3D VisA
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3DVisA Bulletin

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Edited by Anna Bentkowska-Kafel
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Editorial

"We are merely using technology as a means of throwing around ideas." This statement demonstrates the remarkable confidence (comparable to the ease of sketching on the back of an envelope) with which young researchers are applying specialist visualisation as a robust research tool in the Arts and Humanities. This kind of self-assurance in their own technical proficiency is redefining the notion of interdisciplinary research. Academic and technological expertise, once two distinct areas of specialty, are now found integrated seamlessly in modern scholarship by students with a profound understanding of both. The quote is from Matt Jones, a M.Sc. student in Archaeological Computing: Virtual Pasts, at the University of Southampton. Matt is the recipient of the 3DVisA Student Award 2007 for his essay, included in this issue, describing the development of a computer model of Southampton as it may have looked in 1454. Matt made a considerable effort to document the reliability of his visualisation. A panel of experts in 3D visualisation was unanimous in commending his transparent interpretation of historical sources, archaeological data and the extant fabric of the town, and pointing out the gaps in this evidence. It was primarily his account of the decision making process and Matt's method of portraying levels of certainty in the information conveyed by the model that secured him the first prize. He provided this record alongside the model. The next step for the developers of heritage visualisations is to ensure that this information is made an integral part of the model and is accessible at any time, as postulated by the London Charter (*www.londoncharter.org*).

Continuing the debate on the veracity of representation and experience of virtual reality, this *Bulletin* brings two new instalments. Although all contributors to date agree that the process of digital recreation of the past is solely a matter of interpretation, there is considerable controversy in understanding the issues involved. Hilary Canavan presents a stark defence of the *Cerveteri Reborn* project (see March 2007 issue) and generally, any of today's visualisation created 'in a scholarly or sensitive' manner. Her piece responds to what she considers to be a completely misguided commentary by the philosopher, Hanna Buczyńska-Garewicz (see September 2007 issue), in which the latter deplores the impoverishment of human experience of time and space in virtual reconstructions of cultural heritage. An equally heated argument can be found in Michael Greenhalgh's reluctance to accept a computer model of extant architecture as a substitute for photography that would justify the expense and labour of 3D recording and modelling. The article by Annemarie La Pensée provides expert insights into the complexities of one such technology, namely 3D laser scanning, used in the documentation and virtual reconstruction of artefacts. She describes three projects carried out by Conservation Technologies, National Museums Liverpool, in collaboration with other cultural institutions, and explains how this technology works. Having demonstrated the high level of accuracy in the non-contact capture of 3D data and the veracity of visualisation, Annemarie's concluding remark cautions against the subjectivity of this method of recording.

As a Virtual Reality artist, Daria Tsoupikova is free from many constraints of heritage visualisation. Her practice-based research, exemplified by the *Rutopia* installations, is mainly concerned with the study of the aesthetics and narratives of the traditional Russian folk art that inspires her art. The digital medium enhances her painterly technique, adding to the exuberance of colour and form. The immersive space of the CAVE® at the Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago (UIC) has opened up *Rutopia 2* to interactive exploration of its imaginary worlds, while the use of fast networks has enabled Daria to develop this artwork into a global participatory installation.

I hope you will enjoy reading the articles which appear here in abridged form. Full text versions and more illustrations are available online. This issue marks the end of the two-year funding for 3DVisA research activities from the UK Joint Information Systems Committee (JISC). I wish to thank all the authors for their engaging and stimulating contributions to this forum. The 3DVisA Network development activities continue until April 2009 in partnership with the UK-wide scientific Visualization Network (*www.viznet.ac.uk*), a highlight of which will be the second joint vizNET and 3DVisA conference, to be held at the University of Loughborough on 7th-9th May 2008. ■

Featured 3D Method

3D LASER SCANNING IN 3D DOCUMENTATION AND DIGITAL RECONSTRUCTION OF CULTURAL HERITAGE by Annemarie La Pensée

Laser scanning offers just one way in which the 3D surfaces of objects can be recorded. Pioneered in the automotive and aeronautical industries, this technology has found its way into heritage owing to its non-contact techniques, high accuracy and resolution.

3D recording using non-contact laser scanning.
© Conservation Technologies, National Museums Liverpool

Short-range systems are used for the capture of objects that range in size from a few millimetres to several meters, and typically have the accuracy in the sub-millimetre range. Triangulation-based laser scanners are the most common form of sensor utilised in this category, and alongside fringe projection systems, are able to provide the most accurate data sets.

