3DSpectral

Revealing secrets: Multispectral 3D digitization of Cultural Heritage and Natural History Collections

DURATION
15/01/2017 – 15/04/2019

BUDGET
150 000 €

PROJECT DESCRIPTION

2D multispectral imaging is already in use for a long time in different domains like quality control, medicine, teledetection, forensics, astronomy and art study or art restoration amongst others. Using different spectral wavelengths enables to reveal the invisible and having an indication of material composition as each element has a specific spectral signature. In art, in the case of paintings for example, IR allows to see under the picture layer (underdrawings, previous painting) and UV allows to see retouches, restoration or even forgeries. In forensics, botany or dermatology, UV allows to see disease (parasite/bacteria infestations) or stresses and could therefore be applied to monitor conservation of collection objects. Using IR can visualise differences of temperature or hidden elements. In general, UV enhances surface details relative to visible light while NIR allows to see beyond surface details.

Fig. 1: Composite picture of Pandinus imperator exposed by flash on the left side of the picture and by 2 UV 365nm at the right side. Source:J. Brecko, A. Mathys, W. Dekoninck, M. De Ceukelaire, D. VandenSpiegel & P. Semal. 2016 (Submitted). Revealing invisible beauty, ultra detailed: The influence of low cost UV exposure on natural history specimens in 2D+ digitization.

Fig. 2: Detail of a Mayan ceramic under visible light (left) and under UV (right). Source: Grant, L.A, and E.C. Danien. 2006. The Maya Vase Conservation Project. UPenn Museum of Archaeology, USA.

Regarding natural history collections, researchers are aware of the fact that the sight of many creatures is more sensitive to one of these spectra and do take this into account in their research. Therefore we should consider the digitization of our collections while exposing it to other light sources than visible light. The multispectral digitization allows to records some UV active patterns displayed in different taxonomic groups (plants and animals) and on rocks and minerals which are not visible to the human eye. They can be used as complementary taxonomic criteria for species identification.

On the other hand, 3D recording is more and more used in cultural heritage and natural sciences for scientific studies or for educational purposes. Several programs of 3D digitization allowed to create virtual catalogues or augmented reality museums/sites and displays (GB3D, Smithsonian X 3D, Sketchfab, Cultural institution Sketchfab pages, VR3D, Virtual library of the Idaho Museum of Natural history, etc.). The Belspo AGORA 3D project allowed evaluating most of the 3D and 2D+ digitization technologies available on the market. The project selected the most interesting technologies for the digitization of the federal collections and produced protocols and guidelines.

3DSpectral

Several of these techniques are now used daily for the digitization of the federal collections in the framework of the DIGIT-03 digitization program.

As a logical next step, scientists wonder what the result of the combination of both 3D and multispectral technologies would be, as well as the combination of Reflectance Transformation Imaging (RTI) and multispectral. Several institutions are trying to build a consortium around this thema. But so far research on implementing multispectral 3D has been limited. Some projects propose to "geo-reference" local point of hyperspectral measurements on the 3D model. Other projects suggest to project 2D multispectral images onto 3D models with experimental settings. Recording full 360° multispectral photogrammetry models has never been attempted. Moreover, multispectral enables to characterise accurate colour, help capture challenging surfaces (highly reflective or translucent materials for example. Many translucent materials, which cannot be captured with other techniques using visible light, appear to be opaque in UV imaging), enhance contrast, reveal invisible patterns and help monitoring collections.

In this projet, the developed technologies will be applied on the federal collections in the framework of the DIGIT-03 program not only when non-multispectral methods are unable to produce high resolution models (e.g. lack of contrast or reflecting surfaces) but also when objects reveal unseen characteristics.

The project will also stress on the standardisation and the quality control of data and metadata produced by multispectral equipment and evaluate if existing technologies are compatible to disseminate through the internet and the existing portals like Europeana.

The project will develop and evaluate a low-cost setup by using a de-filtrated DSLR instead of the expensive dedicated multispectral instrument and develop its own light setup, corresponding to the need of the federal institutions involved.

The developed prototype(s) will be available for the needs of the partners in the framework of the federal DIGIT-03 program and for specific research or digitization projects.

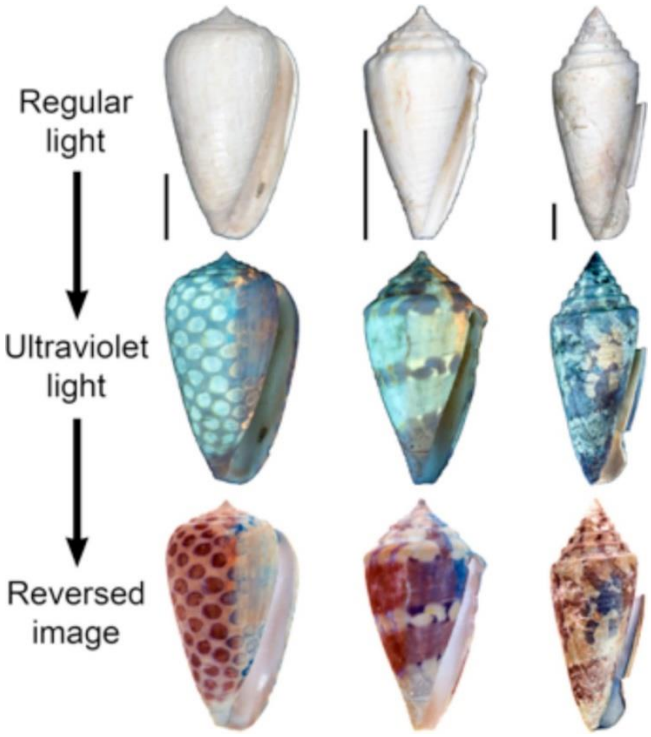

Fig. 3: "Examples of ancient coloration patterns revealed by UV light. Top row: three fossil shells from the Neogene of the Dominican Republic photographed under regular light; all scale bars are 1 cm. Middle row: the same specimens photographed under longwave UV light. Bottom row: reversed images that show how fluorescing regions correspond to parts of the shell that were once darkly pigmented." Source: Hendricks, JR, 2015. Glowing Seashells: Diversity of Fossilized Coloration Patterns on Coral Reef-Associated Cone Snail (Gastropoda: Conidae) Shells from the Neogene of the Dominican Republic. PLoS ONE 10(4): e0120924.

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