The application of threedimensional digital modelling to contemporary craft ceramics research

A case study in mappings between scientific invention and artistic inspiration for the project The Hunt for Submarines in Classical Art

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Introduction

This report stems from a project which aimed to produce a series of mappings between advanced imaging information and communications technologies (ICT) and needs within visual arts research. A secondary aim was to demonstrate the feasibility of a structured approach to establishing such mappings.

The project was carried out over 2006, from January to December, by the visual arts centre of the Arts and Humanities Data Service (AHDS Visual Arts). It was funded by the Arts and Humanities Research Council (AHRC) as one of the Strategy Projects run under the aegis of its ICT in Arts and Humanities Research programme. The programme, which runs from October 2003 until September 2008, aims ‘to develop, promote and monitor the AHRC’s ICT strategy, and to build capacity nationwide in the use of ICT for arts and humanities research’. As part of this, the Strategy Projects were intended to contribute to the programme in two ways: knowledge gathering projects would inform the programme’s Fundamental Strategic Review of ICT, conducted for the AHRC in the second half of 2006, focusing ‘on critical strategic issues such as science and peer review of digital resources’. Resource development projects would ‘build tools and resources of broad relevance across the range of the AHRC’s academic subject disciplines’. This project fell into the knowledge gathering strand.

The project ran under the leadership of Dr Mike Pringle, Director, AHDS Visual Arts, and the day to day management of Polly Christie, Projects Manager, AHDS Visual Arts. The research was carried out by Dr Rupert Shepherd.

The project fell into five sections:
• Definition of methods
• Analysis leading to the definition of a number of clearly defined ICT needs for visual arts research
• Survey of relevant scientific research into advanced ICT
• Exercise in mapping needs to technologies
• Investigation of an exemplary case study resulting from the mapping of technologies to needs

The project’s outputs comprise:
1 A report outlining the methods employed, the findings of the survey and analysis, and the mapping between the results of the two main strands
2 A database containing the information gathered during the survey and analysis, and facilitating the mapping between the two
3 A report on the exemplary case study

This case study is the third of these outputs. The report and database can be obtained from the project website at ....
Artistic needs

The artist: Magdalene Odundo

Magdalene Odundo is a ceramicist, currently working in Farnham in Surrey, where she is also professor of ceramics at the University College for the creative Arts at Canterbury, Epsom, Farnham, Maidstone and Rochester. Born in Nairobi in 1950, she was educated in India and Kenya. After studying graphic design in Nairobi, she travelled to Britain for a foundation course at the Cambridge College of Art in the early 1970s, soon transferring to three dimensional work at the West Surrey College of Art and Design. A short spell at the pottery at Abuja, Nigeria, in 1974 was highly influential, and it was there that Odundo saw the methods of hand building typical of the Gwari area which have formed the basis of her practice ever since. She took an MA at the Royal College of Art in 1982, and has exhibited internationally in solo and group exhibitions since 1977. Her work is represented in many public and private collections in the UK, Europe, USA and Africa. It is characterised by a highly restricted range of forms, and a palette almost entirely limited to the orange red of the clay and shades of black achieved in firing. Her main aim when creating a work is that it seem to be visually and physically ‘right’, and this transcends any more conceptual concerns. To this end, she places great importance on the perfection of the interior surfaces of the pieces, even though these remain concealed from viewers.

Odundo’s biography might suggest a strong commitment to African forms, yet her work is perhaps best characterised as ‘hybridised’. Whilst an African influence is undeniable, it is by no means the only one: her works have assimilated forms from sources as diverse as early American, KabariSudanese, Egyptian, Minoan, GrecoRoman, early Iranian and Japanese ceramics, Japanese, Chinese and African bronzes, Elizabethan costume, or European works by artists such as Brancusi or Richard Long, as well as the British 20th-century Studio Pottery movement – as embodied by Bernard Leach and Michael Cardew, for example. She saw many of the works that inspired her in London museums in the 1970s and 1980s. Odundo herself resists classification, declaring in 1982 that ‘I will only draw from Africa if it suits me in my quest for perfect simplicity, for natural forms.’

