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DIGITAL TWIN: MURALLA DE AVILA AND ESCUELAS MAYORES OF THE UNIVERSITY OF SALAMANCA

"Good practices of digitization of natural and Cultural Heritage as anti pandemic measures (Spain)"

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Institution: University of Salamanca, EPS Avila

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CAMPUS DE EXCELENCIA INTERNACIONAL

tidop RESEARCH GROUP

Online – *Aguilar de Campoo 28/06/2022*

OUTLINE

- ❑ TIDOP Research Unit
- ❑ What is a Digital Twin?
- ❑ Muralla de Avila-Digital Twin
- ❑ Escuelas Mayores-Digital Twin
- ❑ Conclusions

OUR EXPERIENCE

2005

2014

ITOS3D

IMAGE TO SMART 3D ENGINEERING

60+

More than 60 employees and growing…

Interdisciplinar

10+

Experts in the most advanced geospatial technologies

15/35

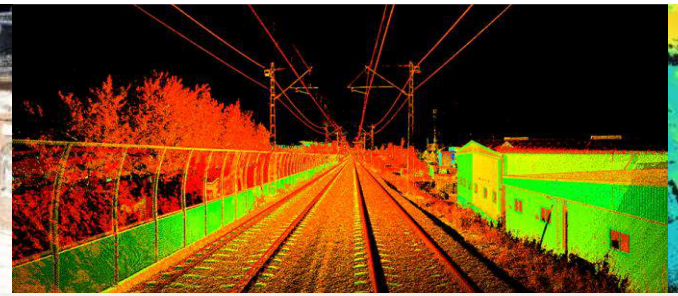
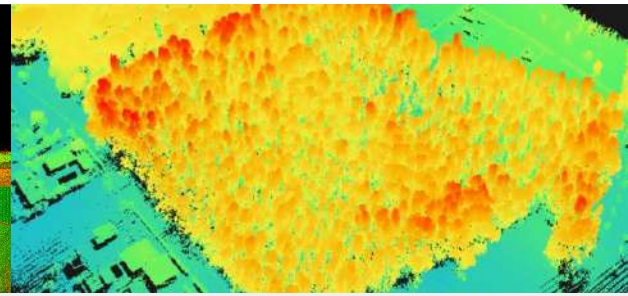
Patents and Intellectual Properties (Software)

300+

More than 200 projects/contracts behind us

Different clients

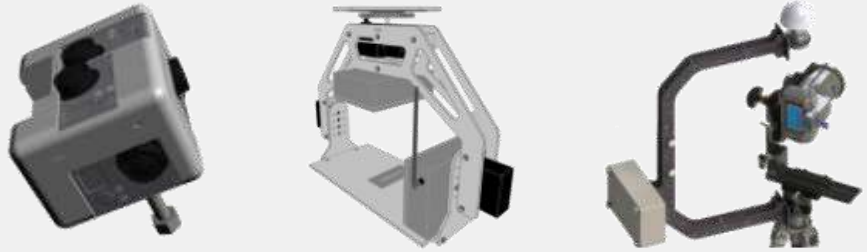
WHAT MAKES US DIFFERENT

In-house software/patents

Geospatial analysis

Artificial Intelligence



Data acquisition

OUR PRODUCTS

CrashMap

HeatMap

INDUSTRY 4.0

WeldMap

MatMap

energy tools

Sun Map

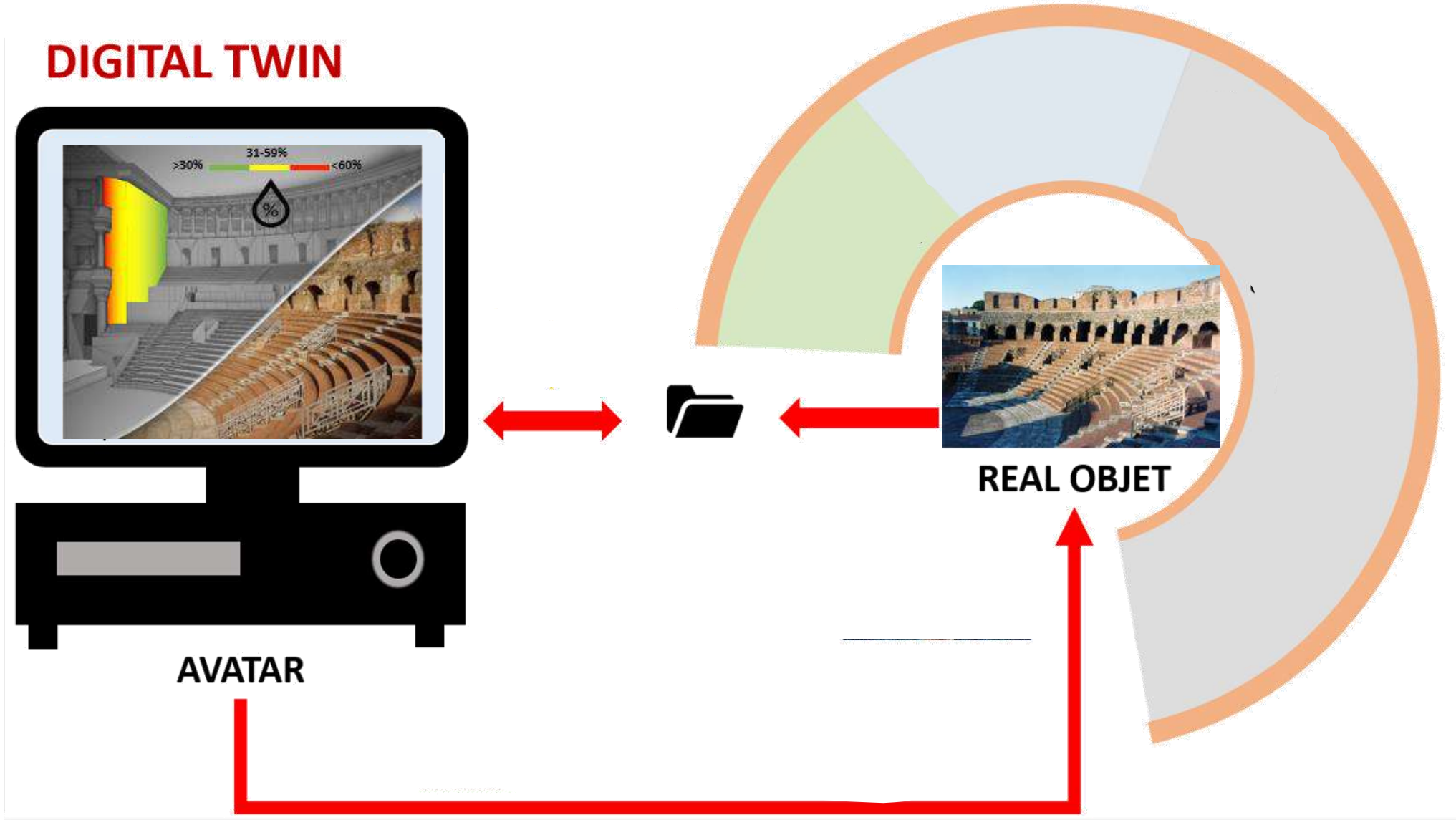
GesCal

hidrology

HidroMap

Revela Duero

WHAT IS A DIGITAL TWIN?



