Inteligencia artificial profunda: los "ojos" computacionales que pueden ayudar en la restauración de los artefactos del patrimonio cultural

Deep artificial intelligence: the computational "eyes" that can help in the restoration of cultural heritage artefacts

The OPERA project (https://sites.google.com/view/pce-opera/) explores the potential to innovatively develop the knowledge from two apparently non-convergent fields of activity. The research aims to put forward modern computational approaches to understand the past from its remains found in the present, and seeks to achieve that by the microscopic analysis of artefacts before restoration through the "eyes" of artificial intelligence.

The quantification of the results of physico-chemical analyzes (digital microscopy, X-ray fluorescence spectroscopy, RAMAN infrared spectroscopy, X-ray radiography, computed tomography, etc., unified with specific chemical microanalysis) performed in specialized laboratories with complex and expensive equipment, corroborated with the analysis and experience of multidisciplinary trained restorers to identify the various phases of artefact degradation, is currently an extremely elaborate and specialized process.

The use of a new non-destructive method of analysis and identification of the state of archaeological objects is a desideratum in the field of heritage restoration by the fact that the result is fast and provides credible information to novice restorers, archaeologists, museographers and researchers of cultural assets from the immediate moment of their discovery.

This collaboration between the two fields is the first attempt to use deep learning for the microscopic analysis of artefact material composition and corrosion, in conjunction with other non-destructive physico-chemical analysis, using data from the field of investigation and restoration of cultural assets in poor condition of conservation.
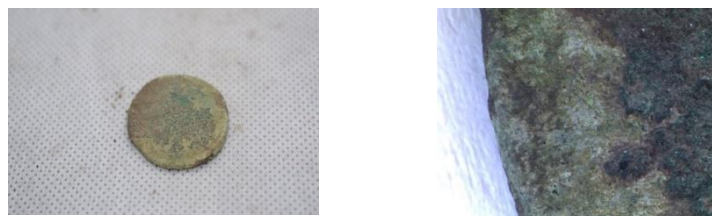
Coin and stereo microscope image
XRF analysis: Cu 38.06, Fe 4.19
*Deep learning prediction: **Cu 41.55, Fe 3.40***

Stereo microscope input of an iron artefact (left), the manual delineation of corrosion compound types by human expert (middle) and segmentation found by deep learning (right)

By using intelligence-endowed algorithms, starting from the data provided by restorers and investigators, it is desired that the obtained results recreate, also for the first time, images and 3D models. The digital reconstruction of objects made by human hands, hundreds or thousands of years ago, which have been subject during all this time to a continuous and intense process of degradation, can be of real use in the process of restoration and implicit conservation of the cultural heritage, by identifying structures, creating images from some abstract information, digitally recreating missing elements from an artefact up to modelling a 3D virtual entity of an object as it would have been in its original state.

Recreation of a corrupt traditional Romanian vest with deep learning inpainting

The presentation will be given by a computer science investigator in deep learning, also in the presence of the head of the Laboratory for Restoration and Conservation of the Oltenia Museum, History and Archaeology Section, Craiova, Romania (https://muzeulolteniei.ro/).