

# A Blender open pipeline for a 3D animated historical short film

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## Abstract

*"APA and the History of Bologna" is the first 3D stereo movie made with Blender according to high philological standards and related to the history of an entire city with four different geo-referenced historical digital terrain models and several scenarios, from the Etruscan up to the present day. The methodology developed for this realisation, centered on open source and interdisciplinary framework, has been of great help in this endeavour.*

Categories and Subject Descriptors (according to ACM CCS): I.3.8 [Computer Graphics]: Applications—

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## 1. Introduction

The intent of the Genius Bononiae initiative - Museums in the city (<http://www.genusbononiae.it>) is to bring together in a common inter-cultural path (artistic and museographical), some buildings of the historic center of Bologna, recovered and restored to public access.

One of these buildings, Palazzo Pepoli Vecchio, will become the Bologna City Museum (opening December 2011), featured with an immersive room ready for 3D stereo movies designed ad hoc by Cineca (<http://www.cineca.it>). In this space the public, halfway of the museum visit, will be involved in an emotional experience: a journey through time, a sort of Big Bang of Bologna's history through 2700 years in just 14 minutes led by a friendly 3D character: the Etruscan APA, whose name means "father". Lucio Dalla, a popular "Bolognese" singer, actor and director, has voiced him.

It is, probably, the first 3D stereo movie made with Blender according to high philological standards and related to the history of an entire city with four different geo-referenced historical digital terrain models and several scenarios: Etruscan, Roman, Medieval, Renaissance, Seventeenth and Eighteenth century, up to the present day. The methodology developed for this realisation, centered on open source and inter disciplinary framework, has been of great help in this endeavour.

## 2. The movie concept

The idea of rebuilding the city of Bologna has brought to the director's mind the Paris of "Ratatouille" (Disney-Pixar 2007) as a source of inspiration, both for the style and atmosphere of the model. Following these coordinates the art director defined the visual concept layout inspired by the colors and tones seen in the movie by Pixar.

Along with the style setting came the important work of defining the main character: the Etruscan Apa.

He comes to life from a bronze Etruscan vase of the VII b.C. visible at the Archaeological Museum of Bologna, near piazza Maggiore, which thus becomes the first scenography for our story. In a dark and stormy night, starting from a general view of the city, passing through Via Rizzoli, by the statue of Neptune and Piazza Maggiore, the story begins inside the Museum with the appearance of the main character, who will accompany the viewer through the centuries. [SRC07]

Apa was initially sketched as a 2D silhouette, hence becoming a 2D drawing created by the character design and immediately used for testing clothes and their color, Apa's expressions and first movements.

After recording Apa's dubbing (voiced by the popular Bolognese singer Lucio Dalla), the character animator was able to start generating him in 3D. Lucio Dalla's voice and acting encouraged the creation of a new and double



**Figure 1:** A night view of Bologna.



**Figure 2:** The Archaeological museum at night.

Apa: sometimes mysterious and sometimes funny, slightly different from the one thought by the character design.

As a 3D model we should imagine Apa as a virtual puppet, made of many controls moved by the animator in search of a believable acting.

### 3. Working organization

In order to get a good result, the project required the experience of different teams with various professional



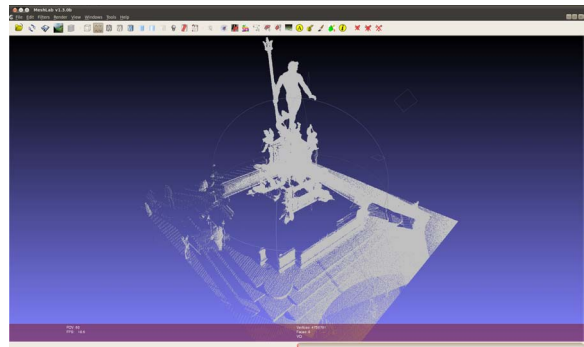
**Figure 3:** Character design: 2D testing.

skills. Therefore, the first problem was how to communicate in real time during each other's work.

