Breamore File 2

Photogrammetry. By James Miles

The Breamore pail and the Anglo-Saxon glass bowl were both recorded using photogrammetry. Photogrammetry is a digital recording method that utilises overlapping photographs to create a three-dimensional replica of a given object. The method is able to produce these digital replicas by analysing and measuring each pixel within an image; the software used extracts depth values for each image and each pixel is aligned in a virtual space. The photographs used are taken from varying positions and contain a minimum of 60% overlap. This process involves a large number of photographs within each model production but allows for a thorough re-creation; areas with gaps or few overlaps produce limited results. Pixel resolution, exposure values, object type, and computing capabilities affect how each model is processed. Lager numbers of photographs require lengthier processing times; larger pixel qualities require further calculations per pixel and thus further increases time. Exposure values, with pixels being too light or too dark, influence how the images are stitched together. The greater the computing power available, the quicker the processing time. The models that were produced were completed on a 64GB RAM computer that had an Intel i7 CPU, allowing for each model to be completed within two days. Using a computer with a lower processing power would have resulted in longer processing times. When capturing photogrammetry data, methodological recording processes differ depending on the object in question. The method works best when recording objects that have a consistent colour, and struggles when processing shiny or transparent features.

The Breamore pail, with its physical shape being cylindrical and straightforward, was processed using 120 images. More images could have been taken but would have resulted in longer processing times, with no improvement on the results gained. Each photograph was aligned, as shown in Fig. 1, with each camera position highlighted in blue. Each image was masked to remove unwanted detail, such as the pail's stand (Fig. 2); this allowed for the software to focus on selected pixels, rather than the full images which included background information that was redundant. These images were processed to produce a high-resolution point cloud; the points included within the model exceeded nine million. The points were meshed to create a complete model and a texture was applied to add a photorealistic quality to final result (Fig. 3). The resultant model was scaled using known measurements and a virtual replica was exported to allow for analysis. The final model has over twenty million faces and is available to view online (https://sketchfab.com/models/c0c12b159653449d8723da00513d8a9e) and a video animation (https://vimeo.com/147731549) was also produced to highlight the surface detail.

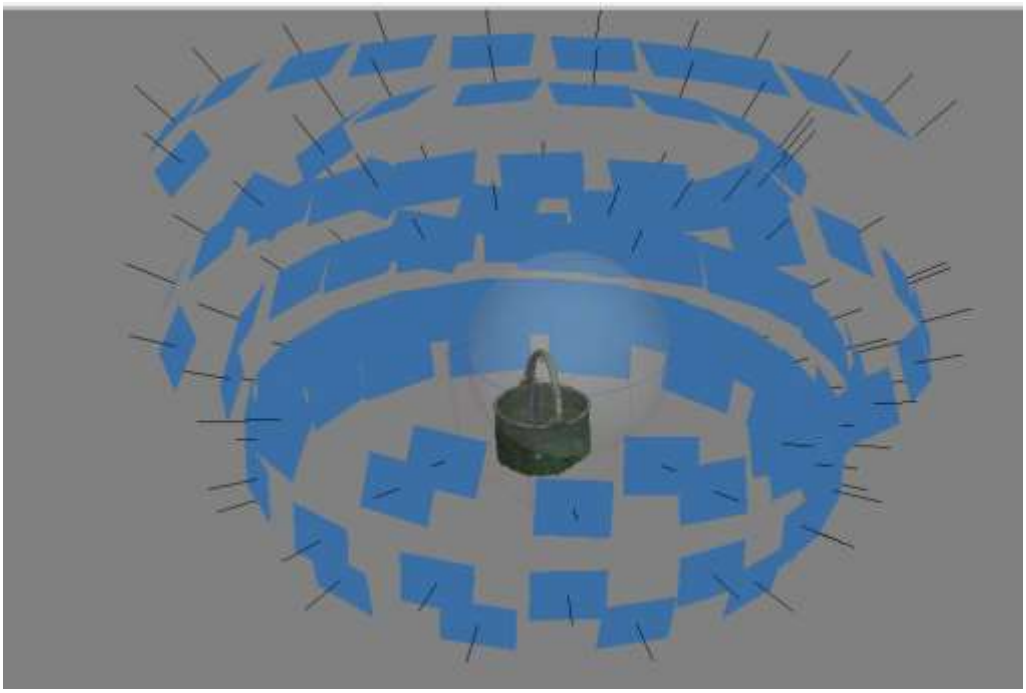

Figure 1. The alignment of each photograph used within the photogrammetry production of the Breamore pail

Figure 2. A masked image within the photogrammetry process. The areas inside the white lines are used within the modelling process to improve time and computational processes.