Triangulation based 3D laser scanners work by recording the light reflected from a surface when a low-power laser is projected onto an object. The distance between the laser emitter and the detector is known, as is the angle at which the light leaves the laser emitter. As the angle at which the light arrives back at the sensor is being measured, by basic trigonometry, points on the surface are recorded. A 3D laser scanner can capture many tens of thousands of data points per second and the result is a data set made up of typically, many millions of points. These collections of points describe the surface geometry of the object being recorded in 3D. Once processed, colours and textures can be readily applied to these virtual surfaces.

Data obtained by non-contact 3D recording have many varied uses in the 3D visualisation of cultural heritage. Recent projects undertaken by Conservation

Technologies of the National Museums Liverpool, in collaboration with other cultural institutions, include the recording and visualisation of a Mesolithic fish trap excavated near the Tara Hill in Dublin, Ireland; and a Megalithic stone, carved in a circular pattern, unearthed in Heygate, West Yorkshire. A medieval figure of St Christopher in Norton Priory, Cheshire was also scanned and 3D data used to create a computer model in which missing original parts and painted decoration were reconstructed.

A computer model of the St Christopher sculpture, Norton Priory, Cheshire and a digital reconstruction of missing original features. © Conservation Technologies, National Museums Liverpool.

The increasing demand for better access to much of our cultural heritage could become detrimental to some of the most important works. 3D records of heritage objects may help to provide an immediacy that has to be lost to protect the original, as well as providing invaluable interpretative tools for museum displays and educational facilitators. It is crucial that an accurate record of the decision making process involved in any reconstruction is kept and is accessible in the future. There is the fear that 3D visualisations are perceived as in some way more 'real' than a 2D representation or description. In fact, both 2D and 3D representations are impressions of what might have been, and both are therefore entirety subjective. Just because digital visualisation can be animated and increasingly begins to look like the world around us does not, in any way, validate the information it contains. I would venture that the perceived credibility attached by some to 3D reconstructions will quickly lose its relevance. As new generations grow up with 3D virtual representations so they will instinctively apply the same scepticism that we bear in mind when looking at a photograph or reading an eye witness testimony from history. It will be common language how these representations have been created and hence the subjectivity of their creators will be taken into account.■

More at *www.viznet.ac.uk/3dvisa*

Featured 3D Project

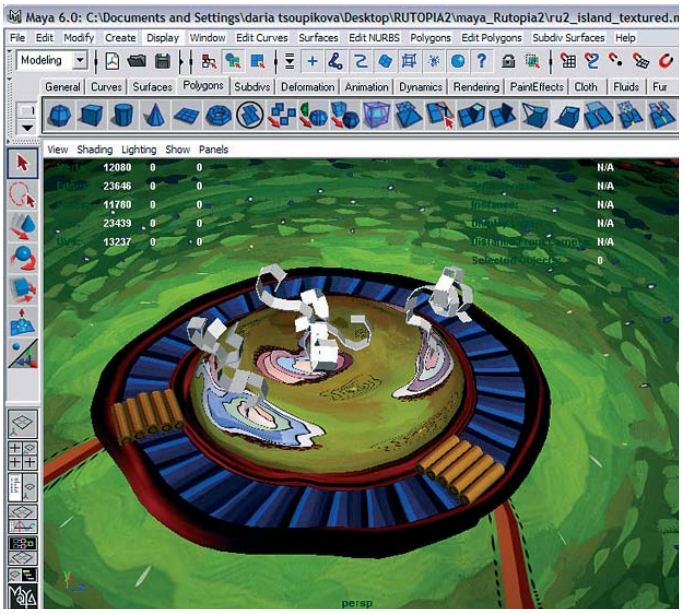
Rutopia 2
DEVELOPMENT OF VIRTUAL REALITY ARTWORK by Daria Tsoupikova

The creation of Virtual Reality artwork started in the late 1980s with the advancement of VR technology and display systems. It flourished in the 1990s after the invention of the Automatic Virtual Reality Environment (CAVE®) system at the Electronic Visualization Laboratory (EVL), University of Illinois at Chicago (UIC) in 1992. The CAVE® is a VR theatre shaped as a cube. The walls of its room are composed of rear-projection display screens and the floor is made of a down-projection screen. High-resolution projectors display 3D imagery on each of the screens by projecting it onto rear (walls) and upper (floor) mirrors that reflect the imagery onto the screens. Inside, the CAVE® participants wear stereo glasses and can navigate in the VR environment and interact with the 3D graphics.