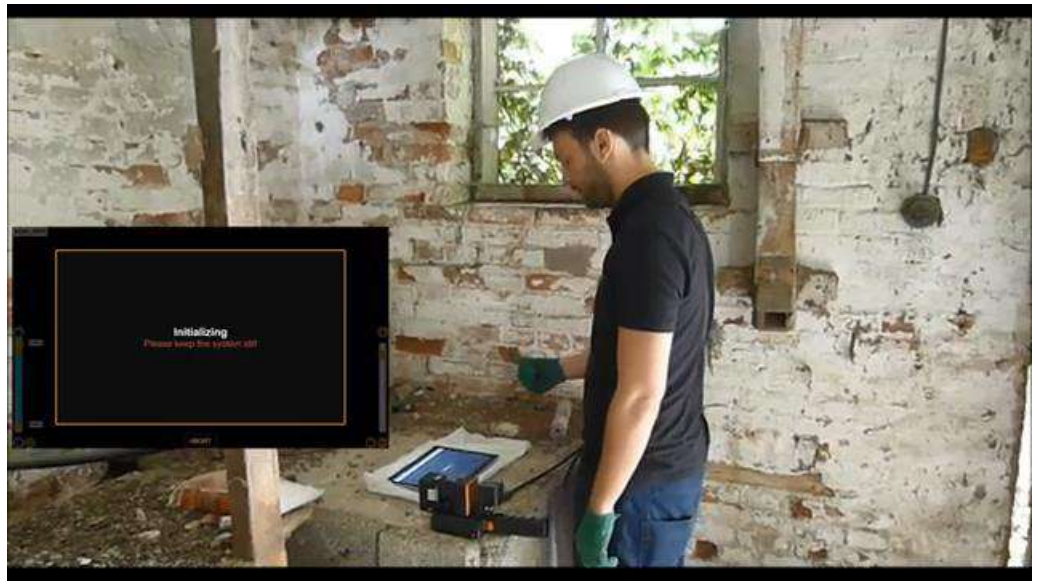
DIGITALIZATION

MONITORING

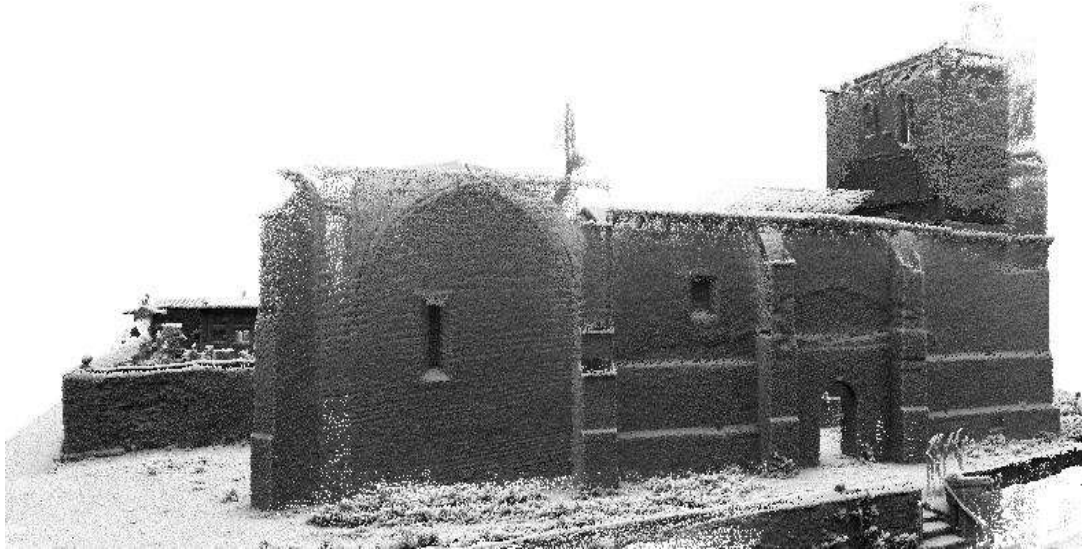
KNOWLEDGE

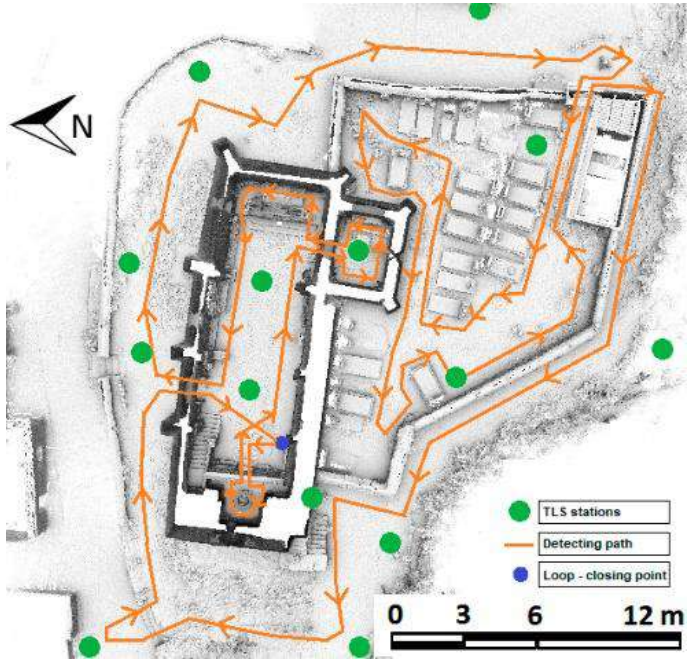
PREVENTIVE AND PREDICTIVE CAPABILITIES

DIGITALIZING CULTURAL HERITAGE WITH WEARABLE TECHNOLOGIES

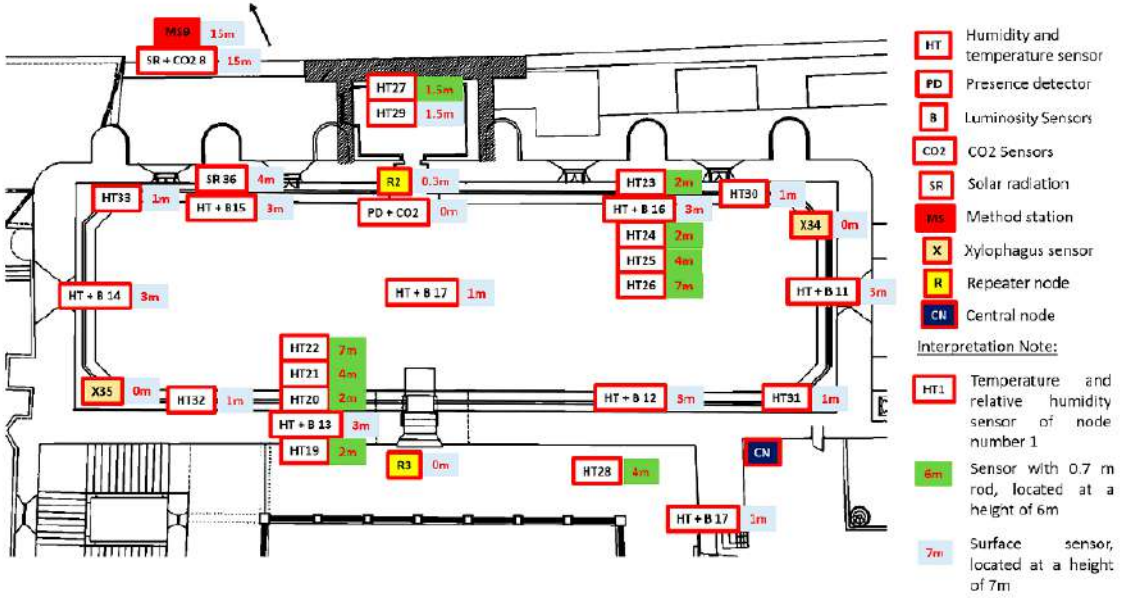


- ✓ Intuitive
- ✓ Low-Cost and easy to implement
- ✓ Metric properties (1-2 cm accuracy)
- ✓ More efficient than laser or photogrammetric techniques
- ✓ Ideal for complex Cultural Heritage scenarios



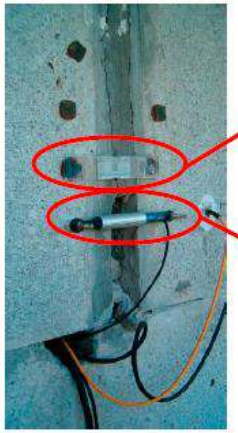


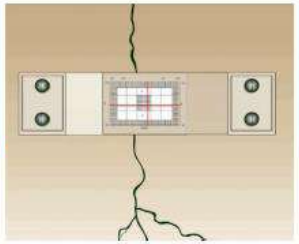
MONITORING CULTURAL HERITAGE WITH IoT SENSORS



- ✓ Dynamic capabilities
- ✓ Low-Cost and easy to implement
- ✓ BigData performance and BigData analytics
- ✓ Great variability of sensors and parameters
- ✓ LoRaWAN network

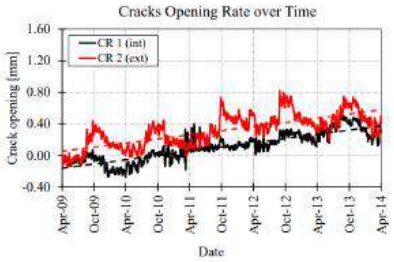
- Moisture
- Temperature
- Luminosity
- Inclination
- Fissures
- Etc.





