Laser Scanning of the Harriett, Purton

Introduction

In September 2009 the VISTA Centre, University of Birmingham carried out a laser scan survey of the hulk of the Harriett at Purton, Gloucestershire. The aim was to provide a highly detailed 3-dimensional record of the hulk as a point-in-time record of the structure, as well as to trial the use of laser scanning as a method of recording and presenting the Purton hulks.

Methodology

A Leica HDS6000 laser scanner was used to record the surface of the hulk (Fig.1). The HDS6000 is a phase-based terrestrial laser scanner with an operational range of 0.2 to c.50m.

Laser scan survey operates a line-of-sight system, so in order to achieve full coverage of the area to be surveyed a number of setups were required to ensure that there were no voids in the data, and to maintain a consistent level of measurement resolution. The laser scan of the Harriett involved ten separate set-ups.

The overall measurement resolution was ≥3mm spacing across the surface of the hulk.

In addition, the rear of the hulk was recorded at a higher resolution, in order to gather greater detail on the carved transom (Fig. 2).

The Leica HDS6000 laser scanner collects data as a series of xyz co-ordinate measurements. As well as these basic parameters, the strength of the laser's return signal is recorded. These 'intensity' readings help to map the differences in material, or material conditions, and are typically presented across a spectrum of colour from the highest recorded intensity return to the lowest. As well as intensity data; rgb colour information was gathered in order to provide a full colour point cloud. This was collected in the field using a panoramic digital SLR (10Mp), calibrated to the height of the laser scanner.

Processing/Results

The individual setups were stitched together to form a single amalgamated data set in a process referred to as 'registration'. This was achieved through the use of custom targets which are identified by the laser scan software and used to identify the position of the scanner in relation to the other setups.

The use of targets in the field meant that the individual datasets were registered together with a Mean Absolute Error of 0.001 m.

The additional RGB information gathered using the panoramic digital camera will be added as a texture map to the fully registered point cloud, and the resulting full-colour point-cloud archived.

In addition to the basic registration, the rear transom of the hulk was fully meshed to provide a solid surface model. This process enabled a better visualisation of the

carving on the transom (Figs. 3 & 4. The processing allowed the removal of colour from the model, and the manipulation of a digital light source to highlight details difficult to see with the naked eye. The results (shown at Figs. 5-8) show additional lettering not picked up by earlier visual surveys.

Data Archiving

The data will be archived in accordance with English Heritage guidelines (EH 2007). This involves the storage of the fully registered, full-colour point cloud in a standard, non-proprietary format. In this case, the .pts file format will be used. This is an open ASCII format dividing the data in seven columns, listing the attributes x,y,z,intensity,r,g,b.

In addition to the delivery of this dataset to the Friend of Purton and English Heritage, the data will be fully archived and stored by the University of Birmingham for a minimum period of 6 years from the date of collection.

Recommendations for Further Work

The fully registered laser scanning data can be used to generate 2D line drawings detailing a detailed plans, elevations and cross-sections of the hulk (Fig. 9).

At a basic level, the 3D point cloud data could be used to produce a video flythrough of the site, suitable for presentation on a website, or on a standard format DVD.

In addition detailed meshes such as those at figures 5 to 8 can be created for the entirety of the hulk.
The resulting mesh can be distributed as either a flat image or a 3D VRML or OBJ model for website or DVD usage.

A reduced version of the 3D model could likewise be placed into Google Earth, to enable greater web dissemination.

Comparative analysis is a technique used to compare two 3D models to detect movement. In the case of heritage management, this technique can be used to monitor erosion or movement of a structure or monument. Repeated scanning of the hulks at Purton, at intervals of every couple of years, could help to detect the deterioration of the hulks and better inform the conservation strategy used to protect them.

Future survey of the hulks should incorporate accurate ground control through the use of differential GPS, or tie the laser scan data into previously established ground control, to provide control for an accurate survey of the site, and the monitoring of the site over time.