Notwithstanding, an African influence can be seen in Odundo’s technique. Her pots are hand built, rather than thrown: the base, walls, shoulder and neck are gradually built up by hand and smoothed down with a scraper; in this, they recall African practice, amongst others. The surface finish is achieved by a combination of burnishing the unfired clay with a wooden or metal scraper, and coating with a slip (a liquid mixture of very watery clay) rather than a glaze – a technique used by Greek and Roman potters. The colours are obtained by different firing conditions. Orange pots are produced by normal firing in a well ventilated kiln. The black pots are fired a second time in a saggar (an enclosed

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container) alongside wood or similar materials: as the fuel burns, it produces a carbonising atmosphere within the saggar which turns the clay black. Repeated firings may further refine a pot's colour.

Odundo’s pots are nonfunctional – she refers to them as ‘pieces’, rather than as ‘vases’ – yet they retain a basic functional form: they are all capable of being used as containers. In this, they evoke the ritual and ceremonial uses of ceramic vessels in a range of cultures. Odundo, who wrote her final year essay at Farnham on ‘Rites of Passage in Kenya’, has publicly referred to the use of pots in African rituals. For example:

When I came back to Kenya in 1975 I became aware by how the African process of life was shadowed by pots. Funeral rites, for instance, could involve pot making and pot breaking. In almost all traditional African societies, all rites of passage were marked with ceremonial ritual, and for these, birth, marriage, death, including those meant to appease those living in the world beyond, involved the use of ceramics; bridal gifts, such as the Nupe giving out bridal pots, that were beautifully made and inlaid with metalwork, a set of cooking pots always making up part of a girl’s trousseau among the Mijikenda of Kenya or internment, which accorded the dead with an array of pots.

Yet insisting upon the ritual associations of Odundo’s work is not to restrict it to a single set of associations: In Africa, functionality never has a onedimensional meaning. An object could be used in a ritual for the dead, which is a utilitarian purpose, for instance; then given to the king or chief who, as guardian of the people, may posit the objects on a shrine, this imbuing it with sacredness, rendering it fit for the gods, untouchable for the living and later to be used as part of worship or in healing. These different meanings are preserved in the object. They become part of its history.

As Simon Olding has observed, ‘the ceremonial impact of the vessel is very important to her. Odundo likes to consider them as vessels that might be shared, lifted and used for both private ceremony and public ritual.’ The important point here is that the ceremonial or ritual uses of a pot almost always involve its movement; and movement is a quality that has long been important to Odundo. Whilst teaching at the Commonwealth Institute in the mid 1970s, she often watched and drew dancers whilst they were rehearsing and performing. She is, she says,

attracted to something that is almost a kind of electricity in how pliable the body can be. Thus with plastic, malleable clay, which, while it is capable of being shaped to capture that mesmerising, hypnotic achievement, the pot ends up in a motionless state. This is what I try to capture.

Movement of many kinds – human and organic, swift and slow – also plays an important role in the drawings which Odundo makes as she develops forms for her ceramic pieces. In fact, drawing is central to her practice: ‘She constantly draws the shapes she is

thinking about, planning changes and sketching variations in a fascinating thinking process before starting work.\textsuperscript{19}

The pots’ tactility is also important for Odundo, who intends that they invoke responses in their viewers related to holding and touching them, experiencing them as solid, three dimensional, textured objects.\textsuperscript{20}

Needs

A series of needs which might be met by digital imaging technologies were developed following a long discussion with Magdalene Odundo, held as part of the Hunt for Submarines project on 2 May 2006. The main themes which emerged were:

- Ways of manipulating existing works in order to develop new ideas
- Three dimensional modelling and reproduction
- Capturing the dynamics of making

Ways of manipulating existing works in order to develop new ideas

As noted above, Odundo makes extensive use of drawings to evolve and develop the forms of her ceramic pieces. The pieces also evolve during making, so that an initial drawn idea is often somewhat removed from the finished piece. Whilst drawn forms can easily be reworked on the sheet to develop further variations, the same is not true of ceramic forms. Some system for taking images of existing ceramic works, and reworking them to develop new forms in the ways that working drawings can be manipulated, would be a great help in evolving new works.

