The 5th International Symposium on Virtual Reality, Archaeology and Cultural Heritage VAST (2004)
K. Cain, Y. Chrysanthou, F. Niccolucci, N. Silberman (Editors)

Stylized Browsing in Space and Time

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Abstract

Work-in-progress is presented on rendering methods for a future system that allows ordinary users to browse a terrain database augmented with time-varying cultural and ground-cover features. An argument that line-based expressive methods have some advantages over shaded display as well as some initial results are presented.

Categories and Subject Descriptors (according to ACM CCS): I.3.2 [Computer Graphics]: Graphics Systems

1. Introduction

An explosion is occurring in the availability of on-line data relating to archeology and related disciplines such as paleontology, geology, and paleohydrology. Much of this is geometric information, either scanned from the real world or hand-modeled. In addition, the GIS community has been creating methodologies for managing time-vartying spatial databases [AS03]. Some work has already been done on how to browse historical data [LG99]. Our research aims to display such data in a natural manner. Our specific interest is in developing novel methods for displaying how cultural artifacts and vegetation change over time and space. This paper describes how a browsing system might operate, and discusses the visual presentation research we are pursuing.

2. A session with the hypothetical system

A user's browser displays the view from the University of Utah over Salt Lake City with the Great Salt Lake visible on the horizon. The images have the pen-and-ink and watercolor style of architectural "presentation graphics" with detail and texture indicated with just a few strokes, and most colors muted to make the lines prominent. This is the same style used in most manuals and textbooks. The user first moves across the rendered city in the air, looking down at the bustling people and traffic. A particular building catches the user's eye. The user clicks the mouse and a web browser brings up information known about the building, such as its being built in 1870. The user adjusts the time indicator back to 1870. Over the course of thirty seconds (based on the user's preference settings and heuristics) the adjacent buildings come and go, and a trolley system appears and disappears in front of the building.

The user is now in 1870 and has a clearer view of the lake. The user moves to the lake, and can see moving water and small amounts of human activity. The user now more aggressively moves backward in time to 9000 B.C. and watches the shores of the lake fluctuate widely as the water rises and falls. Now the user asks the system to "flag" areas where the database has high densities of unsynthesized data. A flag appears to the west of the lake. The user zooms to this and sees two caves. A click on the caves opens a browser window that indicates the caves are the oldest known inhabited sites in Utah, and were used over several thousand years by paleoindians. The user enters Danger Cave, and observes a group of paleoindians preparing food over a fire.

The user now turns selects "uncertainty rendering". Here objects in the database that are stored with a high confidence are rendered with clean lines and detailed textures. Objects stored with low confidence are drawn with sketchy lines and no color. For example, the petroglyphs near the mouth of the cave still exist and thus have high confidence. Petroglyphs in the back of the cave, if they existed, have been destroyed by rockfall and erosion. They have been created speculatively by the archeologist based on other sites, and are thus drawn with low confidence. Note that the system merely accesses archaeologic data. More sophisticated archaeologic uses would be done by other programs, just as the current Web is not used for general data manipulation.

The user now exits the cave and asks for the nearest significant events in the past and future near the cave. In the future is shown the arrival of agriculture in the area around 200 A.D. In the past is shown the draining of Lake Bonneville around 10,000 B.C. Here the ancestor of the Great Salt Lake, spanning most of the state of Utah and having an average depth of hundreds of feet, lost most of its water volume through a collapsed narrow pass into the Snake River. The user selects the beginning of the past event and can see the shores of the giant lake, and a variety of wildlife including mammoths and giant land sloths. Still in uncertainty mode, there are also a few sketchily drawn humans; it is debated whether paleoindians were present in Utah that early in time. A visual flag indicates an interesting