The research and artwork in *Rutopia 2*, a follow up to Rutopia, explores the relationship between the aesthetics of virtual environments, traditional arts and the effect of VR aesthetics on the user's perception and emotions. It examines how traditional art principles, such as balance, colour, repetition and rhythm, can enhance the navigation and interactivity in real-time, digital 3D environments. Rutopia 2 was designed for the exhibition on the CAVE® and C-Wall VR systems. A participant in the C-Wall presentation can interact with the project and navigate in the environment. The user's position in the virtual world is tracked from the glasses and wand trackers. When a person navigates and interacts with the virtual environment, messages are sent to the system and information is then streamed back into the C-Wall in real time.

Rutopia 2. The initial sketch for the network and interaction. By moving one's head through the screen in the tree in the space 1 the user enters the remote space 2 in real time. © Daria Tsoupikova

Rutopia 2 describes a magical garden with interactive sculptural trees. It was conceived as a virtual environment linked to a matrix of several other unique virtual environments that together create a shared network community. When visitors enter the virtual space, they see a gray, monochrome world with a small island surrounded by a river. Visitors can use one of the two bridges across the river to enter the island. The island has three interactive areas in which the user can grow the trees by simply approaching them. Each tree appears as a rapid sequence of flipping and rotating rectangular screens. Those screens finally stick together in the shape of a tree. Once the trees are fully grown, the screens convert to the portals that link to remote worlds. Each window shows the view of the remote environment connected to it. The island mode changes from the grayscale to multicoloured. Visitors can look through the screens to see distant environments just like one can look through a window and see the outside. The high - resolution details of the remote worlds are depicted on the screens of the trees. By moving his or her head through one of the virtual screens, the user enters the connected environment. Visitors can explore the remote spaces consisting of imagery found in Russian fairytales and folk art.



Rutopia 2. Development of textures using 3D Paint tool in Maya software (work in progress). © Daria Tsoupikova

Rutopia 2 was created using Ygdrasil (YG) framework, developed as a tool for creating networked virtual environments by EVL's Dave Pape. It is focused on building the behaviour of virtual objects from reusable components, and on sharing the state of an environment through a distributed scene graph mechanism. The scene graph is a framework structure that organises objects, nodes, and behaviours. Ygdrasil includes a number of nodes that implement common virtual world components, such as transformations, sounds, user avatars, navigation controls, timers and triggers that detect when a user enters an area. Ygdrasil is being used in the design of artistic and educational virtual reality applications.

The windows of the trees were made using the new stencilBuffer node. This node acts as a mask covering the areas outside the windows so that only the selected window area allows a view to the other world. The other world consists of two objects, the rendered object and the stencil object. The rendered object is the geometry of the remote place which the user can see through the window. The stencil object forms the viewing window and is used by the stencilBuffer mask so that the user can see only a portion of the rendered object through the region defined by the stencil object. Each third window-hole on a tree is connected to the same view of the remote world in an alternating fashion. Participants can recognise and visually connect lower and upper parts of the remote world projected on the different level windows to appreciate an even broader view of the remote environment.

The first tele-immersive demonstration of *Rutopia 2* in 2005 established network collaboration between Moscow, Amsterdam, Chicago and San Diego. It was held at the IGRID Conference, Calit2, University of California, San Diego in collaboration with the Geophysical Centre of the Russian Academy of Sciences (GC RAS), Moscow, Russia. The C-Wall system was used at the conference site while the Moscow team used the CAVE® simulator mode (non stereoscopic real time interactive 3D model of the CAVE® simulator). The network used CAVEwave/National Lambda Rail connection between San Diego and Chicago sites; SurfNet connection between Chicago and Amsterdam sites; and GLORIAD connection between Amsterdam and Moscow sites. Skype was used for audio communication between remote avatars throughout the network.■

More at *www.viznet.ac.uk/3dvisa*

Featured 3D Resource

SOUTHAMPTON IN 1454: A 3D MODEL OF THE MEDIEVAL TOWN by Matt Jones, the winner of the 3DVisA Award 2007

This paper describes the making of a 3D computer model of medieval Southampton in the year 1454. This particular year was chosen as there is good documentary evidence for the town's layout and good archaeological evidence for various elements of the town. The choice of such an exact date is due to the existence of an important document, dated to 1454, known as the *Southampton Terrier*. This document lists and details all rent-paying properties in the town. It was used by L.A. Burgess in the 1970s to produce a town plan. The finished model will be exhibited in the Museum of Archaeology, Southampton.

