The Northumberland and Durham Rock Art Project

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Heritage3D workshop
Devonshire Building, Newcastle
Thursday 29th June 2006
Prehistoric Rock Art

- Prehistoric rock art comprises abstract ‘cup and ring’ marks
- They are found across many regions of northern Britain
- Often the rock surface appears to form part of the overall design

2400 known panels in England of which over 1500 are in Northumberland and Durham

Roughting Linn, Northumberland
Northumberland and Durham Regional Rock Art project

DISCOVERING, STUDYING AND DEFINING HISTORIC ASSETS AND THEIR SIGNIFICANCE

Rock art pilot project: recording rock art in Northumberland and Durham

This two year project launched in 2004 is a partnership between English Heritage and the County Councils for Northumberland and Durham. It is the pilot for what may become a national project. Its key aim is to recruit and train volunteers who will then record all known engravings in Northumberland and County Durham using a standardised methodology. The information will then be entered into a specially-designed database. The archive will be made available via the internet and will provide a valuable resource.

- Two year project launched in 2004
- Partnership between English Heritage and the County Councils for Northumberland and Durham
- It is the pilot for what may become a national recording project
Project Aims

- Test different techniques and develop a standardised methodology for recording rock art content, context and condition
- Use this methodology to record baseline data for all known prehistoric rock art in the region
- Develop a digital database and web-site which will form the basis of a National Rock Art archive
- Involve the community in recording and other appropriate aspects of the project
- Test high-resolution recording techniques at selected rock art panels and sites, including 3D laser scanning and detailed landscape survey
Traditional recording approaches

- Rock art has traditionally been recorded using two dimensional techniques, such as rubbings and photographs.
- Although adequate for basic documentation, both techniques are limited in terms of the level of detail, three dimensionality and objectivity of captured data.
- In the case of rubbings, repeated use of the technique can be harmful to the rock surface.
- The limitations of the techniques can constrain in-depth examination and condition assessment of the carvings/host rock, which can in turn mislead our interpretations.
Metric survey techniques

“The measurement and pictorial presentation of land and buildings to a specified standard”

Direct (non image based):
- Hand Survey
- Theodolite/REDM Survey
  (Reflectorless Electromagnetic Distance Measurement)
- GPS (Global Positioning System)

Indirect (image based):
- Rectified Photography
- Panoramic Imaging
- 3D Laser Scanning
- Photogrammetry
Considered for rock art project

“The measurement and pictorial presentation of land and buildings to a specified standard supplying reliable and repeatable base data without specific thematic input”

Direct (non image based):
- Hand Survey
- Theodolite/REDM Survey
  (Reflectorless Electromagnetic Distance Measurement)
- GPS (Global Positioning System)

Indirect (image based):
- Rectified Photography
- Panoramic Imaging
- 3D Laser Scanning – *high-tech*
- Photogrammetry – *both low and high-tech*
3D Laser scanning – application within project

- Laser scanning **not** considered for recording all panels across both counties
- Principally due to cost of bringing in specialist equipment and expertise
- Used instead for selective high resolution recording of 5 panels, to allow assessment of factors relating to the creation and deterioration of the carvings
- Include fixed reference points – 10mm diameter stainless steel discs – to allow repeatability of measurement to <1mm for monitoring purposes
3D Laser scanning – application within project

- Project brief developed based on the draft addendum for laser scanning
- Important considerations include point density/resolution, data formats and post-processing requirements

Notes to be Read in Conjunction with Metric Survey Specifications for English Heritage

1.2 Provision of point cloud data
1.2.2 Point density and measurement precision
For each traversed panel, 3D laser scans are to be acquired at 0.3mm resolution. Processed data is to be supplied at this resolution, although prior to delivery, the contractors are to provide advice on any potential dilution of sub-data.

1.2.4 Overlapping scans
Data from overlapping scans will be acceptable to fill areas of overlapping data.

1.2.6 Data voids
The number of voids both within each scan and the post-processed data are to be minimized.

2.1 Method used and required accuracy of control
The scanning should aim to be entirely non-contactive on the rock, including re-measurement of temporary survey targets on the rock surface, with the latter approved and provided by the project officer. There is no requirement to tie the scans into the Ordnance Survey National Grid – a local coordinate system will suffice for each panel.

2.2.11 Intensity/colour
Where the suggested scanning system provides colour information, this is to be encoded.

2.2.12 Supporting imagery
Additional digital colour imagery of the scanned area is to be provided. This is to be georeferenced with sections 4.7a and 4.7b of the Metric Survey Specifications for English Heritage, which outline the national standard of digital imagery for heritage applications.

2.2.13 Delivery of survey materials
Two copies of the standard deliverables, as set out in sections 2.2.13 of "An Addendum to the Metric Survey Specifications for English Heritage – The Collection and Archiving of Geospatial Laser Scanning Data", shall be provided to Dr. Emily Farrell, English Heritage. The Laser Scanning Data shall be processed in an amenity manner to be provided on a CD-rom. All data are to be provided in Binary Image Interchange Format (BMP). No other data formats will be provided.