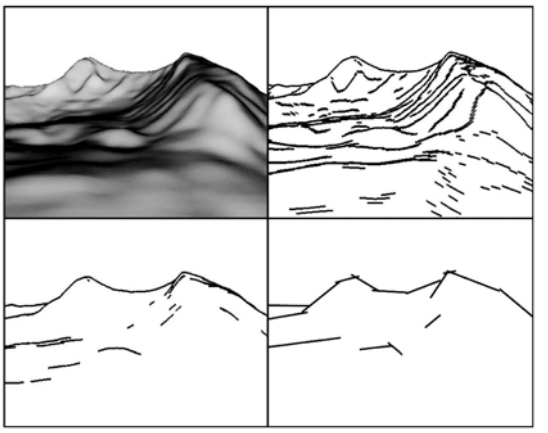

Figure 1: Four different displays for the same terrain data.

feature to the North. The user can go witness the site of the landslide. By selecting the end of the flood, the user over thirty seconds can watch the inland sea drain, and the shorelines vastly contract. Finally, the user can zoom back to the present day to see the current cultural features and distant lake.

3. Presentation style

Our strategy for display style should account for four important issues:

1. putting cultural features in a spatial context;
2. visually indicating uncertainty in the data;
3. focusing attention on items of interest;
4. visually indicating changes over time.

While some excellent progress has been made in displaying detailed large-scale terrains [HFDA03], we have pursued a line-based simple display paradigm. This has the advantage of displaying both sparse data and uncertain data. Architects use conventions to indicate the completeness of design. For early stages they use rough line or charcoal sketches. This has been used in computer graphics as well [ZHH96]. Sketchy drawings have already begun to be applied to terrains [LV02], but how to best sketch terrains is still a wide open question.

Our initial development has investigated how to display the terrains the cultural features populate. Figure 1 shows four different display styles for the same terrain. The include shaded, which we believe makes it too obvious that the data is sparse, and would make it difficult to "stitch" buildings onto when the data is not well registered. Two others use contours (silhouettes) and suggestive contours [DFRS03] which adds lines to the image and shows more terrain features. Finally the sketchy drawing is produced by hand but we believe could be automated. Any of the three line drawing styles could be appropriate in differing situations. For example, more detail might be used near a cultural site, and if the terrain data is speculative it could be more sketchy. We speculate that in some cases ridges and other salient terrain features may need to be accented.

In the next stage of our research we will investigate how to integrate cultural features into such renderings. Our current plan is to use colored line drawings in the spirit of Potter's thesis [Pot03]. Later we will investigate portraying changes over time. Ultimately we plan to use a specific archeologic site that has changes in both cultural features and vegeta-tion/climate as a test case for a browsing interface.

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Excavation Recording and Documentation

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Colonia Clunia Sulpicia

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Abstrat

The investigation of the icthyofallic sanctuary of Colonia Clunia Sulpicia has been a very complex one and still remains. The delay is due to the bad conditions of the cave, the weakness of the figures and the lack of a technological development to go further. We wish to present the plans achieved during 2004 and those for the next year. They include the whole town with a special interest on the exclusive and only sanctuary.

Categories and Subject Descriptors: J.2 [Computer Applications]: Physical Sciences and Engineering, Archaeology

1. History of Colonia Clunia Sulpicia

Colonia Clunia Sulpicia is an ancient Roman town placed in the Comunidad Autónoma de Castilla y León, Province of Burgos, in the North of Spain. It is the ancient Roman Province Tarraconensis.

The town is known at least since the 16th century and has been investigated and studied since the early 19th century. Modern systematic archaeological investigations started in 1915 and continue today. The site is now open to the public and is visited all year round.

The first quotation of the town is by Titus Livius who says that Pompeius besieges Sartorius in the winter of 75 BC in the city of Clunia, an indigenous town at the time. According to Dionus Cassius another siege took place in 56, but it was interrupted by the rigour of the Castillan winter. In the 1st century AD Galba, then a Roman general, rebels against Nero and departs from Clunia to reach Roma, as reported by Suetonius. During Tiberius reign, imperial coins are minted in Clunia. In 77 aC Plinius states that Clunia is already a conventus juridicus that is a seat for justice administration.

Clunia suffered from the economic crisis of the 3rd century, but there is a temporary recovery during the 4th and 5th century. The city is progressively abandoned in the 6th and 7th century and Christian remains start to appear. It is completely deserted in the 10th century.