Three dimensional modelling and reproduction

As a ceramicist, Odundo works in three dimensions; yet reproductions of her work are only circulated in two dimensions, reflecting the limitations of print reproduction and the conventional methods of digital imaging used in most UK art schools and arts and humanities higher education establishments. As large ceramic pieces, Odundo’s work is fragile, and relies upon reproduction for much of its dissemination. A system which could capture and produce three dimensional models of her work would greatly facilitate:

- Lecturing and dissemination of work: a digital file is much more portable than a large, fragile ceramic. It can also be enlarged and projected, making it much easier for the artist to describe, explain and illustrate the concerns which shape her work. This would have particular benefits in two areas on which Odundo focusses in her work:

\textsuperscript{19} Cooper 2004, p. 32. \textsuperscript{20} Odundo, in conversation 2 May 2006. Such responses have been acknowledged by, for example, Hill 1987, p. 8 and Staal 1994, p. 16.
• The relationships between the interiors and exteriors of pieces: visualisation software could, for example, allow for exterior surfaces to be rendered semi-transparent, showing interior and exterior simultaneously.
• Movement and animation: digital models can be moved and animated in ways that a fragile ceramic piece cannot, allowing viewers to gain a much more ‘mobile’ view of the work than could be achieved in a standard gallery setting.
• Teaching: access to three dimensional models would help students to understand and visualise the pieces in the ways described above.
• Replication: digital models might be used to produce three dimensional reproductions of Odundo’s work (perhaps using rapid prototyping technologies). This would aid:
  • The creation of physical copies which can be handled with less fear of damage than would be the case with Odundo’s originals.
  • The creation of limited edition reproductions, making long term engagement with her work – the kind that is only possible with prolonged and repeated contemplation – more widely available: Odundo’s originals, the result of extensive and painstaking work, are unique and expensive.

Capturing the dynamics of making

Making ceramics is a dynamic process: it is based upon a series of movements which shape the raw clear into a finished work. There is a strong pressure on practiceled researchers to investigate, analyse and disseminate the processes by which they evolve and create their works; yet methods of capturing and disseminating these processes are remarkably underevolved.

Limitations

It should be noted that these needs only relate to particular aspects of Odundo’s research and practice. They avoid, for example, issues related to her interests in touch and tactility.
Imaging technologies

The imaging technology: Arius3D

Arius3D is a Canadian company which specialises in the full colour laser capture of three dimensional objects, culminating in the production of high resolution colour three-dimensional images. They concentrate their business in the areas of cultural heritage, scientific imaging, and education.\(^\text{21}\)

The Arius3D scanner was originally developed and patented by the National Research Council of Canada; Arius3D are the sole licensees.\(^\text{22}\) It uses a single beam comprising laser light in three wavelengths (red, green and blue) to capture colour and position using a charge coupled device sensor. Scanning in the different axes is carried out in different ways:

- **X axis (horizontal measurement):** the laser beam is scanned across the object surface using a moving mirror. The position of any point along the axis is given by the mirror’s angular position when the point is acquired.
- **Y axis (vertical measurement):** the apparatus is moved vertically. The position of any point along the axis is given by the position of the apparatus.
- **Z axis (depth measurement):** the position of any point in depth is obtained using triangulation. Currently, Arius3D claim a resolution of 250 ppi (102 µm/pixel) in the X and Y axes, and 25 µm in the Z axis, for the scanner; and a capture rate of 3000 points (or an area approx. 5.5 mm square) per second.

The system has several advantages:\(^\text{23}\)

- Because colour and geometrical information are collected using the same sampling beam, they are perfectly registered.
- The system does not use ambient light to illuminate the object being scanned, so the resulting images are free of defects such as glare, shadow, colour cast, etc.
- It captures to a very high resolution, allowing for the production and reuse of derivative copies in a variety of resolutions and formats.
- It uses very low levels of illumination during capture.