Fig. 1 Laser scanning of the Harriett with the Leica HDS6000

Fig. 2 Point Cloud of the rear elevation

Fig. 3 Rear right transom

Fig. 4 Rear left transom

Fig. 5 Mesh of rear left transom

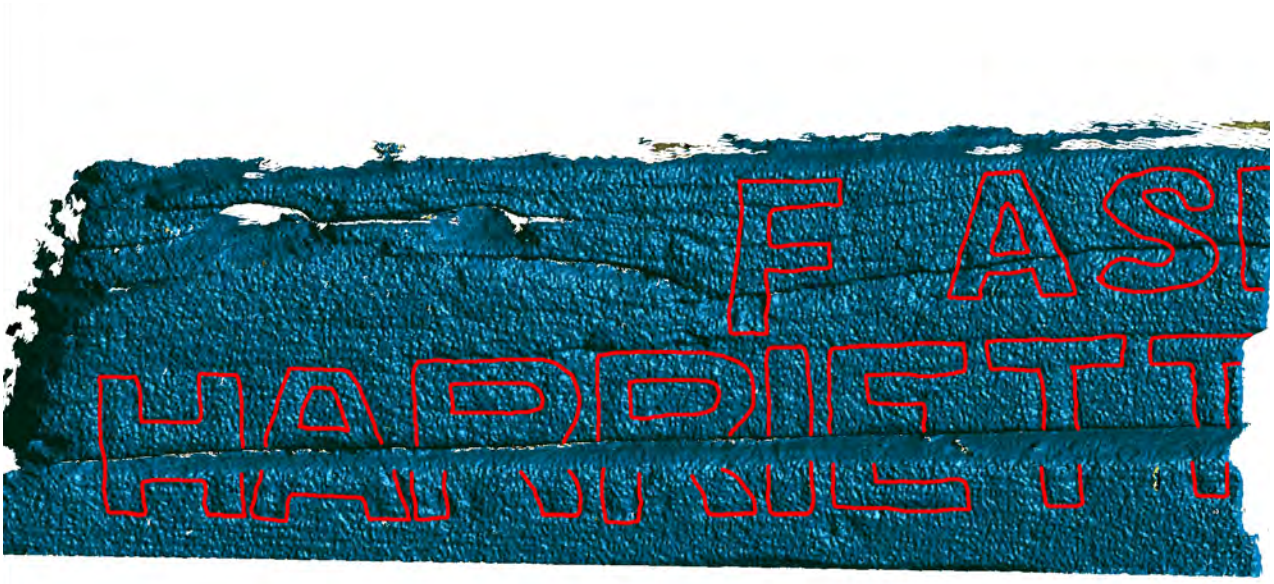