Fisurometro. Fuente: Google imágenes

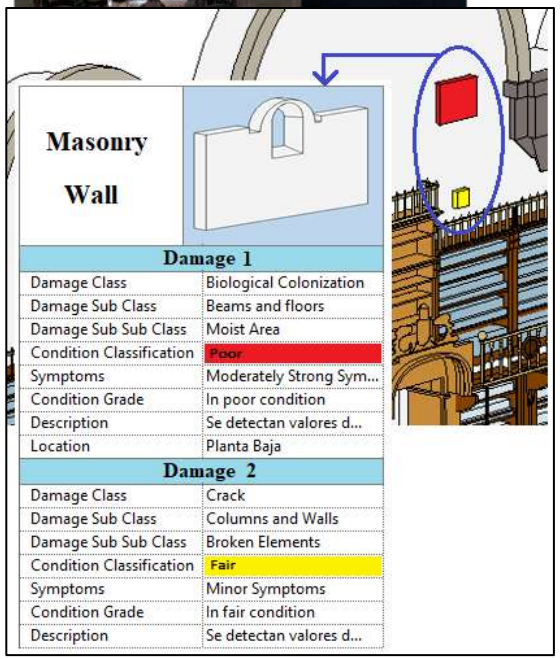
Fisurometro y LVDT. Fuente: Puliga, 2014



ARDUINO ⇨ LoRa ⇨ ThingSpeak

KNOWLEDGE IN CULTURAL HERITAGE

Class No.	Condition Classification	Symptoms	Urgency Risk Classification	Comments
0	Good	No symptoms	Long term	No immediate actions required | Preventive monitoring is necessary
1	Fair	Minor Symptoms	Medium term	The condition of the fabric is not perfect but does not need immediate action | Monitoring is necessary to prevent further decay
2	Poor	Moderately Strong Symptoms	Short term	The condition of the fabric is such that it needs timely repair or additional inspection and diagnosis work
3	Bad	Major Symptoms	Urgent and Immediate	Urgent repair is necessary |Urgent additional inspection and diagnosis work
NA/NI	Not Accessible	Parts not (safely) accessible	Not Inspected	Parts that are 'not inspected' are either not (safely) accessible for the building inspectors or not visible



PREVENTIVE MODEL IN CULTURAL HERITAGE

Before the inspection

- Identification of the building
- Information of the owner

During the inspection

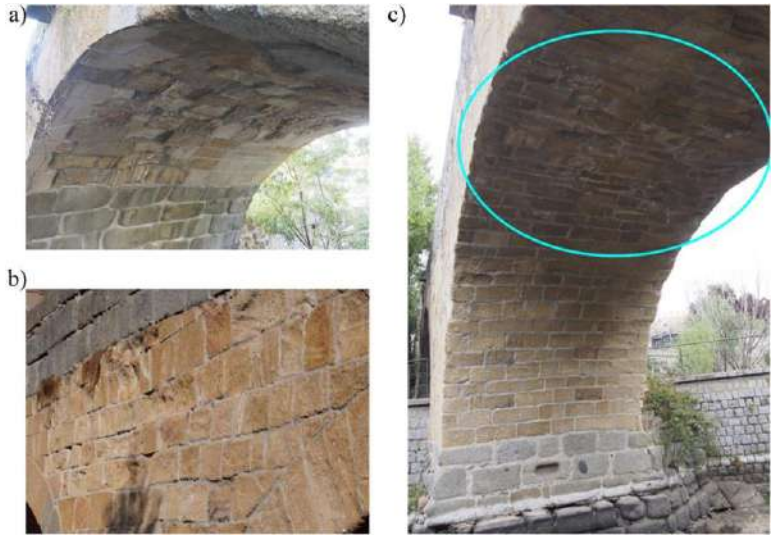
- Conservation state of the building

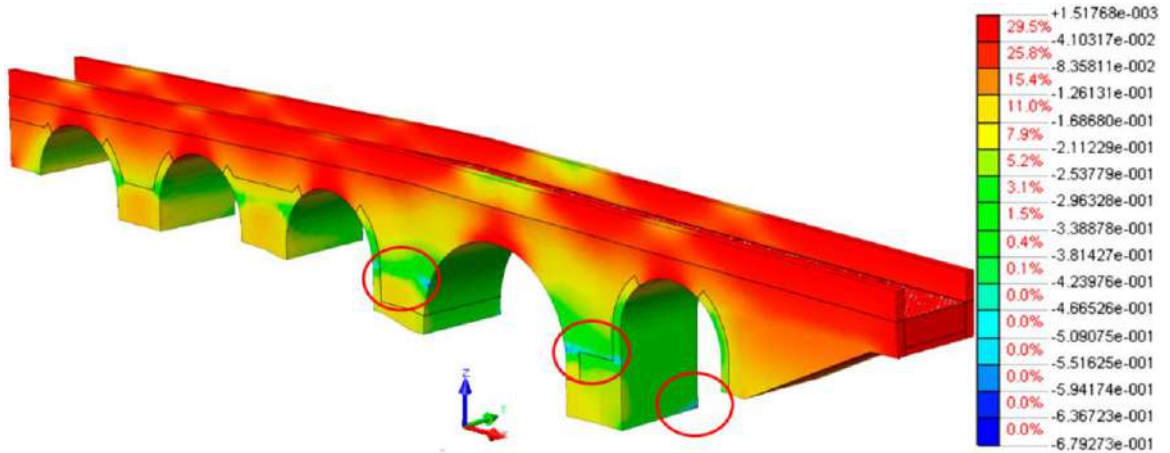
After the inspection

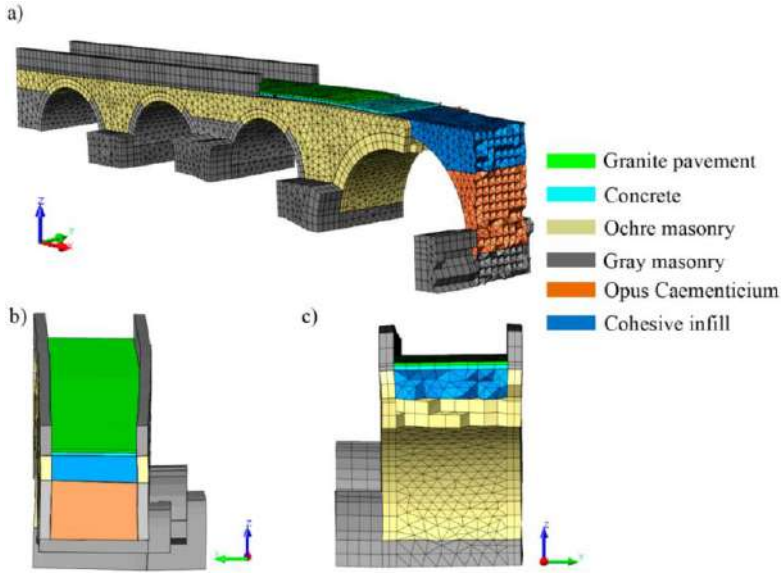
- Assessment
- **Preventive Conservation Plan**