Clunia covered more than 100 hectares on top of a karst plateau some 150 meters high over the plains. It had a population of something between 30.000 and 50.000 inhabitants. It was an important administrative centre with public buildings such as the theatre (phot.1), the forum with a basilica, two imperial thermae, possibly a circus and large houses. Buildings are decorated with marbles, mosaics and sculptures. The town was connected with the large Roman roads by the Vía del Duero, quoted by Antoninus.

The main problem in the area is water supply. It was impossible to build an aqueduct due to the height of the plateau so water was provided by wells draining water from the karst. In 1976 a cave was discovered more than 600 m long, with

water inside and well holes on the ceiling, corresponding only in part to the surface wells. In 1981 the exploration of the cave reached the furthest part as yet known, approximately under the forum area, reaching an underground sanctuary dedicated to Priapus, the god of fertility and water. It probably dates from the town foundation.

2. The peculiarity of the site

The cave "Cueva de Roman" is carved in the karst rock some 15 m below the top surface. The entrance is placed on the side of the plateau, and in front of which existed a reservoir to collect water springing from the rock and to maintain water at a constant level inside the cave. There are ancient engineering works which connect different tunnels and facilitate a large water flux inside. The overall capacity of the site is more than 1.500.000 litres. Proceeding in the tunnel, se find the bottom of more than 15 wells; they are all closed in the surface and it is unknown where their top ends are placed on the surface.

Exploration of the cave is very difficult because of water and mud, and the lowness of passages and deep lakes (5 m). It takes 3 hours of hard, cold and humid walk to cover the overall length.

At the end of the cave – rather, at the end of the explored part – a large cave opens with a sanctuary 100 m long by 20 m wide, of variable height from 50 cm to 1.5-2 m.

There are ithyphallic sculptures, human faces, a bird and inscriptions all made by mud in several places in the site (phot 2).

The inscriptions are very important for the administrative history of the town as they bear the names of the magistrates as aediles and quattuorviri. One of these is the aedilis Bergius Seranus, probably a relative of M. Julius Seranus, known for the municipal coins with his name of the Tiberius time.

3. Current investigations at Clunia

Archaeological investigations at Clunia are organized in a Master Plan, including research, exploitation, diffusion, preservation and conservation and the methodology for future work. The Master Plan has been designed by Dr Tuset, archaeologist, and Dr de La Iglesia, architect, both responsible for the team working on Clunia. In 2003 it has been designed a complementary plan of investigation of the karst structure with a special attention to the "Cueva de Roman" or the ithyphallic sanctuary, the wells that connect with it and the peripherial springs of the town.

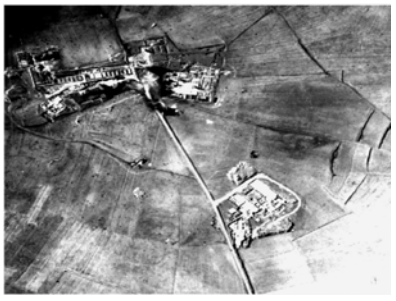
The work achieved during 2004 include:

- exhaustive study of aerial photos, ancient and modern.;
- geological and tectonic study of the plateau and immediate surroundings;
- geophysical analysis of the karst stratigraphy of the "Cueva de Roman";
- 1st phase of the geophysics study of the cave position;
- geophysical investigation of the wells: the surface openings will be detected by using electromagnetic waves of geophysical analysis to establish the karst structure (caves, holes, cavities) on all the plateau (phot.3);

- archaeological and geophysics research in the theatre to detect the direction of the water canalization;
- geophysics investigation to discover terraces behind the theatre and the remains of its related buildings.
- detailed topography of the theatre (in process), 3D reconstruction for the architectural investigation of the theatre and its decorative elements.