Figure 3. Photogrammetry model of the Breamore pail

The photogrammetry model produced for the Breamore pail was easier to capture and process due to its colour detail. The glass bowl, due to its reflective and opaque nature, proved difficult to complete. Photogrammetry relies on the pixel detail of each image being constant throughout; the opaqueness of the glass bowl, the reflections of the ambient lights and the surrounding room provided too many errors for the software to process accurately. Although 120 photographs were captured, the software was unable to align each of the photographs and too many errors were present for it to be functional. The results of the final model can be seen in Fig. 4 but once the texture is removed, as shown in Fig. 5, the mesh detail is incorrect, with the surface seen as being uneven. This uneven surface is due to the reflections and the opaqueness of the glass, with software believing that details were present above and below the bottom of the glass bowl. Ideally a laser scanning, using blue-light technology, should have been used, but one was not available at the time of recording. Blue-light technology allows for shiny and glass objects to be recorded, and removes the errors found within photogrammetry and standard laser scanning. The modelling process that was used was able to provide some results, but the data relied too much on textural detail to be usable. These problems were anticipated, but an attempt was made to repair the faults; this proved unsuccessful and a final model is not included online due to inconsistences between the real and virtual replica.

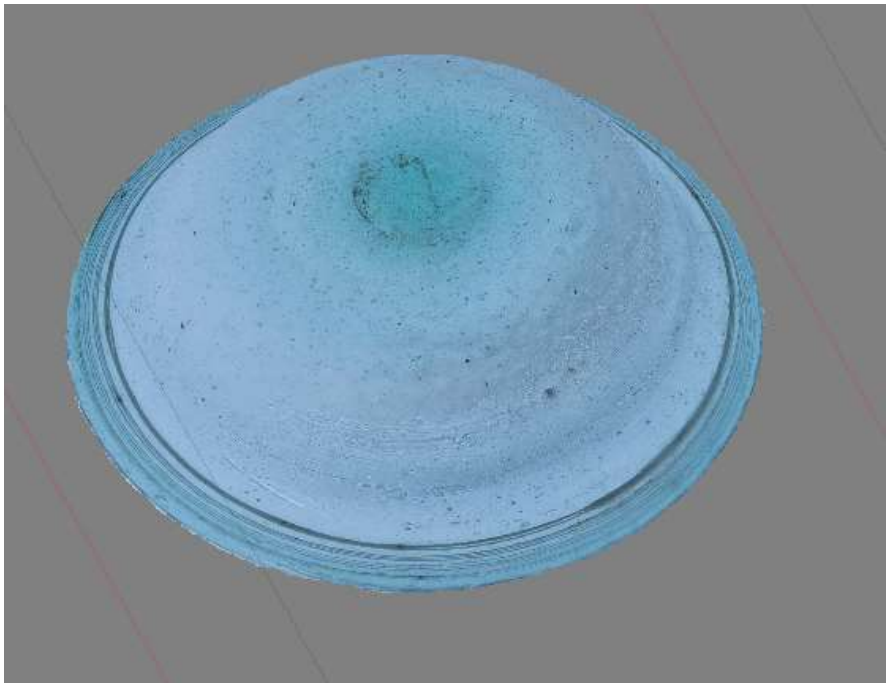

Figure 4. The textured photogrammetry model of the Anglo-Saxon glass bowl

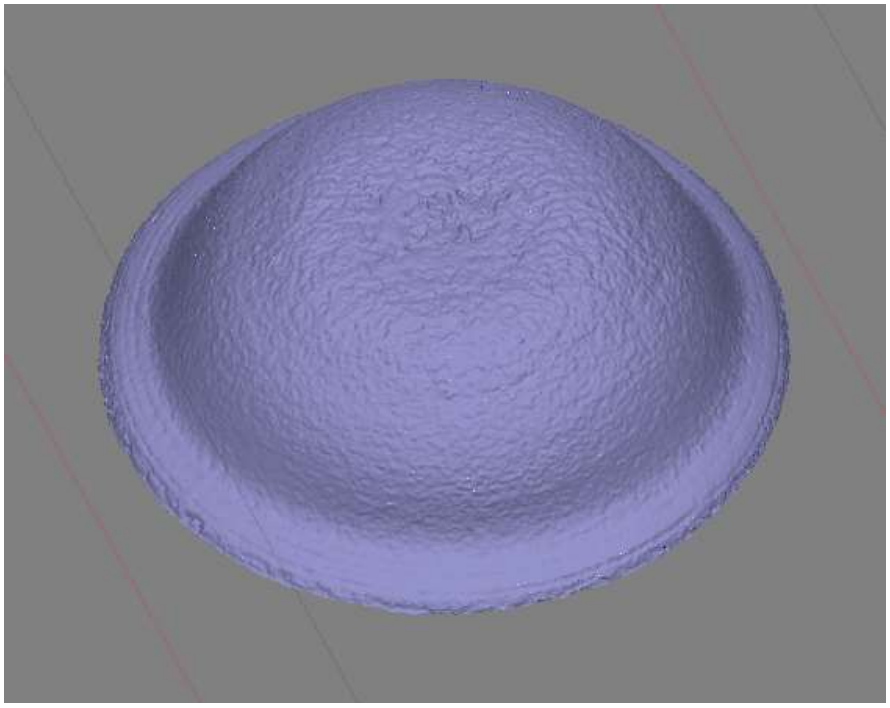

Figure 5. The mesh detail of the Anglo-Saxon glass bowl which contains a number of errors seen in the surface