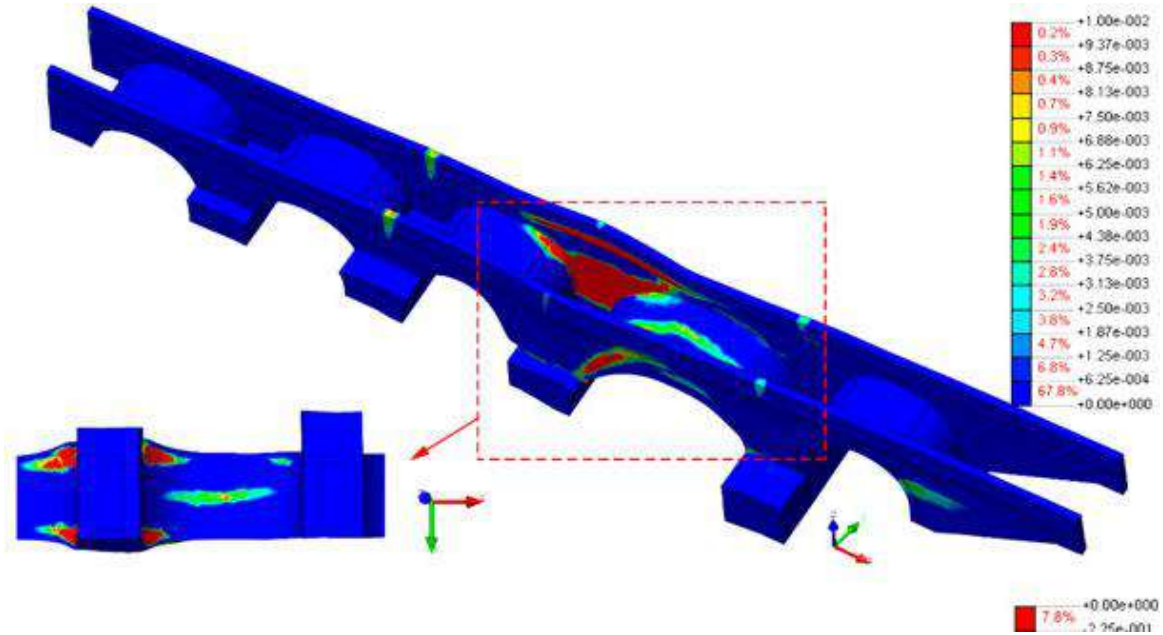
Storage and management of information

PREDICTIVE MODEL IN CULTURAL HERITAGE









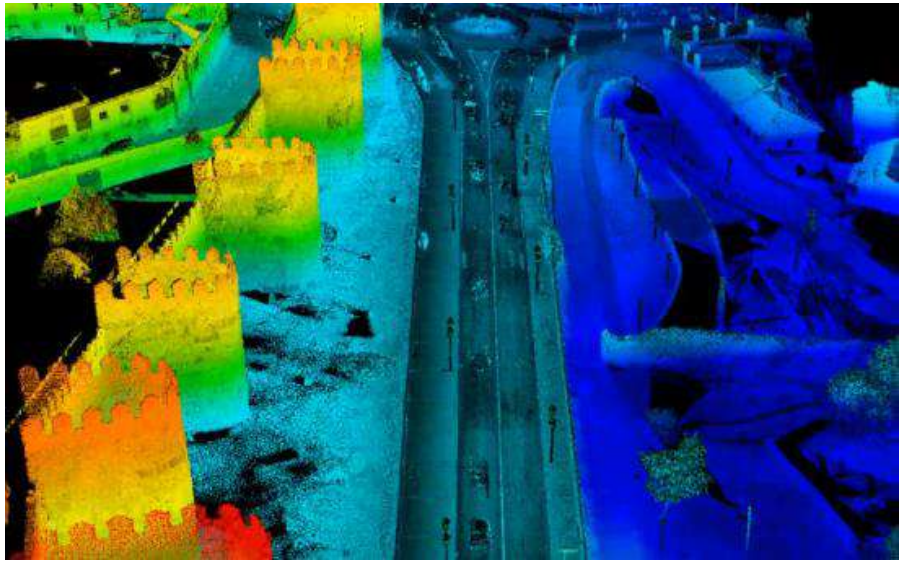
PREDICTIVE NUMERICAL MODELS

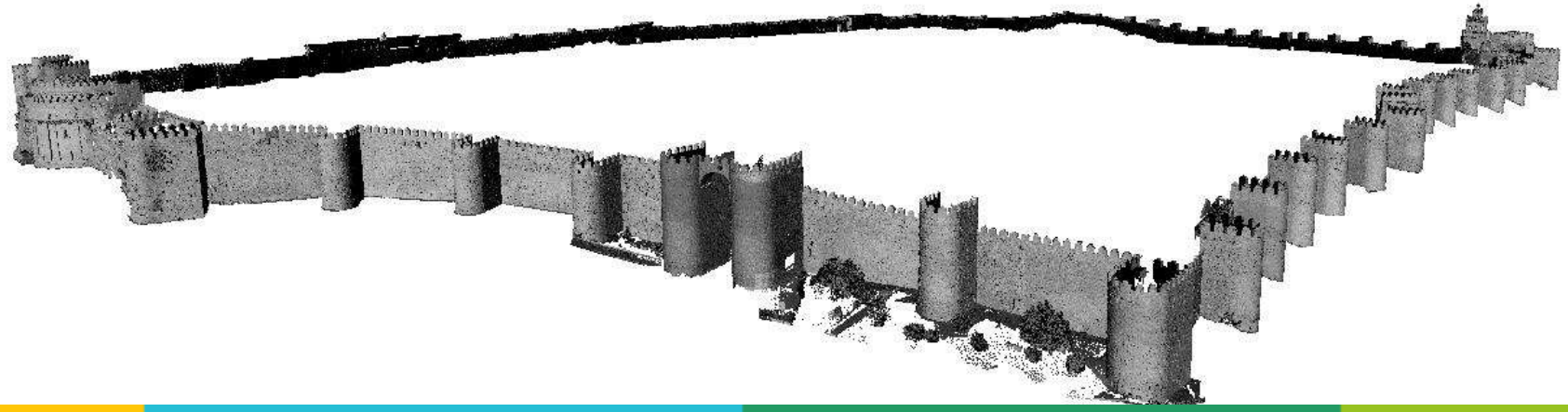
Muralla de Ávila (Spain)