The solution was to use, first of all, an unversioned repository for materials like documentation, images, reports of meeting and everything useful for everyone's work, then a versioned repository for all the data involved in the workflow, like 3D models, lights, camera and camera movement. The selected engine (SVN) was installed on the Cineca's HPC cluster in order to use always the updated repository when rendering and, at the same time, cluster for rendering scenes.

Another tool was a blog to share tutorials for the different software adopted in the project, news about events and all other useful support elements. As a matter of fact, initially devised as a place to share project thoughts and achievements for team members, the MDC blog (<https://rvn05.plx.cineca.it:12001/php/MDC/portal/wordpress>) soon became a real CMS (content management system), useful to show movie produced media and to publish reports by participants involved in the project, tutorials and instruments both as internal transfer of knowledge and as material of interest for the open source community.

Whenever possible, the software was open, like Blender and Meshlab; the only exception was City Engine, but in order to make it accessible to everyone, a license was installed on the Remote Visualization node, adding the advantage of wide memory and fast CPUs to manage large data models, such as the statue of Neptune.



**Figure 4:** MeshLab: Laser scanning of the Neptune Statue.

The repository first and the blog afterwards helped a lot the intense interdisciplinary interaction among all the team members and the recursive cross-checking on each other's work (historians, archaeologists, character designer, photographers, modellers, screen-player, character animator, director).

In the meantime the storyboard was sketched, giving life to a 2D animatic, followed by a 3D one. At this point, started the modelling phase and the subsequent rendering.

#### 4. Workflow and Blender pipeline in an Open framework

The choice of using an open software was useful for relying on an already consolidated 3D Blender production pipeline (i.e. used by the Blender Foundation for "Big Bucks Bunny") but also, whenever necessary, for implementing potential changes in order to follow both creative and historical approach.

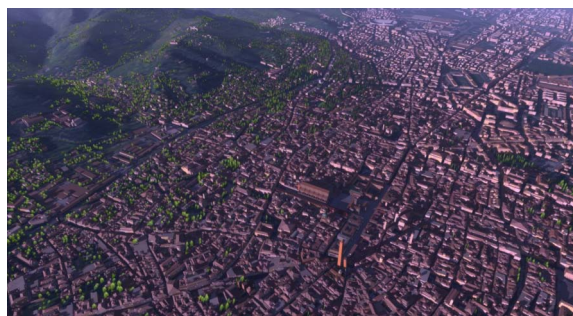


**Figure 5:** *Along the streets of the Roman Bologna.*

The opportunity of using some of the powerful computers presented at CINECA was crucial, not only for managing the data stored in the repositories but, above all, to speed up the rendering of the film through the recently set up Blender Render Farm. The scripting possibility of Blender software helped this set up on a HPC cluster named PLX (580 quad cores Intel Xeon X5550 processors) on which it is possible to submit jobs by using a job scheduler (PBS Pro) that creates a series of jobs distributed on a defined number of cluster's CPU: every frame is made from a single CPU. [Vep08]

Along with Blender, other open software were chosen for this project, such as QGIS and Grass to manage GIS data, MeshLab for 3D laser scanner data and, of course, Blender for the 3D modeling. As said before, only City Engine, a procedural modeling software could not be substituted with an open one. This peculiar software allowed the procedural reconstruction of the nowadays, roman, etruscan and medieval city of Bologna by using user's defined rules. Starting from GIS or CAD data of the plan of the city it was possible to extrude, at random or with a GIS database of heights, all buildings or assign faced texture in a casual but credible way.

The models were imported into the Blender pipeline and integrated with other models inside the different sets. The creation of the sets started from various types of data, such as GIS data, necessary for realizing coherent geo-referenced terrains and enabling the superimposition of current and ancient city models. At the same time, old 3D models, created during earlier projects and developed with different software, were integrated with the new set of



**Figure 6:** *Procedural modelling: an overview of Bologna.*

models created specifically for the film. Old models and data came from already validated archaeological and historical studies, everything new underwent a continuous process of verification and validation.