The second stage (2005) will include:

- The study of the plateau and surroundings with infrared and possibly 3D scanned images, and thermo-photography; (phot.4)



- complete geophysical investigation of one well as a case study;
- study of the micro-climate of the cave, especially of the sanctuary in order to avoid any contamination or to change substantially the humidity condition that has preserved the mud sculptures till now:
- re-open a well down to the cave, including a covering mobile structure on top of it to avoid changes in the internal micro-climate;
- detection of the well network and placement on map;
- geophysical profiles centred on wells to discover the karst shape and its internal connections;
- geophysical profiles among wells to detect karst connections and discontinuities;
- 3D data capture and processing of inscriptions and sculptures in the cave system, especially in the sanctuary; 3D reconstruction of underground spaces;
- creation of a communication systems for the public showing the underground sanctuary.
- The museum and the documentation centre will be created in the period 2005-2006;
- Initial design of documentation centre of site, which includes the creation of an on-line access system to documentation, with user levels and IPR protection;
- Identification and geographical source study of the rocks used with decorative purposes in the public and private buildings.

The geophysical investigation succeeded in giving correspondence between the wells already seen in the cave gallery and their surface openings. The geophysical investigation (SEV) of the karst structure on the plateau is concordant with the results obtained from the investigation of the hydric levels of the wells.

The analysis of the ancient aerial photography is giving us an important background for the planing of the study of the plateau and surroundings with aerial thermo-photography and infrared, which will be achieved during 2005.

The ongoing work and encouraging results being obtained will give us the opportunity to bring the public nearer to this surprising ithyphallic sanctuary and the Colonia Clunia Sulpicia. The Diputación de Burgos provides funds for all these activities.

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TNT: The Neanderthal Tools

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Abstract

TNT is a combined RTD-and demonstration project. It will develop advanced services and applications to improve access to Europe's cultural heritage, namely to collections and artifacts of the Neanderthal species. TNT will enhance user experience in cultural tourism, visualizing scientific objects and artifacts and developing a new repository for intelligent heritage and tourism. TNT will also provide high-bandwidth access to distributed and highly interactive repositories of European culture. Thereby, scientific collaboration among Europe's top notch researchers in the field of Neanderthal research is improved.

Categories and subject descriptors (according to ACM CCS) : I.3.5 Computational Geometry and Object Modeling, I.3.7 Three-Dimensional Graphics and Realism, I.4.1 Digitization and Image Capture

1. Introduction

TNT is a Specific Targeted Research or Innovation Project of the EU "Digicult" program, which facilitates research and preservation work on Europe's artistic and cultural treasures using modern technology. The project was initiated by ART+COM, a company for interactive media-technology in Berlin. Artefacts and fossils are not only being uniformly catalogued for the databank, but also visualized through CT and 3-D surface scans. Moreover, ART+COM is developing tools for the internet-accessible platform which, through visual simulation methods, enable graphic reproduction, measurement and examination of finds. Interactive media technology is new possibilities for the European research community. The creation of a cross-border data pool and the integration of new imaging processes, in combination with a website for the general public, makes TNT unique.

2. State of the art

Most of the scientific Neanderthal collections in the world are in Europe. There is a necessity to record a large variety and quantity of objects, protect them and also present them to the public and to professional researchers world-wide. The collection of a museum consists of many differently structured objects. Some of these objects are permanently on display. However, many of these objects are stored in archives, while others cannot be exhibited due to their condition (fragile, too large, number of objects, missing exhibition space, destroyed, on loan, etc.). As a result a vast amount of artifacts and objects are only known to and accessible by a very limited number of people. This is a severe impediment to collaborative research and to intelligent access to Europe's cultural heritage.

3. Partners

The following organizations are joining forces to organize the system that aims to cluster all the dispersed knowledge regarding the Neanderthals: ART+COM, a company for interactive media technology in Berlin; PXP Software Austria GmbH, an e-Business company in Austria; the Hasso-Plattner Institute in Potsdam, Germany; the Royal Belgian Institute of Natural Sciences in Brussels; the University of Poitiers in France; the Natural History Museum of Croatia; the Neanderthal Museum in Mettmann and National Geographic Deutschland.

