Case study: Recording Prehistoric Rock Art

Type: Photogrammetry, triangulation laser scanning

Keywords: Low cost, photogrammetry, minolta laser scanner

Pre-historic photogrammetry and laser scanning

Introduction

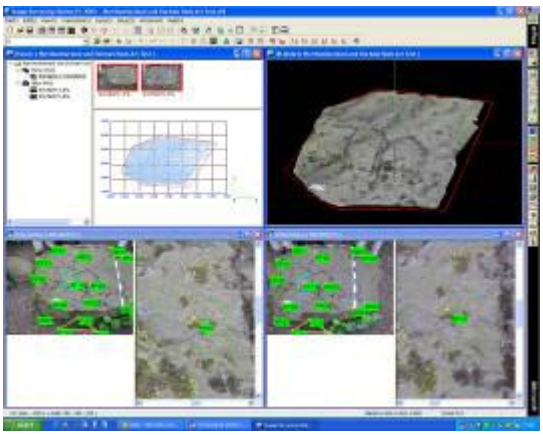
Prehistoric rock art comprises abstract 'cup and ring' marks found across many regions of northern Britain. Often the rock surface also appears to form part of the overall design. Traditionally, rock art has been recorded using 2D techniques, particularly photographs and rubbings. Although adequate for basic documentation, both techniques are limited in terms of level of detail and objectivity and, in the case of repeated rubbings, can be harmful to the rock surface. In addition, the limitations of the techniques can mislead interpretation.

The Northumberland and Durham rock art project, funded by English Heritage between 2004 and 2006, is developing a toolkit to enable non-intrusive digital recording of the rock art and rock surface. The project has recruited and trained about 50 volunteers from the local community and the methodology has been specially designed for them to use with ease. The core aim of the project is to use this toolkit to document all engraved panels (currently around 1500) in this region and produce a comprehensive database, accessible to the general public via a website. For this 'baseline' recording, 2D data are captured using GPS, digital photographs and specific recording proformas, 3D data are captured using stereo photography. High-resolution recordings of select panels have also been made using laser scanning.

Laser scans of rock art at How Gill, Cotherstone and Huntersheugh.

Instruments and software

All volunteers are using Nikon Coolpix E5400 digital cameras. The photogrammetry methodology has been specifically designed for the project's baseline recording by Paul Bryan of English Heritage with assistance on camera calibration provided by Dr Jim Chandler of Loughborough University. Working at a focus range of 1.5m the level of detail that can be recorded using this approach is approximately 2-3 mm. The results are principally being processed through PI-3000 'Image Surveying Station' software produced by Topcon. It is hoped some of this processing will eventually be done by the volunteers themselves following training in December 2005. Laser scanning of five selected panels was performed by Archaeoptics Ltd using a Minolta VI 900 scanner and processed through Demon software. The level of detail selected for this project was 0.5 mm (although the system offers a resolution of 0.17mm).



Topcon's PI-3000 software was used to create digital models.

Why was scanning was selected?

The photogrammetric technique developed for this project is user-friendly, cost effective and time efficient. For a monument type such as this where the carved stones are relatively small, prolifically scattered and often physical isolated, these are crucial issues. Accessibility is also important, and the equipment required can easily be carried by one or two people over considerable distances. These attributes make the technique highly suited to the volunteer-led baseline recording part of the project. In contrast, laser scanning is relatively expensive and requires specialist equipment and expertise both in fieldwork and

processing stages. In this instance, it is ideally suited for high resolution recording of a limited selection of panels.

What problems were encountered?

The stereo photography is still in a trial phase, but the main issues noted so far have been, first, to engage volunteers of diverse ages and abilities with the unfamiliar methodology. There has been a mixed response initially, with immediate take-up by some and considerable reticent by others. We believe that this issue will be surmountable through a cycle of repeated trial and feedback. The second issue is the weather and light conditions, where evenly lit images, using natural light, are preferred to the more traditional 'raking-light' approach to improve processing results. Rain has also disrupted several recording sessions so far.

In terms of processing the principal problems encountered to date relate to calibration and resolution of the chosen Coolpix 5400 cameras. To allow 3D measurements, accurate to 2-3mm, a precise focal length is required along with distortion information for the camera lens. So as not to over-complicate the site work for the volunteers it was decided to calibrate at only one focus setting – 1.5m. For rock panels of approximately 1m x 1m this is a suitable compromise between coverage and detail, but for smaller panels a shorter focus setting would be useful to allow closer-in stereo-photography. Also the 5400 camera uses a CCD with an effective 5.1MPixels. This resolution is more than adequate for general usage but can limit the processing of areas where the carved detail is less perceptible in even, natural light. How to satisfactorily record larger panels, greater than 1m x 1m, without resorting to fixed survey targets, is still an issue for the project.

A laser scan of Ketley Crag Rock Shelter.

What were the final deliverables?

The initial results of the stereo photography have been most promising. Supplied as orthophotographs (jpegs) and surface models (currently dxf as no .obj output is provided by PI-3000) they provide a detailed, objective record of the engravings and surface topography of the host rock. These can be viewed and manipulated at will, allowing examination of, for example, the degree and nature of lichen cover, the relationship between the carvings and erosion patterns of the rock surface, and the relative depth of the engravings. While some detail is omitted due to the level of resolution, the information captured using this technique has considerable potential for enhancing our understanding of the rock art and evaluating its condition. Finally, the exciting opportunities for public presentation represented by 3D data are most welcome in this context where we have, on the one hand, low public awareness, and on the other, very visual but often inaccessible monuments.

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