



UNIVERSITAT  
POLITÈCNICA  
DE VALÈNCIA

## **DOCTORAL THESIS PROPOSAL FOR THE DOCTORAL PROGRAMME IN GEOMATIC ENGINEERING**

**Department of Cartographic Engineering, Geodesy and  
Photogrammetry Universitat Politècnica de València**

### **Provisional doctoral thesis title: Text translated by AI**

“Analysis of the integration of extended reality technologies in documentation, spatial analysis and visualization for the interpretation, management and dissemination of architectural heritage.”

### **Student:**

### **Supervisors:**

Dr. María José Viñals

Dr. M. Carmen Juan

### **Abstract:**

The use of digital tools in heritage management, interpretation and dissemination is a field that is advancing rapidly in the scientific sphere, given its applicability and the benefits it provides in terms of the added attractiveness it brings to heritage resources, as well as the universal accessibility enabled by these tools. This became clearly evident during the Covid-19 pandemic, when heritage was accessible to the public only through digital tools.

The development of immersive technologies, especially augmented reality (AR), virtual reality (VR) and mixed reality (MR), is creating new opportunities for the interpretation, management and dissemination of architectural heritage from a geomatic engineering perspective.

Dissemination has been the first and most common line of work in which these technologies have been applied; however, heritage interpretation and even heritage management are less explored lines of work with significant research potential that can benefit from these technological advances. Therefore, this doctoral thesis will focus on these aspects.

This research proposes the development of a methodological framework for integrating extended reality (XR) tools with

advanced geomatic techniques, such as digital photogrammetry, laser scanning and 3D GIS, with the aim of improving accurate representation, spatial analysis and interactive dissemination of architectural heritage, using Valencia Cathedral as the case study.

The proposal will address three main phases:

1. Conceptualization and state of the art, through a systematic review of existing XR applications in the documentation, analysis, management and communication (interpretation and dissemination) of cultural heritage, identifying relevant methodologies, technologies and results.
2. Design and development of methodological framework for the integration XR technologies with data of and high-precision geomatic models, incorporating information georeferenced & elements interactive aimed at heritage interpretation, visualization and dissemination.
3. Validation of the proposed model through its practical application in Valencia Cathedral, evaluating geometric accuracy, visual and communicative effectiveness, and its potential to support heritage conservation and management.

### **General and specific objective:**

The general objective of this thesis will be to define, theorize and validate a technical and conceptual framework that consolidates extended reality as a scientific tool within geomatic engineering, capable of improving the acquisition, representation, analysis and accessibility of spatial information applied to cultural heritage in complex urban environments.

1. Analyze the current state of the integration of XR technologies in the field of geomatic engineering and their application to architectural heritage.
2. Design a methodological framework for integrating geometric capture techniques (photogrammetry, LiDAR) and XR environments.
3. Develop and validate georeferenced three-dimensional models of Valencia Cathedral for their integration into immersive environments.
4. Validate the geometric accuracy, visual efficiency and interpretive value of XR tools in heritage management and communication.
5. Establish recommendations and guidelines that can be extrapolated to other heritage assets or urban environments of cultural interest.

### **Methodology:**

- Bibliographic and documentary review: systematic analysis of the state of the art in XR technologies, geomatic engineering and heritage management.

- Case study: Valencia Cathedral is selected as a representative pilot environment.
- Acquisition of geomatic data: through photogrammetry, terrestrial laser scanning or processing of pre-existing point clouds.
- Integration XR: development of prototype using engines cross-platform ( e.g Unity), compatible w/ standards of interoperability and open geomatic formats (OBJ, GLTF, among others).
- Experimental validation: tests with users, heritage specialists and geomatic technicians, aimed at evaluating accuracy, usability and interpretive effectiveness.
- Evaluation and modelling: quantitative and qualitative analysis of geometric accuracy, communicative efficiency and the potential of XR in the digital communication of heritage.

**Available resources:**

The research will use the technological resources, software and specialized equipment provided by the supervisors' research groups. The existing 3D models of Valencia Cathedral and the materials generated during the student's master's thesis will serve as the basis for the initial development of the doctoral thesis.

In Valencia, 13 November 2025

Student

Supervisors' signatures

Chongwen Fu

M. José Viñals

M. Carmen Juan