Virtual Southampton 1454. English Street, the block north of Brewhouse Lane, based on Oxford Archaeology's plan. © Matt Jones

Time constraints and the scale of this project, carried out in 2007 as part of M.Sc. study in Archaeological Computing at the University of Southampton, would have made anything but a 'simple' model unrealistic. With any model it is easy, particularly when simplicity is discussed, to misrepresent the data. This is an even more contentious issue when remains are incomplete or non-existent as this often requires leaps of faith and differing levels of assumption. There is often a perceived hypersensitivity towards such leaps of faith by sections of the archaeological community. However, it is important to note that in the creation of such models we are not destroying the data or misleading anybody, assuming the modeller adopts an open approach to the available data and assumptions made. In essence we are merely using technology as a means of throwing around ideas. As long as the modeller is honest with the data used and the conclusions drawn, there can be no criticism of the process.

Indeed it is possible to portray levels of certainty in models; for example colour-coding aspects of the model. In this project, as it intends to represent a hypothetical appearance of the town in 1454, using colours to separate out aspects of the model would be inappropriate. Therefore the ground plan has been colour-coded to represent the origin of the data for a particular aspect of the town and also a table has been created to document levels of certainty. All this supplementary data will be provided alongside the model as it is important to present the model faithfully to visitors to the museum.

This project attempted to construct medieval Southampton as it **may** have looked in 1454. Once data had been gathered from various sources, the building of the 3D model was done exclusively in 3D StudioMax 9. The created model of medieval Southampton in 1454 can tell us a lot about how town planners made use of space. The model allows appreciation of how prominent the notions of defence and religion were within the town. Regarding defences, the castle's presence was immense and most likely would have been visible from most areas of the town and clearly visible from outside the town walls. This was most probably a deliberate ploy to reflect the status of the town. The town gates were also impressive structures; particularly the Bargate and the Watergate. The modelled Eastgate does not look as sizeable as the Bargate but was still an imposing design; perhaps again this was more to reflect the status of the town than as a purely defensive tool.

The model also highlights the regular spacing and intelligent placement of the towers. For example, a tower on the west town wall faces south thanks to a change in the walls direction; clearly this was designed to allow archers to fire south from this tower in the event of an enemy attack. Furthermore the prominence and importance of the sea can truly be appreciated from the model. Half of the town's perimeter was surrounded by the sea. Visually the view from incoming vessels must have been immensely impressive, with the fortressed town occupying the very edge of the land with its wharfage facilities jutting outwards. Such a position was ideal for trade and defence, and the model highlights this well. The number of churches, their location and scale reflects the importance of religion within the town.

A still render of the finished model of Southampton as it might have looked in 1454. © Matt Jones

It is hoped that the creation of the model will encourage museum visitors to postulate such questions regarding medieval Southampton. As aforementioned the openness of the project and the data means that at any time it can be interrogated and added to as new ideas and facts are realised.■

More at *www.viznet.ac.uk/3dvisa*

3DVisA Discussion Forum

COMPUTER NON-REALITY: FOR TRUE BELIEVERS ONLY! Michael Greenhalgh continues the debate on the veracity of computer models

I must confess to being surprised at Daniela Sirbu's introduction (see *3DVisA Bulletin,* September 2007) of various anaemic varieties of theory into the ongoing discussion of the veracity of computer reconstructions. Shifting the argument to theory avoids the issue rather than addresses it. In the academic world you're no-one today without a theory to pile up against Deleuze, Heidegger, Lacan, Baudrillard and the rest – although it is noticeable that true computer scientists manage to get by just with ideas and code. So why side-step the real issue by recourse to theory?

My original assertion bears repeating, namely that no computer reconstruction yet made reaches the level of accuracy of actual photographs, nor will one ever do so, because the process involved is indeed a reconstruction of elements which simulate the real world and do not reproduce it. I maintain that the only area in which such reconstructions have a role to play in academia is where the object or setting no longer exists, and is indeed being reconstructed from suggested rather than necessarily proven elements. But to use a computer to take an actual setting to bits, and then rebuild it tediously in the computer, seems to me a waste of time.