Muralla de Ávila data acquisition

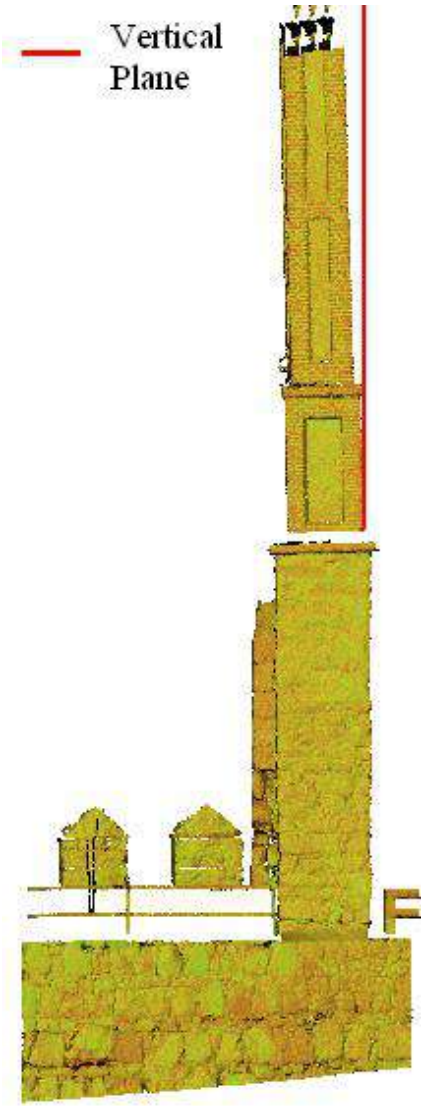
Muralla de Ávila data acquisition

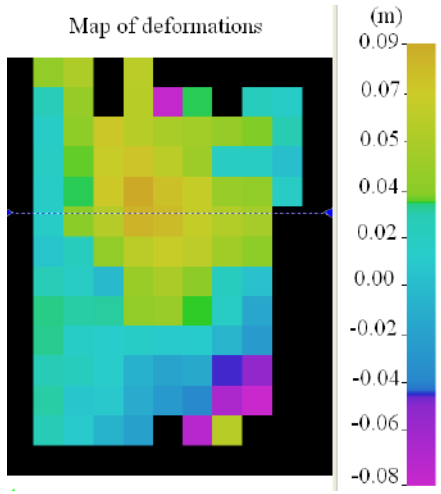
Muralla de Ávila data acquisition

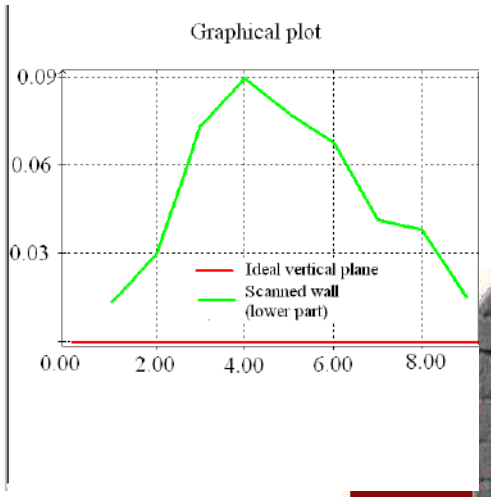


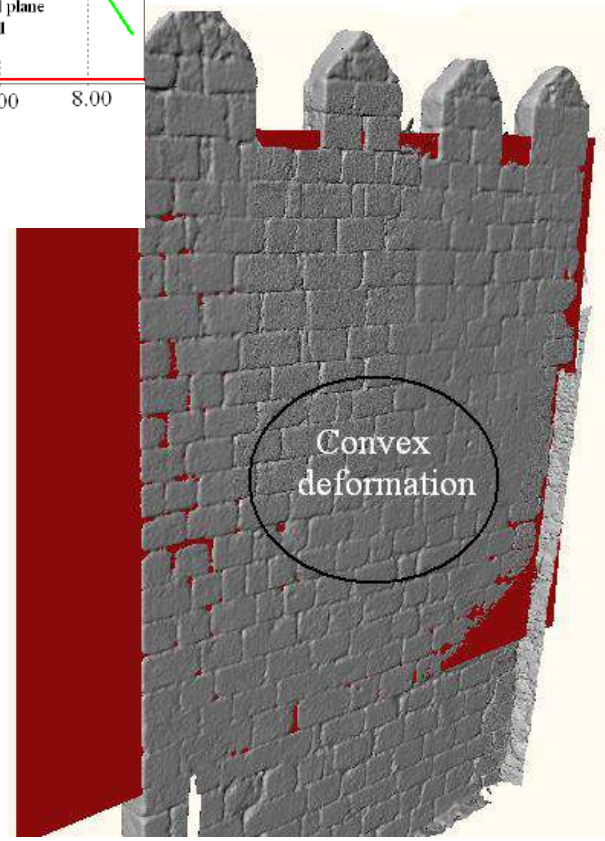


Muralla de Ávila: Structural Monitoring

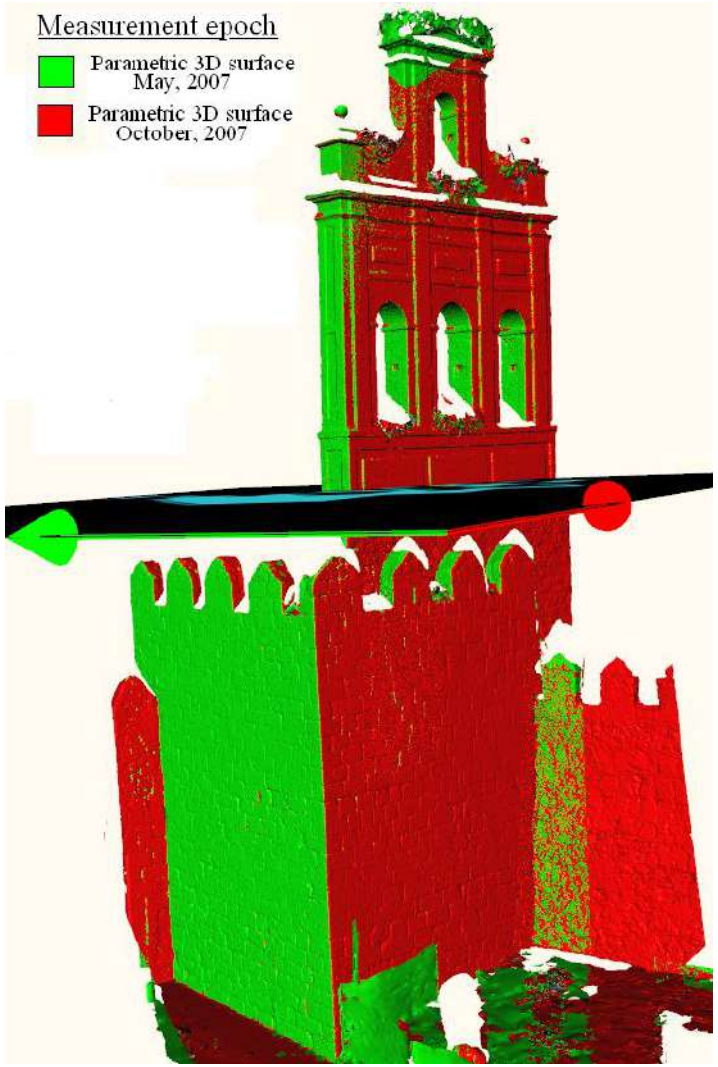


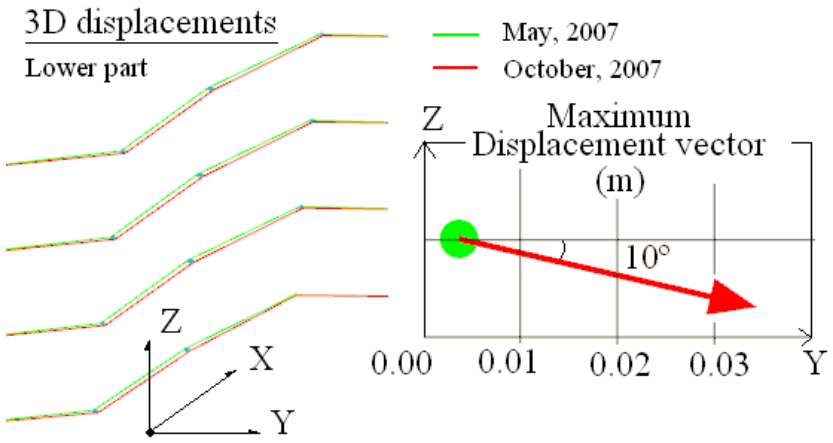


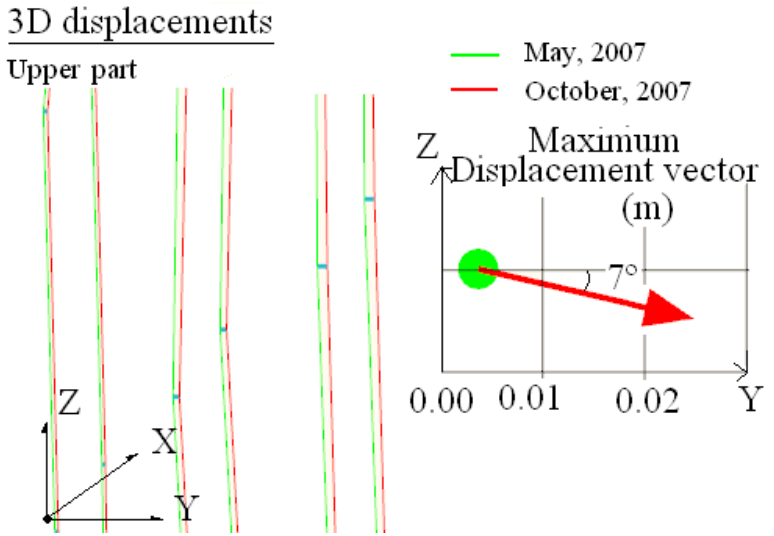




Muralla de Ávila: Structural Monitoring







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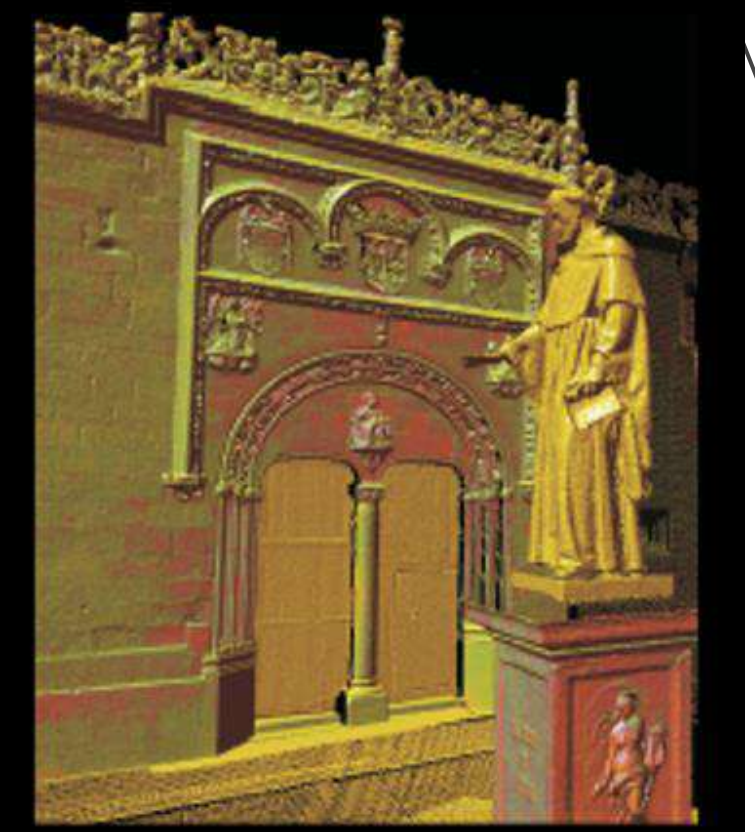
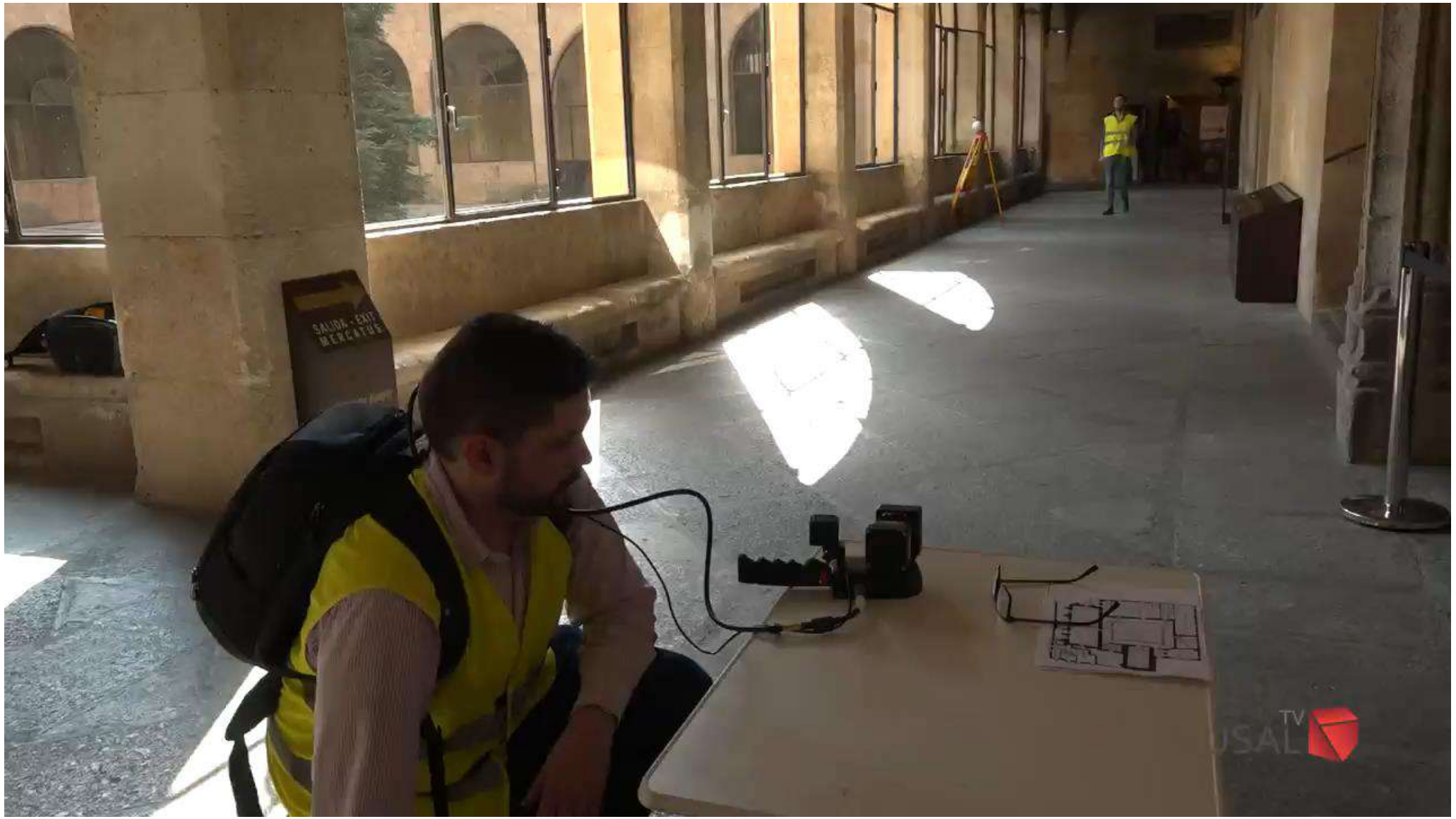


