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Case study

Enhancing the examination workflow for Byzantine icons: Implementation of information technology tools in a traditional context

John A. Stratis [a,1], Christina Makarona [b,*], Dimitra Lazidou [c,2], Elena Gómez Sánchez [d,3], Anestis Koutsoudis [e,4], Marisa Pamplona [d,3], Regine Pauswein [d,3], George Pavlidis [e,4], Stefan Simon [d,3], Nestor Tsirliganis [e,4]

[a] *Analytical Chemistry Laboratory, Department of Chemistry, Faculty of Natural Sciences, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece*
[b] *Faculty of Sciences and (Bioscience) Engineering, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium*
[c] *Museum of Byzantine Culture, Leoforos Stratou 2, 54013 Thessaloniki, Greece*
[d] *Rathgen Research Laboratory of the Berlin State Museums, Schloßstr. 1A, 14059 Berlin-Charlottenburg, Germany*
[e] *Cultural and Educational Technology Institute–R.C. Athena, 58 Tsimiski St., 67100 Xanthi, Greece*

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ABSTRACT

In the interdisciplinary domain of conservation science, a critical and selective eye is required in order to allow researchers to choose the most effective combination of analytical techniques for each project and, more importantly, to process and analyze the resulting volume of diverse data. The current essay attempts to combine a more traditional workflow for the examination of painted objects with techniques borrowed from the domain of computer science in order to yield the maximum amount of information and make that added knowledge more accessible to the researcher. The project was approached as a case study, regarding a post-Byzantine icon. Three-dimensional digitization with a laser scanning system, X-ray radiography and optical microscopy were applied for the determination of several structural characteristics of the painted surface and the icon's state of preservation. Multispectral imaging was used for the collection of surface spectral data, which were subsequently processed by means of cluster analysis in a novel approach to map the composition of the painted surface. Finally, micro-X-Ray Fluorescence (μ-XRF) was chosen as the primary source for surface pointwise elemental composition data while Fourier Transform Infrared Spectroscopy (FTIR) and Gas Chromatography coupled with Mass Spectroscopy (GC-MS) provided additional assistance in the characterization of materials based on their molecular structure. A custom platform was developed to address the issue of multilevel visualization and assessment of the data, designed to act as a tool for viewing and combining the acquired information. Via this integrated approach valuable information regarding the icon was revealed, including the verification of a prior conservation attempt and partial overpainting, the recording and quantification of the warping of the wooden panel and, finally, the identification of the constituent materials and their spatial distribution.

1. Introduction – Aim of the current study

In recent years, the systematic study of cultural heritage has led to the emergence of the conservation science domain as one of highly interdisciplinary nature. Within this scope, the focus of researchers is shifting towards the determination of more effective workflows for the holistic examination of the artifact in question and the subsequent combination of the acquired data, in order to produce concrete results. Taking into consideration the above arguments, the current essay attempts to formulate and apply such an integrated procedure for the examination of painted artifacts. The project was approached as a case study regarding a post-Byzantine icon.

The process of creating an icon in accordance with Byzantine tradition follows a well-defined protocol [1]. However, during the post-Byzantine era (16th till early 19th century) artists became increasingly liberated from the strict rules of Byzantine icon painting and experimented with materials and techniques [2]. The variety of materials used in Byzantine and post-Byzantine panel painting have been the subject of a significant number of studies in

* Corresponding author. Tel.: +32483408265.
E-mail addresses: jstratis@chem.auth.gr (J.A. Stratis), cmakaron@vub.ac.be (C. Makarona), dimitra.lazidou@gmail.com (D. Lazidou), e.gomez@smb.spk-berlin.de (E.G. Sánchez), akoutsou@ceti.gr (A. Koutsoudis), m.pamplona@smb.spk-berlin.de (M. Pamplona), r.pauswein@smb-berlin.de (R. Pauswein), gpavlid@ceti.gr (G. Pavlidis), simon.kdc@t-online.de (S. Simon), tnestor@ceti.gr (N. Tsirliganis).
[1] Tel.: +302310997843.
[2] Tel.: +302313306400/+302313306436.
[3] Tel.: +326 749 10; fax: +326 749 12.
[4] Tel.: +302541078787.