Arius3D have also developed their own three dimensional imaging software, Pointstream, which differs from other packages in that it is raster, rather than vector, based.\(^\text{24}\) Pointstream builds objects up from individual pixels (which have six properties: red, green and blue colour and X, Y and Z position), without creating polygons or applying texture maps. Pointstream data files therefore represent three dimensional objects with a minimum of interpolation and estimation. Arius3D claim that Pointstream...

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images are easily scalable, and note that, because the system does not require polygons to be rendered, smooth display does not depend upon graphics hardware. Poinstream is currently available as a standalone Windows application, 3DImageSuite; and as an ActiveX control, 3DImagePlayer. Using the latter, it is possible to embed Pointstream images within Microsoft Office documents, including PowerPoint. 3DImageSuite is also capable of exporting data using standard formats.
Mapping between needs and technologies

A confluence of opportunities

As noted above, Magdalene Odundo draws much of her inspiration from ceramics from other cultures and periods, often visiting museums and other collections to view and draw the objects they contain. One of the museums she has used is the Petrie Museum of Egyptian Archaeology, which houses University College, London (UCL)'s collection of Egyptian artefacts – most notably the collection assembled by the noted archaeologist William Flinders Petrie, the college’s first Edwards Professor of Egyptian Archaeology and Philology, which it bought in 1913. The collection comprises approximately 80,000 objects from the Nile valley, dating from the Pharaonic, Ptolemaic, Roman, Coptic and Islamic periods.

During 2006, Odundo negotiated a residency at the Petrie Museum, which would enable her to work in the museum, sketching and studying the collection, and eventually lead to the production of new work inspired by the objects she saw. However, the Museum will begin packing its collections away in March 2007, as it prepares to move into new, purposebuilt accommodation which is scheduled to open in 2010. Odundo’s residency might, therefore, incorporate some aspect which relates to the old museum displays before they are dismantled.

Whilst Odundo was planning her residency, UCL were negotiating a collaboration with Arius3D, which included the installation of the latest model of Arius3D scanner in the college’s interdisciplinary Chorley Institute of Spatial Information. Arius3D are expected to work particularly closely with UCL’s engineering sciences and geomatic engineering researchers – and also the college’s museums and collections. Indeed, it is intended that the new scanner be used to image artefacts in the Petrie Museum.

This confluence of opportunities – Odundo’s proposed residence at the Petrie Museum, and the UCL/Arius3D collaboration which was to incorporate three dimensional capture of some of the Petrie Museum’s objects – seemed to provide an ideal opportunity to develop a collaborative project which exploited mappings between Odundo’s needs as a practice led researcher and Arius3D’s digital imaging capabilities.

The resulting project

Consequently, discussions are underway between UCL, the Petrie Museum and Magdalene Odundo with a view to developing a project to investigate the application of three dimensional digital modelling to contemporary craft ceramics, based on the following outline.

Aims

To use advanced three dimensional digital imaging and modelling techniques as an aid to the creation and understanding of contemporary studio ceramics.

Objectives

1. To produce working three dimensional models of the interiors and exteriors of a series of ceramic vessels.
2. To investigate the ways in which these models can extend the artist’s visualisation and understanding of the forms of the vessels.
3. To investigate the ways in which the manipulation of these models might work as aids in the design of new forms.
4. To investigate the ways in which these models can be presented to other artists, students and the general public.
5. To evaluate the models’ effectiveness as aids in the discussion and teaching of contemporary ceramics practice.

Outcomes

1. A set of three dimensional models of the interiors and exteriors of a series of old and contemporary ceramic vessels.
2. A series of reworked digital models which have been used to generate further designs.
3. One or more ceramic works which have been evolved using the reworked digital models.
4. One or more brief reports, conference papers, journal articles or book chapters summarising:
   - the ways in which the digital models extended the artist’s visualisation and understanding of the forms of the vessels
   - the ways in which the manipulation of the digital models worked as aids in the design of new forms
   - the effectiveness of the digital models and their associated software tools when used to present research outputs to other artists, students and the general public.
   - the effectiveness of the digital models as aids in the discussion and teaching of contemporary ceramics practice
References


