OLERDOLA’S CAVE, CATALONIA, PAST AND PRESENT:
A VIRTUAL REALITY RECONSTRUCTION
FROM TERRESTRIAL LASER SCANNER AND GIS DATA

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Olerdola’s cave, Catalonia, past and present: a virtual reality reconstruction from terrestrial laser scanner and GIS data.

1. OLERDOLA’S CAVE

**INTRODUCTION**

- **LASER SCANNER**
  - Data Collection
  - Pre Processing
  - Polygonal Model

- **GIS APPLICATION**
  - DTM
  - GIS Analysis

- **VIRTUAL REALITY**
  - Platform
  - Final Model

**The goal of the project:**

- To perform a digital reproduction of the cave and its surroundings
- To use a fast and accurate technology
- To create an interactive 3d environment
- To support the archaeologist virtual restitution of different hypothesis of the ancient buildings.

**CONCLUSIONS**

3D-ARCH’2009. 3D Virtual Reconstruction and Visualization of Complex Architectures.
25-28 February 2009 Trento, Italy
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2. PROJECT WORKFLOW

INTRODUCTION

LASER SCANNER
Data Collection
Pre Processing
Polygonal Model
GIS APPLICATION
DTM
GIS Analysis
VIRTUAL REALITY
Platform
Final Model
CONCLUSIONS

LASER SCANNER
Point Cloud Model

GIS
Polygonal Textured Model
DTM

VIRTUAL REALITY PLATFORM
Simulation
Viewshed
Shadow
Slope
Augmented Reality

Ortho Images
Videos

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3. TERRESTRIAL LASER SCANNER
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4. TERRESTRIAL LASER SCANNER

Data collection:
- RIEGL LMS Z420i and Nikon D100
- One field day
- 28 scan positions (@10m, 0.1º FOV 80x180º)
- 1,5 million points per scan
- 70 calibrated images
- No registration targets

2 scan positions

Image acquisition
5. TERRESTRIAL LASER SCANNER

Point Cloud Processing:
- 3 Day elaboration:
  - Cleaning unwanted data
  - Aligning scan position
  - Fixing colour of the images
  - Optimizing the resolution
- Raw point cloud model
  - 46.3 millions points 790Mb
- Optimized point cloud model
  - 22.6 millions points 198Mb
- Plan, section and facade ortho images
  - 100pixel/cm resolution
- HD videos

Facade Image 100pix/cm by Pointools

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6. TERRESTRIAL LASER SCANNER

**Post Processing (Polygonal Model)**
- Triangulation of the optimized point cloud
- RAW Model: 45 millions polygons, 250Mb
- Decimation
- Model: 4 millions polygons, 50Mb
- Texture Application
- 140 images (3008x2000pixel)

22.5 millions polygons 250MB

4 millions polygons 50MB

Wireframe model

Textured model
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7. GIS APLICATION

Introducing terrestrial laser scanner data collection and pre-processing.

GIS APPLICATION

Polygonal Model

DTM

GIS Analysis

VIRTUAL REALITY

Platform

Final Model

CONCLUSIONS

Gis Apllication

- ICC Web:
  - DXF Curves 1:5000
  - MrSID Ortho Image 1:5000
- Arc Scene TIN analysis:
  - Viewshed
  - Slope
  - Shadow

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8. VIRTUAL REALITY

- GIS Model
- Polygonal Model
- Point Cloud Model

**LASER SCANNER**
- Data Collection
- Pre Processing
- Polygonal Model

**GIS APPLICATION**
- DTM
- GIS Analysis

**VIRTUAL REALITY**
- Workbench
- ALICE Software

**VIRTUAL REALITY PLATFORM**
- Real Time Visualization
- Group Visualization
- Stereoscopic vision
- Easy Position Tracking
- Collaboration workspace
- Augmented Reality

**CONCLUSIONS**

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9. VIRTUAL REALITY

Alice Software:
- High-quality visualization thanks to the use of different algorithms and other high-end technologies.
- High range of navigation options accessible through classic interactive hardware or using different tracking devices.
- Stereoscopic vision from different virtual reality hardware: 3d glasses, head mounted displays, CAVE, PowerWall and Workbench.
- Space referenced sound
- Collaboration workspace
- Plugin for importing VRML97 (WRL), AutoCAD (DXF), y 3DStudio MAX 4.0(MAX) files
9. VIRTUAL REALITY

**The Workbench:**
- Can be moved to any particular location
- Can be shown to a group of people instead of being single user
- Position in virtual environment can be easily located for tracking purposes

**Laser Scanner Data Collection and Processing**

**GIS Application**
- Polygonal Model
- DTM
- GIS Analysis

**Virtual Reality Platform**
- 2 DLP Projectors
- CPU
- Screen

**Final Model**

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10. VIRTUAL REALITY

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11. CONCLUSIONS

<table>
<thead>
<tr>
<th>ADVANTAGES</th>
<th>PROBLEMS AND POSSIBLE SOLUTIONS</th>
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<tbody>
<tr>
<td>• Is a valid alternative where traditional survey techniques doesn’t give enough information for complex 3d models environments</td>
<td>The triangulation of a point cloud is not a standard process, is still significantly time consuming. Moreover, accuracy lost in this process cannot be exactly controlled. The development of tools able to introduce a dense colored high resolution point cloud in the Virtual Reality platform could permit to reduce the post processing time and to maintain all laser measurement.</td>
</tr>
<tr>
<td>• Data collection is fast and accurate.</td>
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<tr>
<td><strong>LASER SCANNER</strong></td>
<td></td>
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<td>• Enriches the 3d virtual environment, allowing different standard analysis to work interactively with the virtual model.</td>
<td>More possibilities of exploiting GIS data in Virtual environments need further studies to be tested at different level of detail and scales</td>
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<td>• There are many free available databases online, which can be used to adequately represent the context.</td>
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<td><strong>GIS</strong></td>
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<td>• Allows laser scanner and GIS data real-time visualization.</td>
<td>Flexibility of data integration must be improved and high resolution visualization can be implemented. A more portable and easy to use device is needed. This work in progress project opens new future scenarios, in which a more portable and easy to use device can be applied and an augmented reality application can be developed.</td>
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<td>• Permits a first-class interaction between different users and complex data by easy position tracking.</td>
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<td><strong>VIRTUAL REALITY</strong></td>
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