Please note that I do not argue above that accurate reconstructions of monuments cannot be generated in a computer – only that to do so requires extravagant amounts of time, money and skill in varying measure. For example, 3D scanning has been used to model the Great Mosque at Sana'a in Yemen (7th to 12th century). The French and Yemeni team used Trimble 5600 and Trimble 3600 Total Stations (costing in the tens of thousands of dollars) for the control survey, with the set measurement interval for the scanning being 15mm – and this for a building of 2600 square metres.

The bottom line is that computer mapping and reconstruction of real-world objects and spaces do not and will never look like the real thing, because of a continuing inability to deal with detail and accuracy, let alone the crucial matter of texturing. So let us be serious about the extent to which such reconstructions can and should be used in research. After all, if I want to know about Gaul, I read Julius Caesar – not Astérix.■

MISREADING VIRTUAL REALITY Hilary Canavan refutes Buczynska-Garewicz's criticism

Reading Hanna Buczynska-Garewicz's condemnation of 3D visualisation in general and the *Cerveteri Reborn* project in particular in the September 2007 issue of the *3DVisA Bulletin*, is certainly a jolting experience for a student new to the digital humanities and 3D visualisation. In Buczynska-Garewicz's view, 'Certainly there is nothing wrong with the attempts to reconstruct. But false and illusive is the claim that reconstruction can replace the real reality, that Cerveteri can be "reborn".'

As the culmination of a decade-long collaboration between the specialist visualisation labs at the University of California in Los Angeles (UCLA), the University of Virginia and the Politecnico di Milano and very many of the world's leading scholars in Roman history, architecture and archaeology, *Rome Reborn (www.romereborn.virginia.edu)* is one of the most enterprising and academically rigorous visualisation projects in the humanities to date. Understood in this context, *Cerveteri Reborn* can be viewed both as a thematic extension of the visualisation of sites important to the history of the ancient Italic peninsula and as a visualisation project which seeks to find its place in a lineage distinguished by scholarship of the highest order.

This on-going discussion highlights dramatically that the evolution of adequate analytical schemata and peer-review processes have not kept pace with the rapid advance of the technologies that extend the forms scholarly interpretations may now take. Debate as to how reviewers are to contend with the unique visual and virtual-experiential traits of the 3D visualisation medium, as well the blended, multi-media information environment that most often complements academic visualisations is just beginning. And it must be admitted that the misunderstandings and ambiguities evidenced here, in a token example of how 3D visualisations are being received by a largely untutored if scholarly audience, to a significant extent echo, if not compound, ambiguities perpetuated by visualisation projects themselves and, indeed, the medium as a whole, which have yet to establish and work to collectively agreed mores, standards and conventional scholarly apparatus to support intellectual transparency.■

More at *www.viznet.ac.uk/3dvisa*

Recipients of the 3DVisA Student Award 2007

© Angela Geary

The aim of the 3DVisA Student Award is to promote computer-based visualisation as a research method in the Arts and Humanities studies; it recognises students' contribution to this area and offers them feedback from experts. The award is for an essay on the innovative application of 3D computer graphics to any area of study in the Arts and Humanities.

3DVisA is delighted to announce Matt Jones as the winner of the 3DVisA Student Award 2007. His essay describing the process of creating a 3D computer model of medieval Southampton is published in this *3DVisA Bulletin*.

Other essays submitted for consideration have shown the breadth of application of spatial imaging in a variety of fields in the Arts and Humanities, including theatre, museum and sound studies; covering issues as diverse as virtual, graphic soundscapes (archival audio-recordings), qualitative methods for visualisation of movement in historical spaces, and the ethics of exposing the mummified human body to public examination through an immersive display of tomographic images.

The two runners up were Rachel Hann, researching towards a practice as Research Ph.D. at the School of Performance and Cultural Industries, University of Leeds, and Tara Chittenden, a Ph.D. candidate at the London Institute of Education, University of London. The 3DVisA virtual trophy, illustrated here, was designed by Angela Geary, who served on the judging panel together with Daniel Pletinckx and Joseph Robson. 3DVisA wishes to thank everyone who has made this award possible: the students for submitting the essays, the judges for generously spending time on evaluation and feedback, the sponsors, AHRC ICT Methods Network and the publishers, Intellect and Prestel.■

More at *www.viznet.ac.uk/3dvisa*

ATTEND vizNET'08, the second interdisciplinary conference on intersections of visualisation practices and techniques, organised by vizNET and 3DVisA, 7th-9th May 2008, University of Loughborough, Leicestershire, UK. Further information at *www.viznet.ac.uk/viznet2008*.