SMART CULTURAL HERITAGE PLATFORM

Escuelas Mayores, USAL (Spain)

DIGITALIZING WITH WEARABLE TECHNOLOGIES

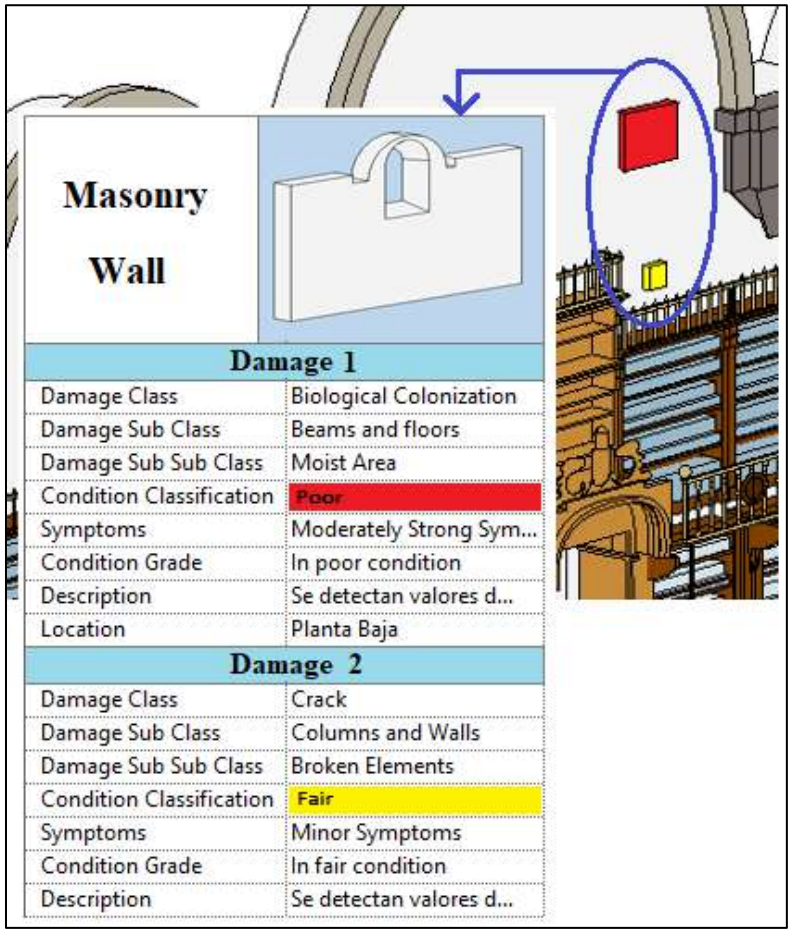


MONITORING WITH IoT SENSORS

ARDUINO ⇨ LoRa ⇨ ThingSpeak

MHS
Monitoring Heritage System

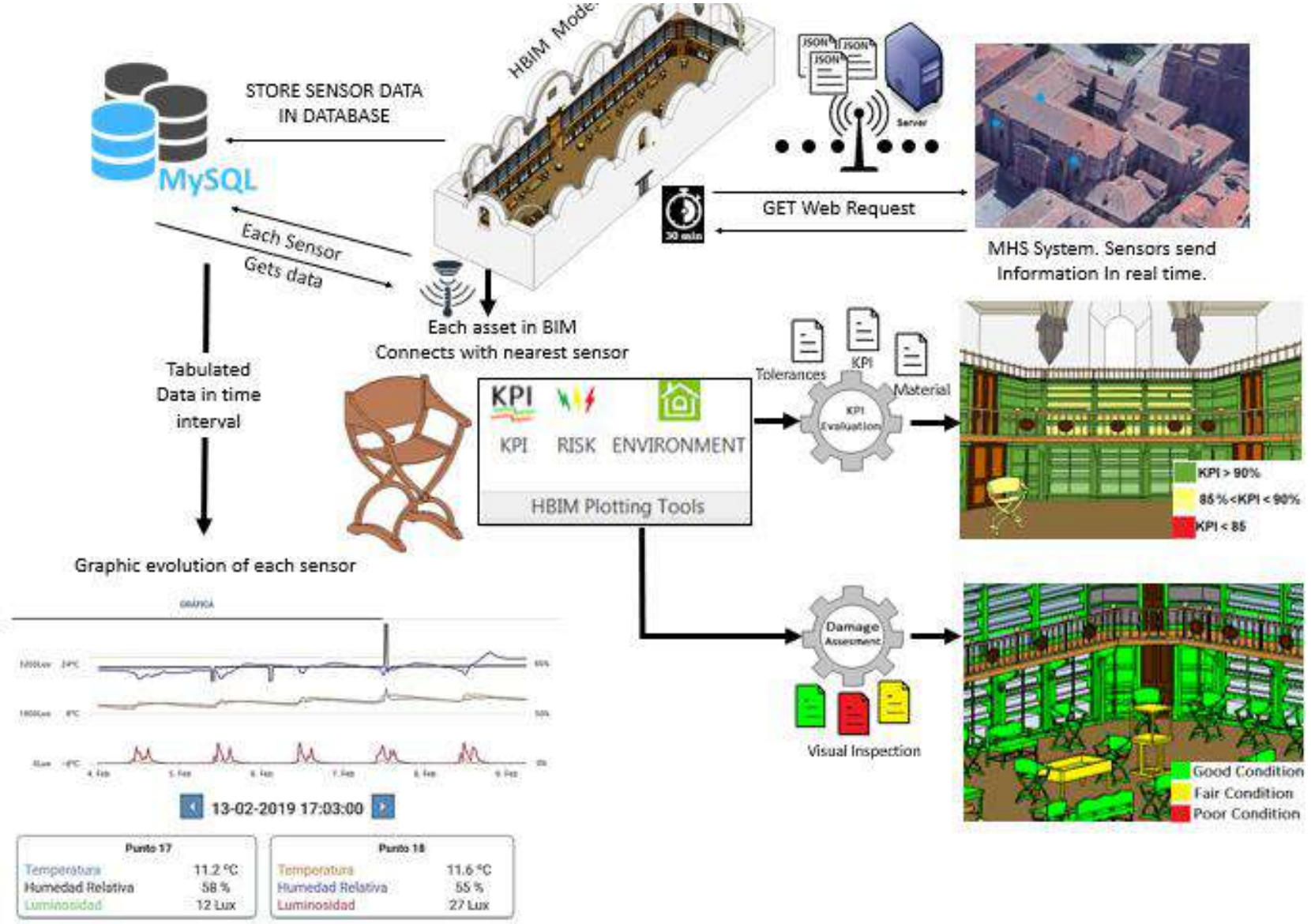
Santa María la Real fundación



Damage 1	
Damage Class	Biological Colonization
Damage Sub Class	Beams and floors
Damage Sub Sub Class	Moist Area
Condition Classification	Poor
Symptoms	Moderately Strong Sym...
Condition Grade	In poor condition
Description	Se detectan valores d...
Location	Planta Baja

Damage 2	
Damage Class	Crack
Damage Sub Class	Columns and Walls
Damage Sub Sub Class	Broken Elements
Condition Classification	Fair
Symptoms	Minor Symptoms
Condition Grade	In fair condition
Description	Se detectan valores d...