Fig. 6 Mesh of rear left transom - detail highlighted

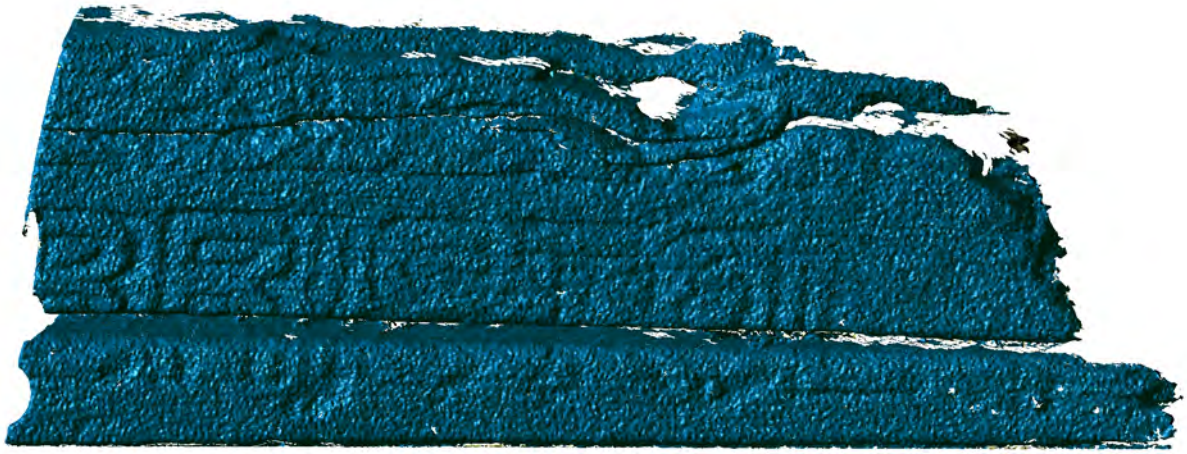

Fig. 7 Mesh of rear right transom

Fig. 8 Mesh of rear right transom - detail highlighted

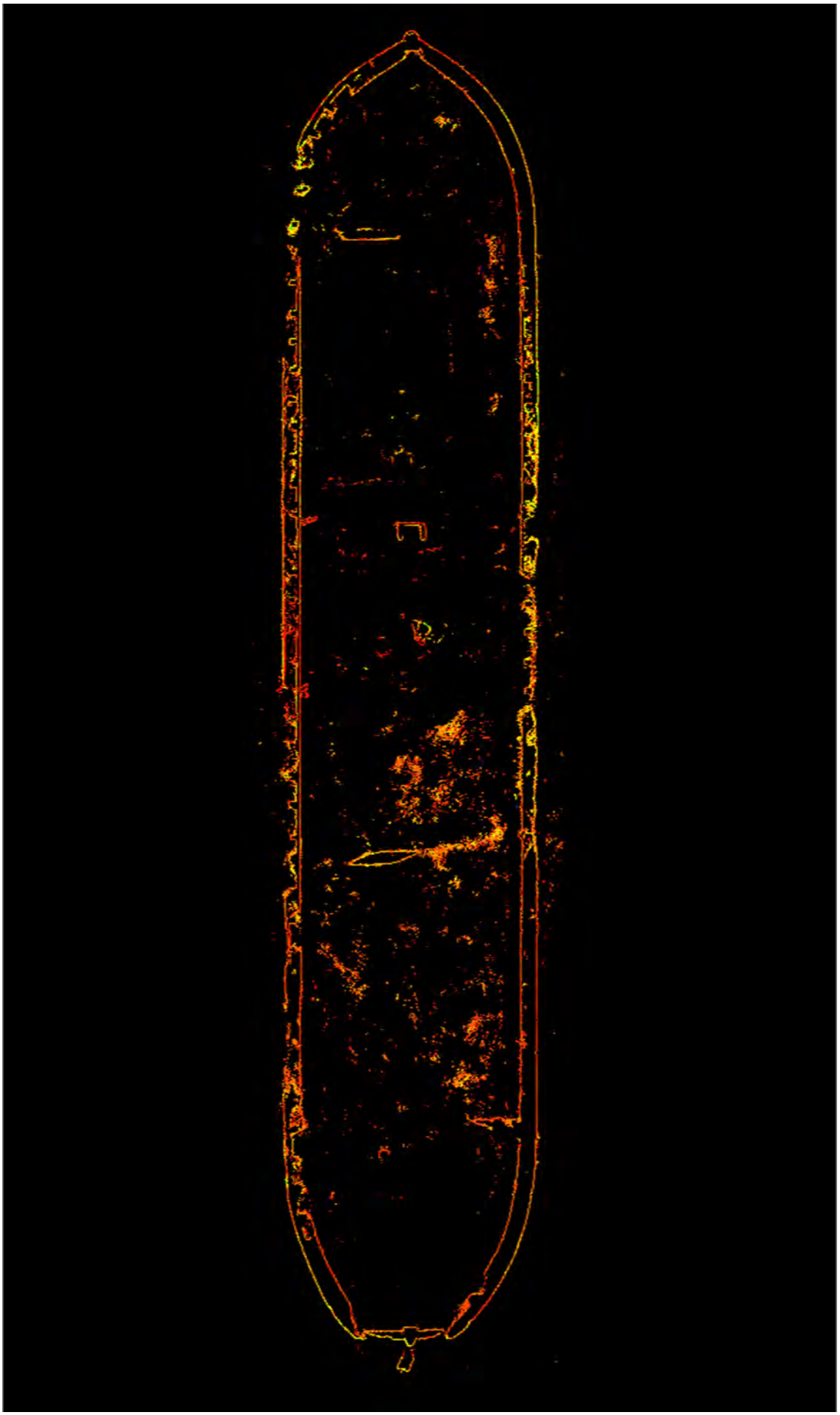

Fig. 9 Orthoslice through of the point cloud in CAD