

'Imaging in Conservation: Looking at Artefacts Under New Light' was held on 10th–11th November 2011 at STFC Rutherford Appleton Laboratory, Harwell, Oxfordshire.

A joint two day conference between the Icon Archaeology and Science Groups was held at the Rutherford Appleton Laboratory in Oxfordshire.

There was a full programme of speakers discussing a wide range of issues within the context of imaging in conservation. The principle discourse was an evaluation of emerging (digital) technologies within the museum community.

Day one got off to a fascinating start with **Sonia O'Connor** (Archaeological Sciences, University of Bradford) who discussed the pros and cons of digital radiography. By digitising an image it enables the working copy to be archived, distributed and manipulated more conveniently than with film. Film images can also be scanned, which if undertaken immediately will provide the optimum copy. We learnt that there is a range of equipment available, ranging from a cheap digital camera to an industrial scanner (which produces the best results). There are, of course financial implications involved with the various methodologies. Further advantages with digitisation are that it is possible to produce life size images and even invert the image. However, although much manipulation can be undertaken to adjust greyscale and low contrast images, it cannot fill in the gaps of a poorly exposed image. Digitisation offers shorter exposure times, ability to capture more information in single images with fewer re-takes, minimal delay between images captured and viewing, lower running costs and a reduction in environmental impact, as water and chemical consumption is not required. Various digital capture options were discussed which included Direct Capture (DDR) which provides the sharpest image (although expensive), Indirect Capture e. g. Computer Radiography (CR) and Digital Radiography (DR). It was proposed that Computer Radiography was currently the front runner as it employs a flexible reusable image plate. As with all the methods it is also dependent on the quality of image plates, the reader and the software employed.

Dr Jim Tate (National Museums of Scotland) spoke about the use of CT (computed tomography) scanning of museum collections. Various examples of CT scans and X-rays were presented, such as the Mar virginal, which enabled overpainted areas of painted panels to be investigated. The system of CT scanning has been effectively deployed for Egyptian mummies, enabling study of the condition of the objects. Current CT technology has allowed smaller slices of data to be collated with more efficient processing than was previously available. In the case of the mummy it was possible to see the bone structure and an amulet through the mummy wrapping. Other examples included a Queen Mary Harp and a Lamont Medieval harp, which enabled the viewer to see poorly fitting mortise joints and internal structural damage such as a crack within the substrate. Tool marks were also visible.

Micro-CT Scanning was also discussed, with an impressive example of a heavily corroded 17th century pocket watch from the Swan shipwreck which, when scanned, revealed the well preserved mechanisms of the watch, and even the makers inscription.

The presentation concluded by proposing that while conventional radiography reveals much technological information, medical CT scanners have excellent potential for wider use in conservation imaging.

Anne Marie La Pensee (National Museums Liverpool) discussed close range 3D laser scanning and how the conservation community could benefit from this emerging technology. It is possible to create 360° 3D digital objects but the quality is dependent on selecting the appropriate hardware and software. Some "uncooperative" surfaces, with less than ideal reflections, present particular challenges, such as marble, varnished and painted wood, gold leaf, gold and jewelled objects. Possible applications for 3D laser scanning include documentation, education, identification and interpreting, conservation, on-gallery activities and replication to within a tolerance of 0.2mm.

This led to discussion that although replication is efficient, hand-finishing is frequently required. Cost is also a major implication as the larger the object the more expensive it is to produce. In order to produce a successful replication many factors are involved. It is important to maintain high levels of accuracy and this involves many variables such as the subjectivity of the data processing, operator influence (alignment, compression, tolerance) and the object size. The most frequent uses of this replica technology are in conservation, reconstruction, display and handling and commercial uses.

During the afternoon delegates toured the Rutherford Laboratory site and were privileged to view Diamond and ISIS facilities. This is the largest scientific project in the UK in the past 45 years and cost £260m to build. It consists of a particle and linear accelerator. The principle is that the accelerator emits light and x-rays which are so powerful that they enable the object to be viewed at crystal level. X-ray Tomography is also possible which enables an object to be viewed layer by layer, for example a scroll that cannot be unfolded can be viewed layer by layer as if it has been unrolled. The tour provided an interesting insight into the potential usage of ISIS and the Diamond Light Source within conservation. Both systems provide non destructive, in-depth analysis of objects at atomic levels, which can aid in identifying substrate microstructures and differences in chemical composition.

The second day of the conference began with **Marianne Mödlinger** (University of Genoa) sharing some fascinating examples of 3D CT scanning and its application in the study of archaeological Bronze Age weapons. This technique can be used in many ways to aid conservation, such as looking at manufacturing methods and aiding dating of pieces. Additionally, it can be used to detect the most appropriate areas for testing, such as identifying later repair materials. When combined with other techniques such as radiography and analytical techniques, it has been possible to find new information about the casting methods and materials used. For example, studies of Bronze Age swords showed changes in casting methods over time, suggesting that the use of the swords changed from a stabbing weapon to a slashing weapon.