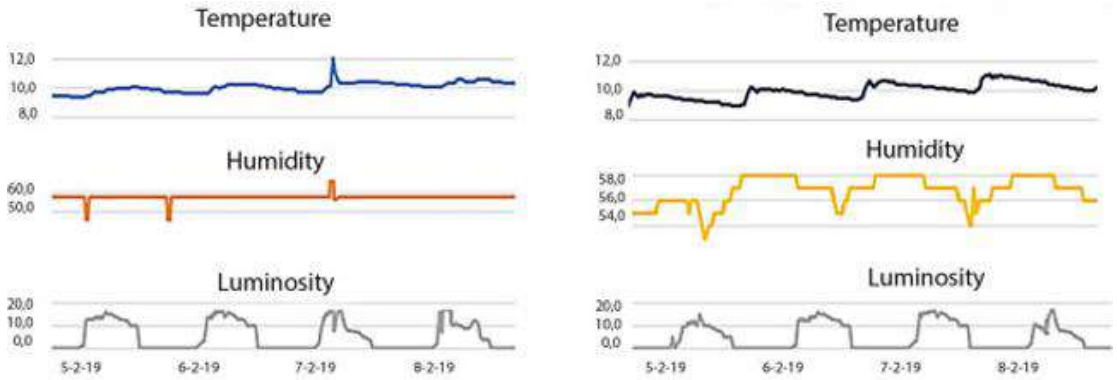
DATA INTEGRATION TOWARDS A DIGITAL TWIN



PREVENTIVE MODEL IN CULTURAL HERITAGE

INSPECTION LEVEL (PREVENTION)

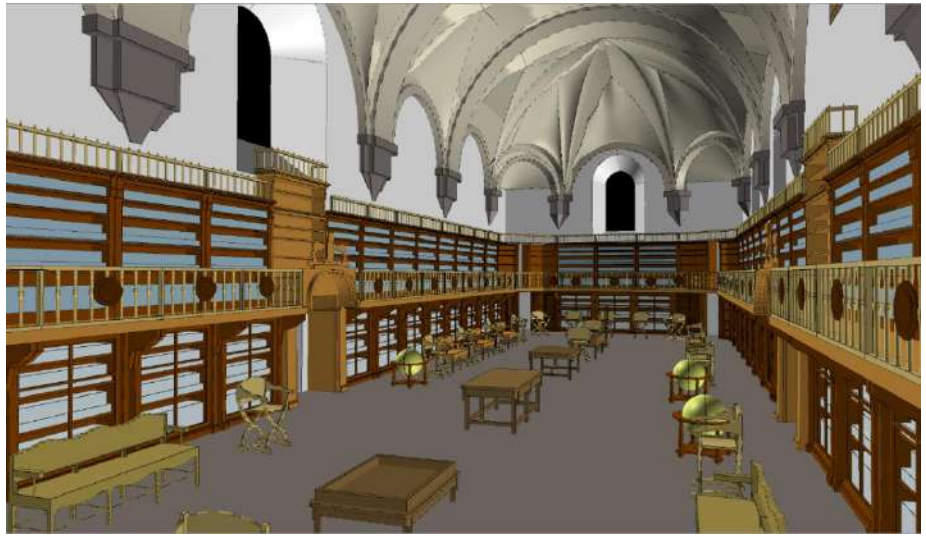
- ✓ Monitoring
- ✓ 2D and 3D inspection
- ✓ Virtual environment
- ✓ Best practices

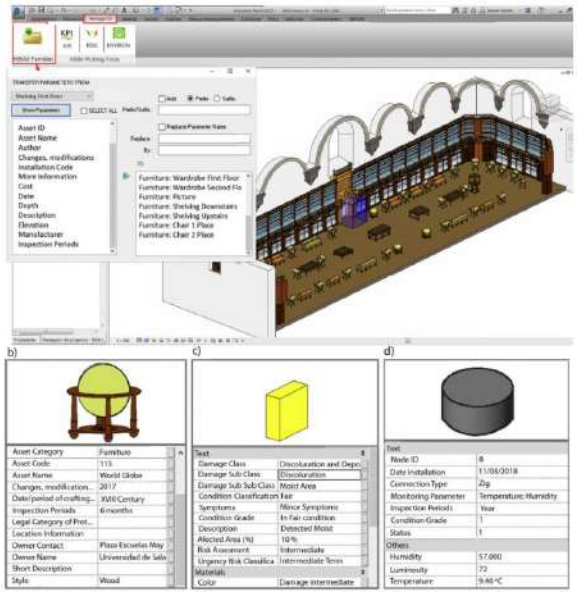


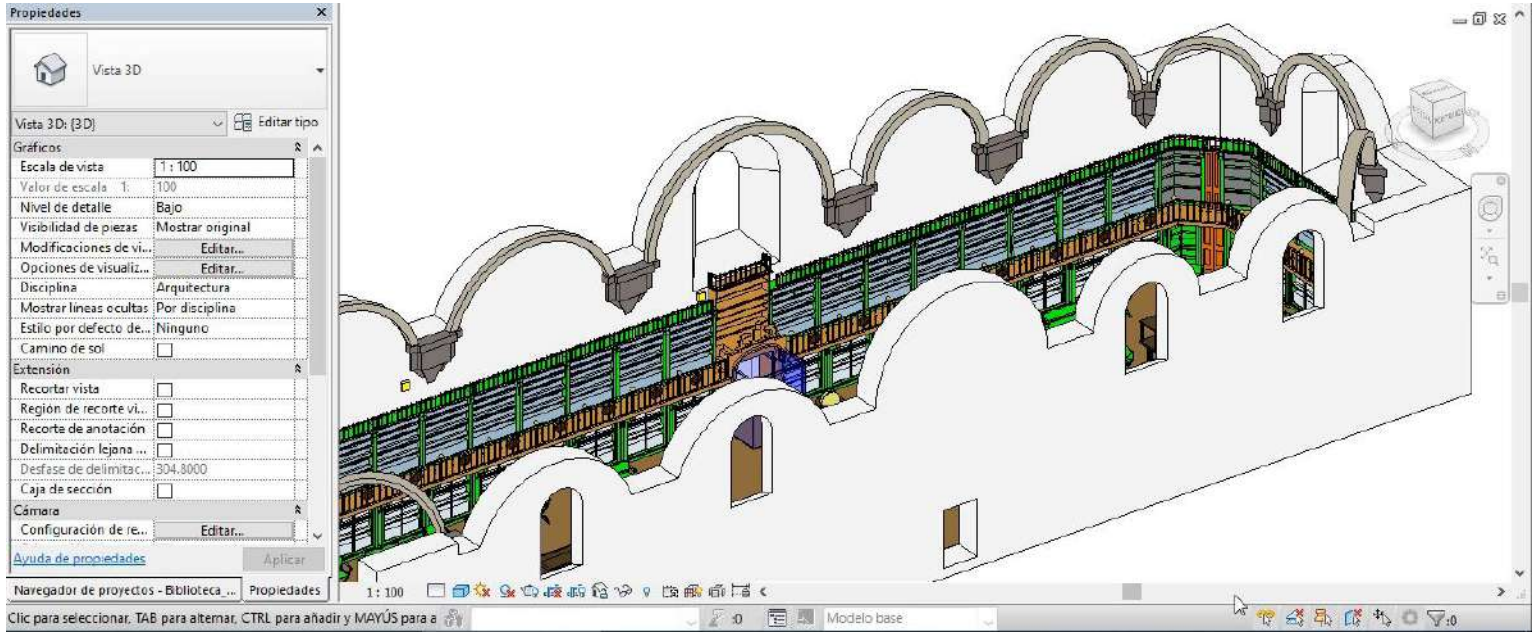
PREDICTIVE MODEL IN CULTURAL HERITAGE

SIMULATION LEVEL (PREDICTION)

