Quick 3D record: a low-cost method for documentation and analysis of scattered architectures in the EMCHAHE project

Patricia Mañana-Borrázns (Incipit, Spanish National Research Council), Rebeca Blance-Rotea (Technological Research Institute, USC) , José Carlos Sánchez-Pardo (USC)

Early Medieval Churches: History, Archaeology and Heritage

This work makes part of the Maria Curie OSIE EMCHAHE project: “Early Medieval Churches: History, Archaeology and Heritage” (2013-2017), led by José Carlos Sánchez-Pardo at the University of Santiago de Compostela (Spain).

The research area of this project is the archaeology and history of the early medieval rural churches and their value for cultural management in Galicia (Northwest Spain).

The project has two main goals:

- First, to generate new archaeological/historical knowledge of the social dynamics in such a peripheral area of Europe during the period of transformations that goes from the end of the Roman World until the peak of the feudal system (5th-11th centuries) by means of the study of the remaining evidences of the religious buildings of this period.
- Second, to learn how to re-direct all this knowledge towards a proper and effective management and communication of the important and rather unknown heritage value of the remains of these buildings: architectural, archeological (uncharted or visible), artistic, documentary or even topomonic.

As an archaeological level, the project characterises by a wide perspective, strongly linked to Landscape Archaeology approaches combined with stratigraphical analysis of both underfoot or standing remains of early medieval churches.

In this sense, the project, rather than focusing on a few examples, aims to study a high number of churches in order to get new evidence of the early medieval churches, comparing construction techniques, chronologies and founds as well as distribution areas. As an estimation, the initial compilation of data for the project has recorded 265 churches with possible early medieval evidences in Galicia.

Within this panorama, we have chosen 3 case-study areas:

- Area of Lugo: 2943 km² comprising 51 churches to survey.
- Area of Tras-os-Montes: 1082 km² and 15 churches to survey.
- Area of Ourense: 5820 km² and 36 churches to survey.

So the project faces an important challenge: How to document all these buildings in a feasible and practical way?

Approaches to the study and geometric survey of early medieval churches

Study approach in EMCHAHE

The methodological strategy in EMCHAHE is based on the application of two successive work phases:

- **Prospective phase (extensive strategy)**
  - Revision of documentary sources
  - Creation of a DDS
  - Selection of study areas
  - Architectural survey

- **Analytical Phase (intensive strategy)**
  - Comprehensive study of the early medieval churches:
    - Documentation of the early medieval remains
    - Geometric documentation of singular elements and churches
    - Stratigraphic analysis of paraments
    - Cluster analysis
    - Analysis of mortars and bricks
    - Analysis of lapidary inscriptions and markings
  - Territorial analysis

From the data acquisition to the results

High level of detail can be achieved (singular element)

Photographs of details can achieve high quality.

**Advantages**

- It does not involve a large investment of time, i.e. the case of M. Mamede sarclops: 30 min. for taking photos + 1 h for editing results.
- It improves the analysis: details that can not be observed in reality, can be appreciated in the 3D model: inscriptions, relics, prints, erosion, etc.
- It facilitates the disclosure: the 3Dpdf, sketchfab, etc. enables to visualize and interact with the model.

**Problems**

- You need to enter parameters and control the position and scale of the images.
- It relies on an already good field data record (quality images, enough overlapping, correct lighting, etc.).
- It implies more effort in the post-processing phase.

3D Models from terrestrial photogrammetry

**Advantages**

- It allows to recreate three-dimensionally the constructive phases of the building, propose 3D reconstruction hypotheses, etc.
- It facilitates research and dissemination of results.

**Challenges and Requirements:**

- Great agility is required due to the dispersion of the sites and the time and economic constraints.
- We need a technique that does not involve additional resources and that can be easily integrated into the fieldwork by the archaeologist.
- A technique that allows to correctly represent the elevations and volumes of the studied churches.

From the data acquisition to the results

High level of detail can be achieved (singular element)

Photographs of details can achieve high quality.

**Advantages**

- It does not involve a large investment of time, i.e. the case of M. Mamede sarclops: 30 min. for taking photos + 1 h for editing results.
- It improves the analysis: details that can not be observed in reality, can be appreciated in the 3D model: inscriptions, relics, prints, erosion, etc.
- It facilitates the disclosure: the 3Dpdf, sketchfab, etc. enables to visualize and interact with the model.

**Problems**

- You need to enter parameters and control the position and scale of the images.
- It relies on an already good field data record (quality images, enough overlapping, correct lighting, etc.).
- It implies more effort in the post-processing phase.

Oroimage - Parameters

Essential result for Analytical phase:

- It improves representation: the whole of the elevation can be represented unobstructed and without distortion; it involves less time and costs than other methodologies.
- It allows to adapt to the characteristics of each church that needs to be documented.
- It improves representation: sections, perspectives, interactive 3D models can be obtained.
- The photogrammetric methodology developed has proved to be very effective and practical for the needs of a large-scale study.
- It offers flexibility to adapt to the characteristics of each church that needs to be documented.
- It allows to return to the site.
- It improves the heritage outreach, the presentation of the results and reconstruction hypotheses that include not only the 2D stratigraphy but the volumes of the ancient buildings that have survived in the interior of the current churches.

Conclusions

Initially EMCHAHE did not envisaged the use of any heritage geometric documentation method except conventional photography, because the wide-scale focus of the project was directed to the study of the ancient churches within a larger context. The new evidences of the underfoot remains of both underearth or standing remains of early medieval churches have become an important and rather unknown heritage value of the remains of these buildings: architectural, archeological (uncharted or visible), artistic, documentary or even topomonic.

Initially EMCHAHE did not envisaged the use of any heritage geometric documentation method except conventional photography, because the wide-scale focus of the project was directed to the study of the ancient churches within a larger context. The new evidences of the underfoot remains of both underearth or standing remains of early medieval churches have become an important and rather unknown heritage value of the remains of these buildings: architectural, archeological (uncharted or visible), artistic, documentary or even topomonic.

Initially EMCHAHE did not envisaged the use of any heritage geometric documentation method except conventional photography, because the wide-scale focus of the project was directed to the study of the ancient churches within a larger context. The new evidences of the underfoot remains of both underearth or standing remains of early medieval churches have become an important and rather unknown heritage value of the remains of these buildings: architectural, archeological (uncharted or visible), artistic, documentary or even topomonic.

Initially EMCHAHE did not envisaged the use of any heritage geometric documentation method except conventional photography, because the wide-scale focus of the project was directed to the study of the ancient churches within a larger context. The new evidences of the underfoot remains of both underearth or standing remains of early medieval churches have become an important and rather unknown heritage value of the remains of these buildings: architectural, archeological (uncharted or visible), artistic, documentary or even topomonic.