

CENOBIUM – Ein Projekt zur multimedialen Darstellung romanischer Kreuzgangkapitelle im Mittelmeerraum

CENOBIUM – A Project for the Multimedia Representation
of Romanesque Cloister Capitals in the Mediterranean Region

Ute Dercks
Kunsthistorisches Institut in Florenz, Max Planck Institut
Via Giuseppe Giusti, 42, I-50121 Florence
phone +39-055-24911-38
dercks@khi.fi.it

Federico Ponchio / Roberto Scopigno
Visual Computing Laboratory
Istituto di Scienza e Tecnologie dell'Informazione (ISTI) National
Research Council (CNR) Area della Ricerca CNR di Pisa
Via G. Moruzzi 1, I-56124 Pisa
phone +39-050-315-2929
federico.ponchio@isti.cnr.it / roberto.scopigno@isti.cnr.it

Zusammenfassung

Das online-Projekt CENOBIUM ist eine multimediale Darstellung von romanischen Kreuzgangkapitellen in Form hoch auflösender Digitalfotografien und 3D-Modellen. Das Forschungsprojekt verfolgt das Ziel, Kapitelle mit ihren Originalstandorten virtuell zu verknüpfen, um sie in ihrem architektonischen und historischen Zusammenhang zu präsentieren und den künstlerischen Austausch im 12./13. Jahrhundert anhand der Bauskulptur aufzuzeigen. Seit 2007 ist das Projekt multimedial und multilingual online über das Internet frei zugänglich. Im Mittelpunkt des jüngsten Updates standen unter anderem eine verbesserte Darstellung und eine optimierte Interaktivität der 3D-Modelle im Internet durch die Integration von WebGL-Technologie.

Abstract

The online project CENOBIUM is a multimedia presentation of Romanesque cloister capitals. High-resolution digital photographs and 3D models will virtually link the capitals to their original surroundings, thus representing them within their original architectural and conceptual contexts. The project has the central aim to study artistic exchange in the twelfth and thirteenth centuries in architectural decoration. The first multimedia and multilingual online phase of the project has been freely accessible on the internet since 2007. The last update focused inter alia in an improved visualization and optimized interactivity of the 3D models by integrating WebGL technology.

CENOBIUM (Cultural Electronic Network Online: Binding up Interoperable Usable Multimedia) aims at articulation of the dynamics of cultural exchange at work the twelfth and thirteenth centuries through the medium of architectural decoration. The specific case study is a select group of capital cycles found in medieval cloisters throughout the Mediterranean. The complex and demanding decorative concepts adopted there were mainly executed by itinerant architects and sculptors. The supraregional activity of these masters reflected the art of their time, which was disseminated through Europe, as well as between the cities and monasteries in the regions bordering the Mediterranean, by growing mobility along pilgrims' ways and trade routes.

On the other hand CENOBIUM points to the introduction of multimedia investigation of art works as a regular research-instrument for different user groups. It demonstrates the potential benefits of the integration of modern techniques of visual representation with cutting-edge web technology in the pursuit of new knowledge about artefacts of the past. Therefore, CENOBIUM combines both – traditional and innovative methods of Art History with the latest in digital data technology – in order to open up new horizons of art historical scholarship that have not, until now, been exploited to their full potential and not been accessible.

Therefore, the project is undertaken by the Kunsthistorisches Institut in Florenz, Max-Planck-Institut¹ in cooperation with the Istituto di Scienza e Tecnologie dell'Informazione (ISTI), Consiglio Nazionale delle Ricerche (CNR), Pisa² and in association with several international partners.³



fig. 1 and 2 Screenshots of the CENOBIUM project (<http://cenobium.isti.cnr.it>)

In the CENOBIUM project modern technologies such as high-resolution digital photography, digital 3D scanning and interactive computer applications are used to overcome barriers that have hitherto hampered the study of capitals in situ: distance from the object, lighting conditions or conservational measures. These digital methods of analysis and research make it possible to study architectural sculptures in close up, just as did the sculptors themselves when they created them. They also reveal surface structures, colors, material textures and relief carving in unsurpassed detail. The simultaneous representation of several capitals and their sequence within the cloister also help to elucidate the overall message and iconography of the cycles, ranging from the coherence of the pictorial programs to the arrangement of individual themes and motifs. This permits, in turn, important conclusions to be drawn about the form and function of individual parts of the building and about liturgical or monastic practices.

The well-known cloister of the Cathedral of Monreale was the starting point of this project. Executed between 1174 and 1189 under the patronage of King William II, this cloister joins

¹ Ute Dercks and Gerhard Wolf. Photographs by Roberto Sigismondi with Silvia Campanella, Dagmar Keultjes and Andrea Marinello.

² Massimiliano Corsini, Marco Callieri, Matteo Dellepiane, Federico Ponchio, Roberto Scopigno.