3DVisA demonstration at the JISC Conference: Enabling Innovation, 15th April 2008 at the International Convention Centre, Birmingham. This event can be followed online, for details see *www.jisc.ac.uk/events/2008/04/jiscconference08.aspx*

VSMM 2008 Conference on Virtual Systems and Multimedia Dedicated to Digital Heritage; 20th-26th October 2008, Limassol, Cyprus; details at *www.vsmm2008.org*

CONSULT The London Charter for the Use of 3D Visualisation in the Research and Communication of Cultural Heritage, *www.londoncharter.org*.

COMMENT on the 3DVisA Report on the Needs of the 3D Community, *www.viznet.ac.uk/3dvisa*

NEW ON THE 3DVisA INDEX OF 3D PROJECTS The Hong Kong-based radiologist and artist, Kai-hung Fung describes the rainbow visualisation technique he developed using computed tomography, see *www.viznet.ac.uk/3dvisa*

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URLs in this Issue

Big Data Project, Preservation and Management Strategies for Exceptionally Large Data Formats
http://ads.ahds.ac.uk/project/bigdata/index.html

Conservation Technologies, National Museums Liverpool, UK
www.liverpoolmuseums.org.uk/conservation/technologies/index.asp

Electronic Visualization Laboratory, University of Illinois at Chicago, USA – *www.evl.uic.edu*

Rome Reborn – *www.romereborn.virginia.edu*

Rutopia 2 by Daria Tsoupikova – *www.evl.uic.edu/animagina/rutopia/rutopia2*

Sana'a, Yemen: 3D laser scanning and model of the Great Mosque, *Technology & more*, 2 (2007)
www.trimble.com/survey_tmarc.asp?Nav=Collection-46215

Ygdrasil, a framework for creating networked virtual environments – *www.evl.uic.edu/yg*

Who's Who in this Issue

Hilary Canavan studied Art History and Modern European History as both an undergraduate and postgraduate at institutions in the USA and the UK. She currently works for the Vice-Chancellor of the University of London on projects that promote collaboration among the University's 19 Colleges. She is an M.A. candidate in Digital Humanities at King's College London and hopes to employ the knowledge and skills gained from this degree in support of her own academic work and in ways that enhance collaborative projects in higher education.

Michael Greenhalgh is Professor Emeritus of Art History at the Australian National University, Canberra. He has previously taught in the UK at the University of Leicester and has been a fellow of Christ Church, Oxford and Corpus Christi, Cambridge. He embraced digital technologies in his research and teaching from their inception, progressing more recently to digital panoramas and Virtual Reality. In 1999-2001 he directed the Borobudur Project, involving 3D modelling of this important Buddhist Temple in central Java.

Matt Jones graduated from Southampton University in 2007 with a distinction in Archaeological Computing, following a first class honours bachelor's degree in History. His M.Sc. dissertation was concerned with digital visualisation of the city of Southampton in 1454, based on the surviving document of that year, Southampton Terrier. The computer model is intended for display at the Museum of Archaeology in Southampton. Matt is currently working for a transport consultancy and hopes to undertake a Ph.D. in the near future. He is particularly interested in the use of archaeological evidence in conjunction with computational methods to validate or disprove historical sources. He is the winner of the 3DVisA Student Award 2007.

Annemarie La Pensée is a laser technology scientist at Conservation Technologies, part of National Museums Liverpool (NML), UK. She gained her Ph.D. in Chemistry from the Liverpool University in 2002. Since joining NML, Annemarie has worked on numerous local, national and international projects, exploiting 3D recording within the heritage field. She is particularly interested in applying 3D technology in novel ways to solve problems in the areas of conservation, architecture, art and documentation. She has publications in the fields of science communication, conservation and digital cultural heritage, including the non-contact recording and replication of cultural heritage, and the use of laser scanning and rapid manufacturing techniques for museum exhibitions.

Daria Tsoupikova is an Assistant Professor at the School of Art and Design and Electronic Visualization Laboratory (EVL), University of Illinois at Chicago (UIC). Her research area and artwork include development of virtual reality (VR) art projects and networked multi-user exhibitions for VR projection systems such as the Cave Automatic Virtual Environment theatre (CAVE®) and C-Wall, Single Wall Automatic Virtual Environment projection system.

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