The completed and validated models were then used by the character animators, the lighter and the director to compose all the scene in terms of movement of camera, character animation rigging and finalization before rendering.

All the camera movement were controlled by stereography experts (Lilliwood) to assure that the movie will not have problems during visualization. [LHW\*10]

#### 5. A scientific reconstruction

In this project technical aspects are as relevant as the faithfulness to historical documents and sources but, if the reconstructions had to start from scratch a year of work would not be enough. Luckily, it was possible to use applications and methodologies implemented for earlier projects. [GD07] For example the reconstruction of the Etruscan necropolis took advantage of the work realised for the Certosa Virtual Museum. [BFM\*04] Since the monumental cemetery stands on one of the two main necropolis found in Bologna, the Certosa project counted on a laser scanning campaign of the stelae, digged on site and preserved at the Archaeological Museum, and a digital terrain model with the geo-referentiation of the stelae. All this material was therefore adapted and improved as the basis for Apa's walk along the sepulchral road. Perhaps the movie could have done even with a lower level of historical faithfulness but a well done work can enjoy more than a life: this version of the necropolis will become an application for the Archaeological Museum.

Not all the historical sets could profit of earlier works. For example, the reconstruction of Saint Petronio's Cathedral at the time of Gian Domenico Cassini - second half of the Seventeenth century - had to be done from the beginning. The architectural structure of the church is still the same, the second world war bombings did not damage it, hence



**Figure 7:** *Apa walks in the Etruscan necropolis.*

the problems laid "only" on the definition of the proper set dressing. Benches or chairs, monochrome or bi-color terracotta tiles for the floor, position and shape of internal fences and altars, use and distribution of candles. For each one of this aspects the research of iconography was long and, in the end, could not offer complete certainty. Nonetheless, in the creation of a communicative application, devised for a wide audience, it is unavoidable to come to terms with a partial loss of philological adhesion to the original version. Historical sources can offer several pieces of information but, even after a thorough research, there are still details that will be reconstructed as a compromise between the documents and the aesthetic and communicative needs.

The same problem arose for an even more recent historical set: Piazza Maggiore at the time of the Jacobin (1796-1799). All the buildings surrounding the city main square were built in an earlier period and stand still there nowadays, but during the centuries several minor changes were made to the facades: windows were moved, reduced or enlarged, porticoes were added or removed and the paving changed. At least, iconography was richer than that available for the previous century and the interiors of the Cathedral, but we had to face the inevitable "artistic licenses" took by everyone reproducing Piazza Maggiore and mediate among the various versions.

## 6. Conclusions and future work

Communication, collaboration, circulation and sharing of information and resources are some of the cornerstones of this project. For example, a shorter version of a "making of" video is available on Cineca's You Tube channel (<http://www.youtube.com/CINECA1969>). It deepens the different aspects of the open Blender pipeline adopted in order to build the Bologna's historical sets and enables an effective visualization of the methodological approach followed in this work.

Moreover, all the philological 3d open content, produced for the different historical ages, including the 3D landscape varying in time within the evolving "forma urbis" (shape

of the city) and its public and religious spaces (squares and churches), will be available in a web repository to be "ingested and reinterpreted" in new creative products, in future upcoming projects involving both students and cultural curators.

Also, Cineca offers the Blender Render farm at low costs for cultural purposes, since the scheduling system makes use of computational idle time.

Future developments will go through several paths. The models will be adapted and tuned for different media according to the specific features of each media, following Mc Luhan's perspective. Mobile apps, 3D digital TV programs, educational games for young museum visitors or even digital scenographies for live performances will be taken into consideration. New e-learning experience could be put in place in virtual collaborative interactive worlds such as the Open sim platform. New interaction metaphors will be explored to find new insights and explore the richness of the content also by BCI interface (Brain Computer Interface)

Bologna is a city of diffuse culture and its history and memories deserve a digital declination up to time and capable of both local and global appeal.

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