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BOOK OF ABSTRACTS

TECHNICAL INFORMATION

TECHNART2023 BOOK OF ABSTRACTS

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NOTE

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MA-XRF AND LIBS INVESTIGATION OF GREEK RELIGIOUS ICONS

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The oil painting technique on canvas prevailed in post-medieval Europe and largely replaced traditional panel painting. However, post-15th century Greek painters kept manufacturing icons (i.e., religious panel paintings) by employing and adapting medieval panel painting techniques. The activity of these very painters' accounts for the thousands of icons nowadays demonstrated in public as well as private collections, and also serving as items of worship in churches, convents, and privately.

In this work, we will present the results of ongoing research focused on examining Greek icons using scanning macro-X-ray fluorescence (MA-XRF) [1,2]. We apply macroscopic X-ray fluorescence scanning spectroscopy, using different experimental set-ups, extending from the state-of-the-art M6 JetStream to an in-house built scanning spectrometer using the handheld spectrometer Tracer 5i. By interpreting the data, we unveil information about the identity of pigments and other additive materials, visualize hidden layers such as underdrawings, reveal technical details, determine the state of preservation/conservation history, and identify previous restoration interventions.

The multi-layered structure characterizing the paintings imposes difficulties in the XRF data interpretation, as the penetration depth of X-rays in pigments incorporated in binders is of the order of tens of microns. The complementarity of applying Laser Induced Breakdown Spectroscopy (LIBS) [3] has thus been examined. In this framework, a series of mock-up samples were manufactured following traditional byzantine painting techniques. These samples were analyzed by LIBS and XRF, and the corresponding experimental results were evaluated to resolve possible depth dependence of the LIBS and XRF signals.

Artificial intelligence (AI) methods, like clustering and neural networks, have been applied for data analysis. The methods benefit inexperienced users as they can analyze the big data sets without exhaustive knowledge of the involved underlying physics.

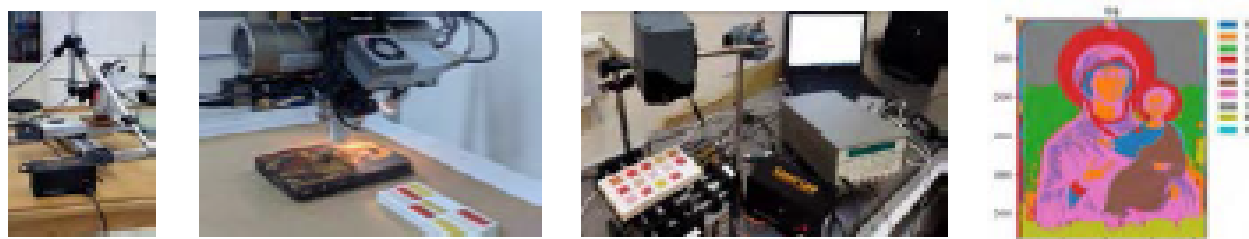


Figure: a) In-house developed XRF scanner using the Tracer 5i handheld, b) M6-Jetstream MA-XRF scanner, c) LIBS set-up, d) Clustering analysis for MA-XRF big data.

[1] M. Alfeld, J. V. Petrosio, M. van Eikema Hommes, G. Van der Snickt, G. Tauber, J. Blaas, M. Haschke, K. Eler, D. Joris, K. Janssens, A mobile instrument for in situ scanning macro-XRF (MA-XRF) investigation of historical paintings, *J. Anal. At. Spectrom.*, (2013), 28, 760–767

[2] T. Gerodimos, A. Asvestas, G. P. Mastrotheodoros, G. Chantas, I. Liougos, A. Likas, D. F. Anagnostopoulos, Scanning X-ray Fluorescence Data Analysis for the Identification of Byzantine Icons' Materials, Techniques, and State of Preservation: A Case Study, *Journal of Imaging*, (2022), 8(5), 147.

[3] Botto A., Campanella B., Legnaioli S., Lezzerini M., Lorenzetti G., Pagnotta S., Poggialini F., Palleschi V., Applications of laser-induced breakdown spectroscopy in cultural heritage and archaeology: A critical review, *Journal of Analytical Atomic Spectrometry*, (2019), 34(1), 81–103