produce problems related to the shape and colors, both in the acquisition and rendering phase. A sequence of vaulted systems, e.g., could present strong contrast of light between the portions underlying the arcades (i.e. all spaces under the arches vault) and external parts (i.e. the façade of buildings), which may create a mismatch between the same color in different areas. The same color can be present different tones as internal and external parts can be completely differently because 'environment impact'.

With the aim to have a faithful color characterization and reproduction in the conservation field, many techniques have been developed and today it is possible to refer to three main approaches (Santopuoli and Seccia, 2008):

- *Sample transcription*: this technique requires a suitable support on which to reproduce the color. The results are highly dependent on the expertise and the visual observation ability of the examiner. The method is useful for cataloguing but, being completely subjective, it cannot be used for reproduction. That method is usually used by the Heritage management;
- *Visual comparison with color atlas*, i.e. the 'Munsell book of color' (Munsell, 1912): a technique highly dependent on the expertise and the visual observation ability of the surveyor. Mainly archaeologists are using that method;
- *Diffuse reflectance measurement with instruments*: color is defined using colorimeters (given the chromaticity CIE L\*a\*b\* coordinates of the color), spectrophotometers (which, in addition, provide the curve of the diffuse reflectance as a wavelength function) or telephotometers (which output the same data of spectrophotometers, but with the possibility to operate at relevant distances from the sample). These are the most accurate, simple and flexible instruments available today to provide control of reflectance and color, but they require countless readings in case of non-uniform color (almost always) since they cover a small area. The instrumental approach is used mainly when restoration work is planned. Usually external specialist is needed.

Summarizing, none of these methods can ensure a right color checking on a wide surface and with a non-uniform color on a rough surface, that is the typical condition of AH and Archeological monuments (Santopuoli, 2000). Secondly, all the methods, besides presenting problems beyond the ability of an actual sample of existing matter, cannot ensure the correct perception of color on any kind of display or a faithful reproduction on a printed support.

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