- ✓ Risk mapping
- ✓ 4D analysis
- ✓ FEM & HBIM
- ✓ Support Decision Taking







SIMULATION MODEL IN THE SKY OF SALAMANCA

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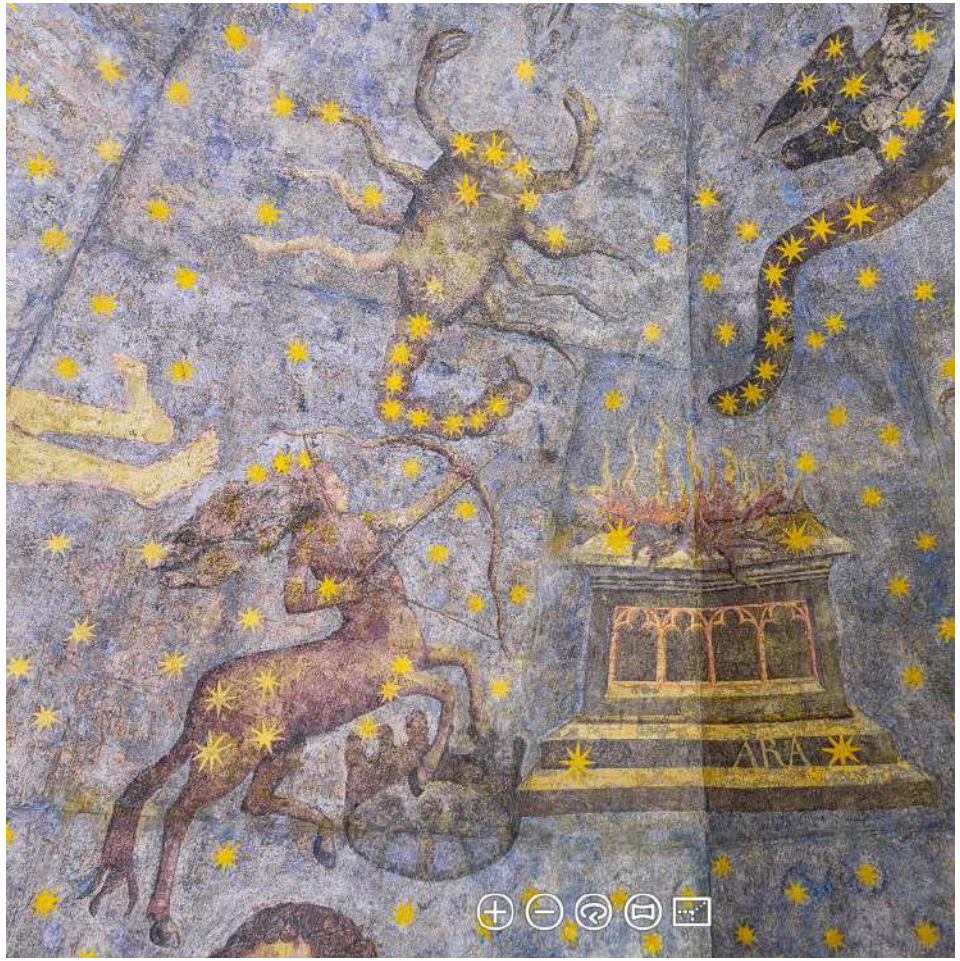
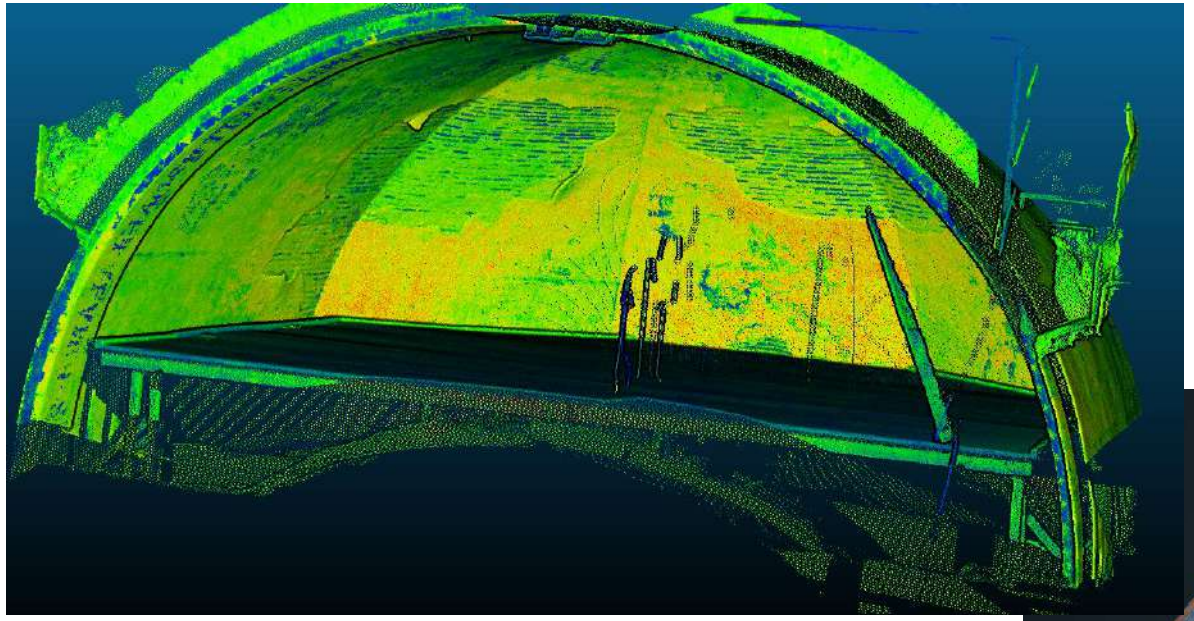
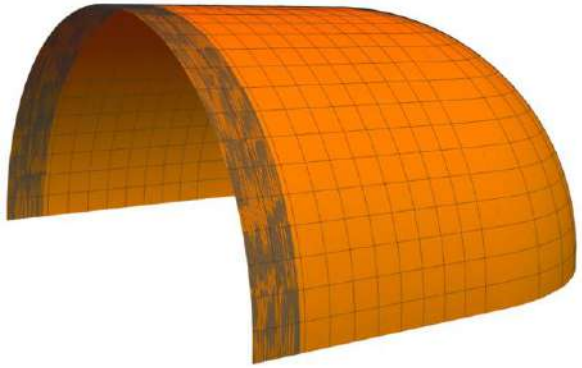
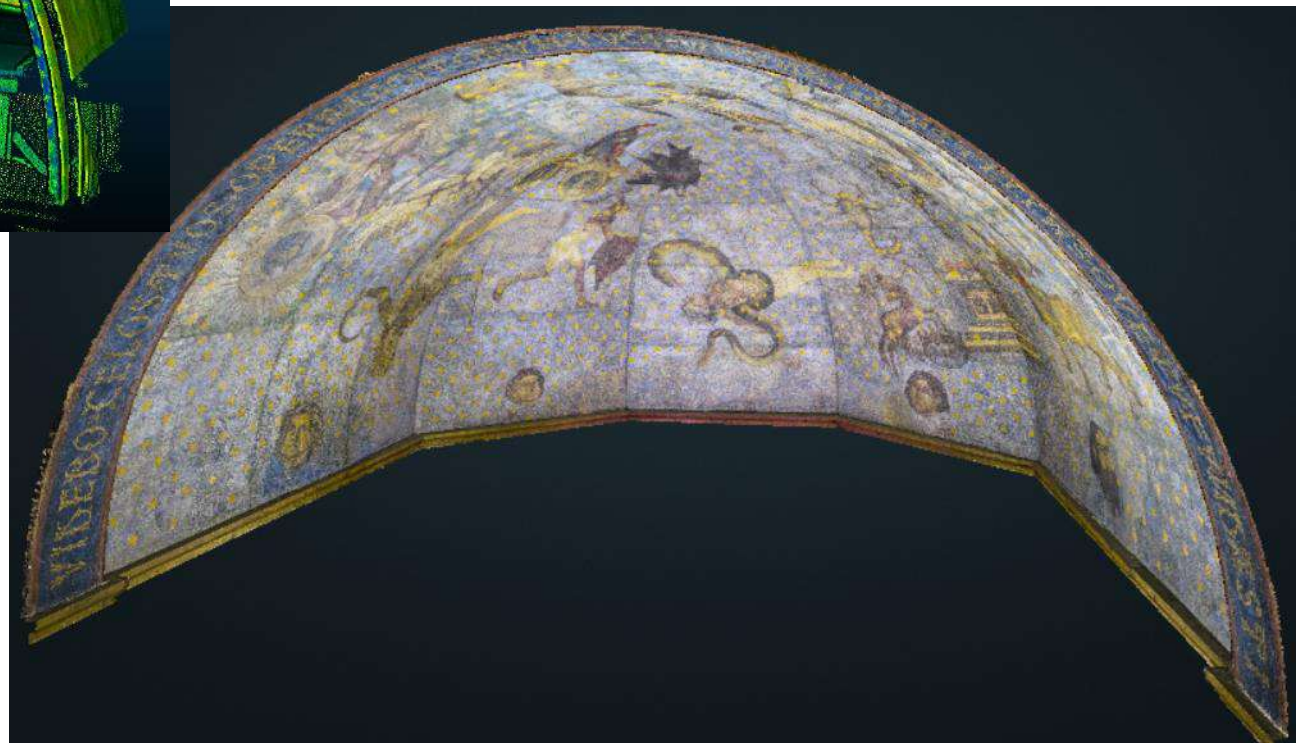
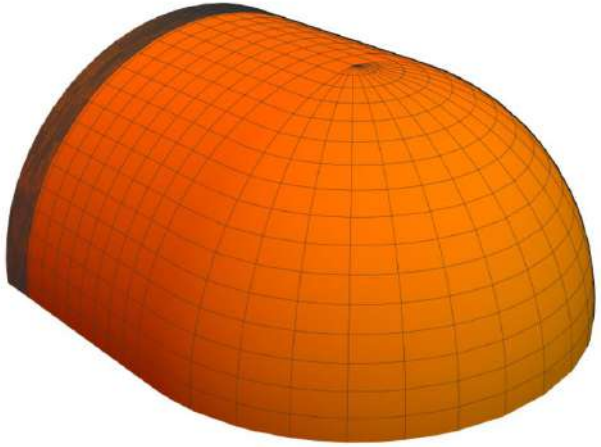


SIMULATION MODEL IN THE SKY OF SALAMANCA









CONCLUSIONS

- ✓ Digital Twins offer a wide roadmap of possibilities in CH
- ✓ Wearable digitalization techiques represent an efficient solution
- ✓ Monitoring sensors based on IoT and LoRaWAN network
- ✓ Smart Cultural Heritage platforms are key to success
- ✓ “*Prevention is better than cure*”

CD-ETA
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European Union
European Regional
Development Fund

THANKS FOR YOUR ATTENTION

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