Photography of the Staffordshire Hoard was discussed by the next speaker, **David Rowan** (Birmingham Museum and Art Gallery). Recording the thousands of pieces by standard macro photography was difficult, due to the shallow depth of field obtainable by this technique. By taking many photographs, step focussing across the depth of the object, and stitching them together using Helicon software, it was possible to create a sharp, fully focussed image. One example was a composite of 57 photographs, all taken using a 40 megapixel camera. David shared some stunning images of the Hoard, and presented a novel way of using photographs in engagement. At the current exhibition in Washington, before and after images of an item are used on an iPad screen, where visitors can 'clean' the dirt from the piece by rubbing the screen with their fingers.

Giovanni Verri (UCL) gave an informative talk regarding the use of visible-induced luminescence imaging in the study of polychromy. An IR camera is used to detect fluorescence after filtering out the visible light that is initially directed onto the object. This is a fairly low tech and easy to interpret technique, which provides a great deal of useful information in determining the presence of specific fluorescent pigments, such as Egyptian Blue. This aids conservation decisions regarding treatment and preservation of surfaces still showing evidence of these original pigments, in addition to providing information about original decorative schemes.

Toby Jones (Newport Ship Project) began his discourse on digitisers with an overview of the project itself. The Newport ship is the remains of a 15th century merchant vessel, found in 2002. The ship was disassembled into the individual timbers in order to remove it safely, and has been undergoing conservation ever since. The Faroarm Contact Digitiser was used to record the outlines and significant features of all the timbers, providing 3D wireframe drawings. From this information, a 1:10 scale model of the ship was created using rapid prototyping of the individual timbers, joined with microfasteners. After laser scanning the model, it was possible to digitally recreate missing areas of the ship which has been used to help determine the original appearance of the ship's hull.

Additionally, techniques such as CT scanning and laser scanning were applied to further inform conservators about many of the artefacts found with the ship.

Conservation photography was the subject discussed by **Yosi Pozeilov** of the Los Angeles County Museum of Art. As senior conservation photographer, Yosi was able to share many images of the items that he has been involved in recording. His photography studio is set up specifically to serve the conservation and scientific needs of the LACMA collection, and also includes maintaining other records such as X-radiographs and slides. He discussed many techniques used in his studio for recording techniques, which include UV fluorescence, IR, and 3D imaging. The issues involved with going digital were also discussed, in terms of setting up an accessible file naming system and file finding methodology.

The next speaker, **Eleni Kotoula** (Southampton University) presented an interesting talk on the process of Reflectance Transformation Imaging (RTI). RTI is an advanced raking light technique, using a series of images from a standard camera and flash or lighting to illuminate the object from different angles. Images are then loaded into a software programme (RTI builder and RTI viewer) which allows manipulation of the light source for three dimensional viewing of the object to more clearly highlight loss, damage and detail. Eleni shared a number of interesting examples including surface markings caused by textile seen on gilded silver discs, and the detail evident on an Alabaster vessel, which allowed clearer visualisation of the manufacturing method. This is clearly a method which is easy and cheap to apply, but takes digital photography and raking light to the next level of analysis.

Sue Judge and **Andrew Kaye** (Diamond / ISIS user office) gave an overview of how to access the facilities at Diamond and ISIS respectively. There are two routes, proprietary and non-proprietary. In the case of the non-commercial work, there must be an intention to release the results into the public domain. While commercial work must be paid for, non-commercial projects can be awarded funding by RAL to provide travel and accommodation costs, in addition to funding the access to the equipment. All the proposals are peer reviewed by a panel of experts, and the most suitable are allocated time to use the facilities, with full technical support.

The day ended with a series of demonstrations relating to the two days of talks. **Toby Jones** provided a demonstration of the 3D laser scanning equipment, **Karla Graham** and **Angela Middleton** brought along their computed radiography scanner with some examples of results, and **Eleni Kotoula** and **Graeme Earl** gave a demonstration of RTI methodology. It was very useful to see all the techniques in action, and reassuring to see that the software needed for processing the images in all cases appeared very user-friendly and straightforward!

Overall, it was an excellent and well organised conference, with very interesting speakers and a good mix of demonstrations, talks, and the opportunity to tour the facilities. Many thanks to RAL for hosting the conference at such an impressive venue, and providing tours, and particular thanks to the organisers, **Evelyne Godfrey** and **Claire Woodhead**, for all their hard work in ensuring the conference ran smoothly.

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