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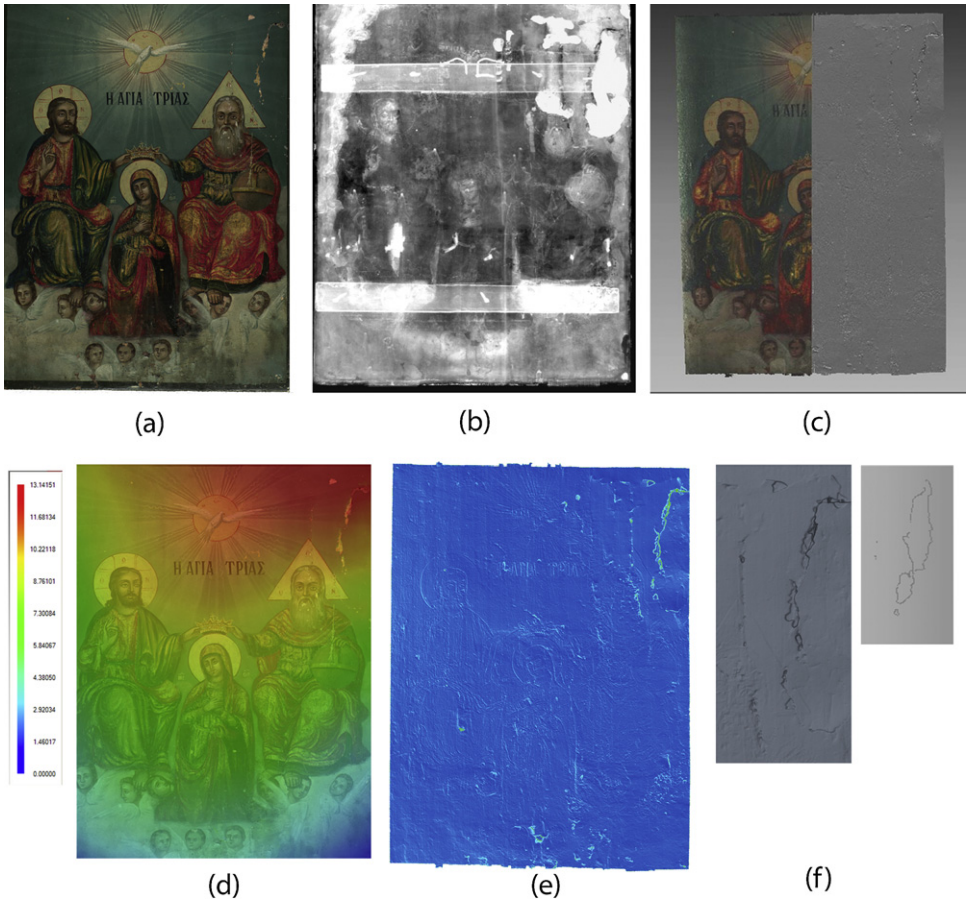

Fig. 1. a: high definition color image of the painted surface; b: X-ray radiograph of the icon (after digitally registering the four individual radiographic plates); c: 3D model of the painted surface, shown with and without color information; d: color-coded elevation map of the surface revealing the warping of the panel; e: color keyed view of the surface relief, showing the incisions outlining the figures; f: extracted outline of the crack at the upper right hand side of the surface.

order to facilitate the conservation of such artifacts and, moreover, as a means of differentiating between different artists or 'schools'. The majority of studies combine micro-FTIR and micro-Raman spectroscopy for the identification of inorganic pigment materials, Gas Chromatography or High Performance Liquid Chromatography coupled with Mass Spectrometry (GC-MS and HPLC-MS respectively) for the identification of organic materials (binders and pigments) and microscopic techniques in order to unveil the full stratigraphy of the icon [3 and references therein]. XRF spectroscopy has also proven useful for the identification of inorganic pigments, based this time on their signature elemental composition [4–6]. Infrared reflectography and UV imaging have been used in an auxiliary fashion for the preliminary examination of both pigments and varnishes [3,7,8]. Finally, structural information of the wooden support and information regarding underlying preparatory layers is usually acquired through the use of X-ray radiography [8].

In the current paper an effort is made to combine these traditional approaches with modern digitization techniques and tools from the Information Technology domain in order to form a more holistic and contemporary workflow. For the purposes of recording structural information, X-ray radiography was complemented by three-dimensional laser scanning of the painted surface, a technique applied successfully in a variety of cases regarding paintings [9,10]. Material characterisation is accomplished, on the one hand, through an entirely non-invasive approach, using multispectral photography coupled with cluster analysis in order to obtain a map of the pigment materials based on their spectral properties. The identification of possible pigments was assisted by the use of μ-XRF spectroscopy, applied in situ, for pointwise elemental data. On the other hand, techniques requiring sampling were also used. Sample cross-sections were examined by optical microscopy in order to study the icon's stratigraphy. The combined application of GC-MS and FTIR provided data regarding both organic and inorganic materials. On a final note, the possibilities of integrating the multitude of obtained data into a single platform were investigated. To this end, a custom platform was created, combining the 3D model visualisation with the available spectral and elemental data in a multilayer integrated representation.

2. Experimental

2.1. Description of the icon

The subject of this case study is a post-Byzantine icon from the region of Moschopoli (Fig. 1a), dated back to the first half of the 19th century. The icon, depicting the Coronation of the Virgin, is painted on a wooden panel (47.8 cm × 36 cm). The surface exhibits various defects while the panel itself presents substantial warping. The paint layer exhibits two different optical qualities, being more matte or more reflective in places, indicating the use of different paint media – egg and drying oil respectively, or even a mixture of both. This fact is in agreement with the testimony of the owner's family, stating that the object had undergone a conservation attempt around 1951. The extent of the areas exhibiting optical properties of a drying oil medium suggests that the icon had been considerably overpainted during the conservation procedure (the entire area of the sky, the halos and partly the figures themselves).

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