³ Soprintendenza per i Beni e le Attività Culturali della Regione autonoma della Valle d'Aosta, Diocesi di Aosta - Ufficio Beni Culturali Ecclesiastici. Institute for Technologies Applied to Cultural Heritage, CNR, Monterotondo/Rome. Soprintendenza per i Beni Culturali ed Ambientali della Provincia di Palermo. Soprintendenza ai Beni Architettonici e per il Paesaggio, per il Patrimonio Storico, Artistico e Etnoantropologico per le Province di Pisa e Livorno. Chiostro Canoniale della Basilica Cattedrale di Cefalù.

various artistic currents of Romanesque sculpture then circulating in the Mediterranean into an architecturally homogeneous ensemble (fig. 2). Along with Monreale, the cloisters of Sant'Orso in Aosta (around 1150) and Cefalù (around 1131/1166 or 1185/1189), belong to the few cloisters in Italy that display an extensive capital programme comprising both narrative and figural representations (fig. 3-5). These cycles of historiated capitals integrate narrative elements into their particular physical contexts. The nature of this type of cloister design – with free-standing columns and a moving viewer – is particularly well suited to narratives that must be seen from all sides. Therefore, they afford the possibility of telling stories through a series of relief compositions, while facilitating a dialogue among and between capitals and other decorative elements of the cloister. In fact, most of the capitals represent episodes of the Holy Bible, which can be appreciated, studied and documented by integrating 2D and 3D technologies.



fig. 3-5 The cloisters in Monreale, Aosta and Cefalù

The project, which started on 2006 and is online since 2007⁴ [1], has been conceived from its beginning as a work in progress, some sort of comprehensive and long-term project. Our goal has been to keep mostly unchanged the overall interface and the basic digital data, but at the same time to be able to evolve the system by endorsing new approaches offered by the fast progress of digital technologies. As a result, the current system can be perceived by users as very similar to the first version appeared on the web on 2007, while in reality most of the technical instruments used have been replaced by newer and more efficient technologies.

The technical work is devoted to the integration and extension of available technologies (databases, image-viewers, 3D viewers, content management, etc.) to study the tree-dimensionality of the capitals and their spatial connection with the surrounding architecture – aspects that cannot be explored only on two-dimensional photography. This integration has been performed in two ways: by merging the photographic data with the shape data (producing 3D models encoding shape and color) and by providing a tool to allow the comparative analysis of images and 3D models (giving to the users the possibility to browse the two media in side-by-side windows).

For the most important capitals of the three cloisters several high resolution digital images and highly detailed 3D models have been produced. This big amount of data has been integrated in a web application where, textual descriptions, high resolution images and 3D models can be accessed from the same page for each capital. This interactive system integrates all the information in an easily accessible way. Furthermore, it outlines the main components of the system which will allow the user to virtually move inside the cloister, to choose a particular capital, and to analyze and study also the information related to it.

The more than 1200 high-resolution digital images of the three cloisters and their capitals taken with a Sinar P3 with the digital back 54H (resolution of 22 million pixels, sensor resolution 5440x4080) are shown by the open-source image viewer IIPImage which is an “advanced high-performance feature-rich imaging server system for web-based streamed viewing and zooming of ultra-high-resolution images. It is designed to be fast and bandwidth-

⁴ <http://cenobium.isti.cnr.it> (fig. 1).

efficient with low processor and memory requirements. The streaming is tile-based, and make it possible to view, navigate and zoom in real-time around gigapixel size images that would be impossible to download and manipulate on the local machine. It also makes the system very scalable as the number of image tile downloads will remain the same regardless of the size of the source image.”⁵

A simple mechanism, the so-called *light-table*, permits to select a subset of representations of interest (either images or 3D models) from any of the digitized capitals and to start a selective visualization and visual comparison of those models/images (fig. 6). The user can select any sub-set during the exploration, and then visualize them on the *light-table* window, that automatically adopts a layout adequate to the number of items the user wants to inspect contemporary.