3.1 Processing of data
Supporting materials should also be provided for post-processing of data into a fully textured model.

2.4.6 Storage and archive of point cloud data
2.4.1 Data format
The current suggested data format for distribution of laser scan data is ASCII. This is to be formatted as X,Y,Z columns, followed by any recorded colour (e.g. R,G,B injected) or intensity values.

2.4.2 File naming convention
The suggested convention for how files are named is:
[Section number]_[Project name]_[Model name]_[Additional information].

Where possible, this convention should be followed although please note it may be acceptable to use filenames longer than the standard 64 characters allowed in the original specification.

2.4.3 File sizes
Individual file sizes are to be limited to the capacity of a standard CD-ROM using standard compression software.

2.4.4 Media
For this project it is acceptable for data to be provided on DVD/CD data using the .R format. Use of rewritable CD or DVD discs will not be permitted.
3D Laser scanning – application within project

- Following tendering, work carried out by Archaeoptics Ltd from Glasgow during June 2005
- Issues faced on site included access to rock panel and appropriate shading of rock surface during scanning within open environment
3D Laser scanning

- 5 sites selected from across both two counties

Ketley Crag Rock Shelter
How Gill
Huntersheugh

Chatton Park Hill
Cotherstone

All images generated using Imp3D software
The impact of lichen coverage could be assessed.
3D Laser scanning – How Gill, Baldersdale, Co Durham

(approx 1.2 x 0.5 m surface)

Opportunity to measure turf encroachment
3D Laser scanning – Huntersheugh, Northumberland

(approx 1.5 x 1.5 m of surface)

Need to capture the very fresh and fragile markings which had been uncovered following excavation

Possibility that the site might be recovered; scanning could give the opportunity to assess rates of delay for re-covered sites
3D Laser scanning – Chatton Park Hill, Northumberland

Images generated using Imp3D software

(approx 2 x 4 m surface)

The impact of physical and chemical erosion could be assessed
3D Laser scanning – Ketley Crag Rock Shelter, Northumberland

 Images generated using Imp3D software

(2 x 4 m surface)

This site is unique but has great display potential - possibly through a museum replica or 3D visualisation.
Rock Art Recording Techniques

Ideally should be

a. Non-intrusive

b. Objective and inclusive

c. Measurable and repeatable

d. Useable by anyone with basic training

e. Cost-effective

f. Lightweight and robust

Does scanning fit with these?
Application of photogrammetry

- New ‘lower cost’ photogrammetry software from Topcon - PI-3000 ‘Image Surveying Station’ – is currently being investigated
Methodology – site photography

• Traditionally stereo-photography for photogrammetry captured using metric cameras – high quality but high cost

• Instead consumer-level digital cameras (Nikon 5400 approx £250) are being used to assist three dimensional recording of the 1500 panels spread across both counties

• All six project cameras have been calibrated, by Dr Jim Chandler from Loughborough University, to precisely measure the focal length and map distortion of the lens

• Working at a calibrated focus range of 1.5m accuracy of detail that can be recorded is approximately 2-4 mm

Image courtesy of Jim Chandler
Methodology – site photography and scaling

- Traditionally scaling for photogrammetry provided by theodolite observation to fixed survey markers

- To simplify the site work, and reduce potential for damaging the rock, a simple combination of scale bars are employed

- In addition an IFRAO colour chart is included in each stereo-pair, to ensure colour balance of stereo-imagery can be controlled
Application by project volunteers

- Following initial training the project volunteers are now acquiring suitable stereo-photography using their own ‘consumer level’ digital cameras.

- Lower-cost software, such as PI-3000, is also being successfully used by some volunteers to process their own imagery to generate a range of outputs to assist the recording process.

- Include digital surface models ranging between 2mm and 10mm point spacing (DXF), orthophotographs (JPEG) and virtual modelling (VRML).
Drawings

- Traditional outputs have been two dimensional line drawings produced from rubbings and photography.
- Can be produced by either digitising off the stereo-pair (photogrammetry) or point cloud (laser scanning).
- Requires some knowledge of what is being digitised – use of sketch provided on recording sheet.
- However, “fitting a line to a cloud of points does not make a drawing”, so is this level of representation acceptable?
Some issues to consider

Archiving

- For the photogrammetry various outputs can be outputted in a variety of formats

  **Drawings**
  - DXF – for CAD

  **Contour Plots**
  - DXF – for CAD

  **Orthophotographs**
  - JPEG
  - BMP

  **3D Models & Animations**
  - TXT – text file
  - DXF – for CAD
  - VRML – for 3D graphics

  **Surface Models**
  - TXT – text file
  - DXF – for CAD

- Which formats should be used for the project, where should they be archived and on what media?
Some issues to consider

- Although showing great promise, processing by non-specialists requires greater, in-depth training to ensure accurate and appropriate data is produced.
Thank you for listening
Any questions?