4. VISICORE

The VISICORE system will leverage a variety of technologies and services provided by modern graphics hardware, operating systems and web browsers. This will allow us to carry out non-core tasks with proven technologies and focus on fields, where innovation will have the greatest impact for supreme rendering quality and collaboration with large 3d-models at interactive speeds. On the hardware level VISICORE will be tightly integrated with the new generation of graphics hardware, allowing it to fully utilize the power of next generation 3d-graphics processors (GPU). Next to standard graphic libraries such as OpenGL, it will also use special purpose shading languages. This allows the direct manipulation of the GPU for visual simulations and hyper-realistic rendering effects. Applying VISICORE to research topics on the Neanderthal man and to the needs of museums in Europe, the limits on how cultural heritage is displayed and how collaborative research in Europe is currently undertaken can be pushed widely. With the VISICORE visual simulation engine researchers will have

the chance to easily exchange content in 3D format via the Internet, to compare results and artifacts with each other, to test theories and to combine results world wide.

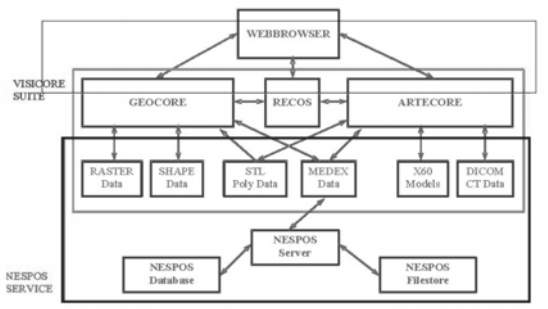

Figure 1: VISICORE and NESPOS architecture. ARTECORE – Artefact Exploration & Collaboration Rendering Engine (View, Manipulate and Annotate 3DDatasets of Archeological Objects. RECOS – Realtime Communication Server (Exchange User Action in Realtime between remote System). MEDEX – Metadata Exchange Format (XML-based File Format for common Metadata). GEOCORE – Geofact Mapping and Rendering Engine (View, Manipulate and Annotate 3D-Maps). Pavel Mayer 2004, TNT-ART+COM.

5. NESPOS

The result of the TNT project in service terms will be the NESPOS -The Neanderthal Species Professional Exploration Service. It will initially be composed of four European scientific Institutions, which are specialized in research about the Neanderthal species. Computer Tomography of major Neanderthal fossils from Germany, Belgium, France and Croatia are untertaken in the framework of TNT.

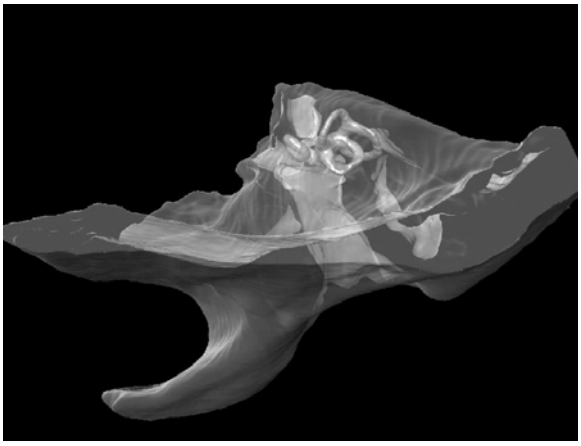

Figure 2: *Superior view. 3D reconstruction of the temporal bone and the inner ear of the Spy2 Neanderthal specimen based on a Computer Tomography). Linda Bouchneb 2004, TNT-RBINS.*

After 2006, The NESPOS Foundation will curate the Multimedia Database and scientific network at the end of the TNT project. Additonnal partners and a large community of users will grow the database and make the NESPOS network the „reference warehouse" about Neanderthals

6. ArchChannel

Scientific content -in the form of popular scientific content or targeting an academic audience -is one of the key premium content areas, for which people are willing to pay (provided quality is good enough). The same is true for tourism related content providing local or regional information on entertainment, cultural events, archaeological sites, etc. So far, most of the representational content residing with Prehistoric Natural History is not available in digital forms via media such as the Internet. The NATIONAL GEOGRAPHIC ArchChannel is planned as a popular science portal which reflects the current state of the European research: Every

Figure 3: Morphing of a modern man profile in order to fit with the skull of Spy1. Patrick Semal 2004, TNT-RBINS.

user is invited to discover the world of the Neanderthals through the internet. From the end of 2005 onwards, the website will not only supply extensive information but also provide numerous interactive modules enabling the user to make an entertaining journey through time to the world of the Neanderthals.

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