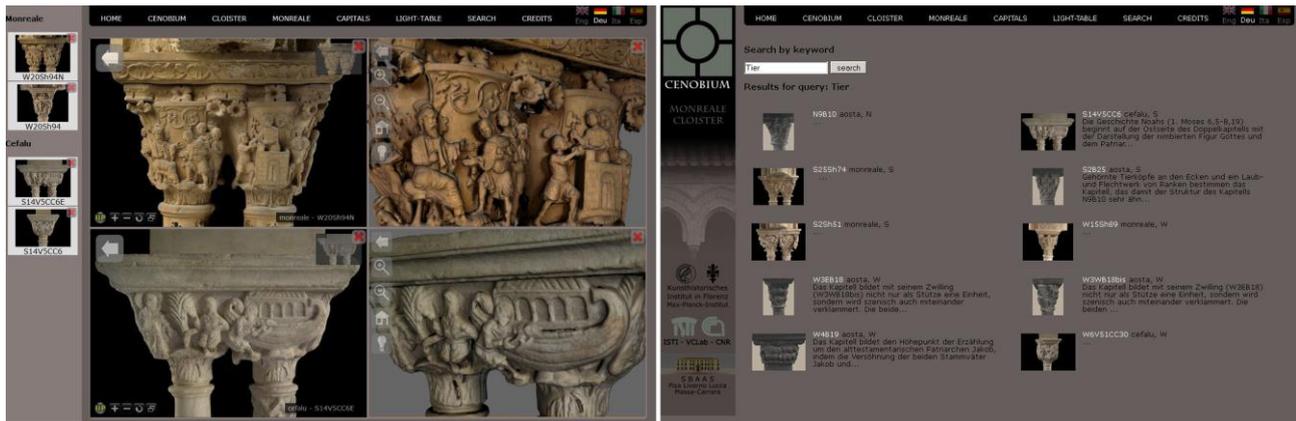


fig. 6-7 The CENOBIUM *light-table* and the results list of a search by words

The website of CENOBIUM offers also a research by words, including the inscriptions of the capitals, keywords and descriptions of all three cloisters and capitals in four languages, English, German, Italian and Spanish (fig. 7).

The main updates currently done on the CENOBIUM system consist essentially in an improved representation and optimized interactivity of the 3D models of the capitals on the Internet, to support a more compact encoding and faster transmission on internet of the related data.

While the viewing of digital images in high definition, without long downloading times and without ignoring aspects of security and copyright, has hitherto not posed any problem, the same cannot be said for 3D models. In the first online-version of CENOBIUM delivered on 2007, the user was first forced to install a special program on his computer to render the 3D models, something that in many research institutes and universities is only permitted on the basis of a strict security regime through the web administration; second, the user should wait the download on his local hard disk of each 3D model he is interested to inspect. The viewing, mobility and lighting of the capitals in 3D, on the other hand, has until now only been possible in locally installed *kiosk* computers, on each of the hard discs of which a copy of the 3D graphics is stored.

This has been radically changed in the last version, since we have designed a new support for presenting 3D models on web pages, providing streaming and multi-resolution visualization management of the 3D data based on the WebGL platform.

WebGL is a cross-platform, royalty-free web standard for a low-level 3D graphics API based on OpenGL ES 2.0, exposed through the HTML5 Canvas element. It allows to render 3D models in standard web pages, without requiring the installation of a plugin, it is supported by major browser vendors: Apple (Safari), Google (Chrome), Mozilla (Firefox), and Opera

⁵ <http://iipimage.sourceforge.net>

(Opera), and it is available on systems with an up-dated graphic driver and a not-too-old graphic card.

While this allows for convenient visualization of 3D models, if the WebGL support is used to visualize complex 3D models than the limited network bandwidth usually results in long loading times and long rendering times. The innovative approach adopted by the new CENOBIUM version, based on CNR proprietary Nexus⁶ approach that supports multi-resolution and streaming of 3D data, allows to overcome these limitations: similarly to modern web mapping services, the model can be rendered at different resolutions and the system only retrieves from the server the pieces needed for the current view. The end result is a fast initial visualization that is refined while the user explores the model (fig. 8).

Nexus was developed by CNR-ISTI to support interactive visualization, with good quality, of models which are too big to be loaded and rendered directly. This has been implemented as a feature added to SpiderGL⁷, again another resource designed by CNR-ISTI and running on top of the standard WebGL interface.



fig. 8-9 Detail of a capital of the Monreale cloister, on the left CENOBIUM project 3D viewer, on the right the MeshLab software

To conclude, we would like to underline that the CENOBIUM project is addressed to support the needs of different user populations and associated needs: academic research, conservation of historical monuments and teaching. It is also a model for effective cooperation between heterogeneous, international organizations and research institutes. The CENOBIUM Project is therefore an example of successful cooperation between two very different disciplines: art history and computer science. The aim is that impulses from the research of both disciplines should mutually enrich each other, in order to visualize the research materials on the one hand and highlight the findings and interconnections between them on the other. So the innovative potential of the CENOBIUM project consists in the joint interest of the partner institutions in creating and further developing new ideas out of each other's inspiration and potential.

The project has been presented in numerous conferences and meetings devoted to medieval studies, cultural heritage and computer science, held inter alia in Barcelona [3], Bonn, Chicago and Tiruchirappalli (India) [2], as also as project of the Max-Planck-Gesellschaft in the Center for new technologies in Munich.

The CENOBIUM project development and data enrichment are proceeding on parallel streams: step by step we are extending the functionality of the system and improving its usability, but at the same time we are also improving the data content, i.e. the range of cloisters digitized and documented.

⁶ <http://vcg.isti.cnr.it/nexus>

⁷ <http://spidergl.org>

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