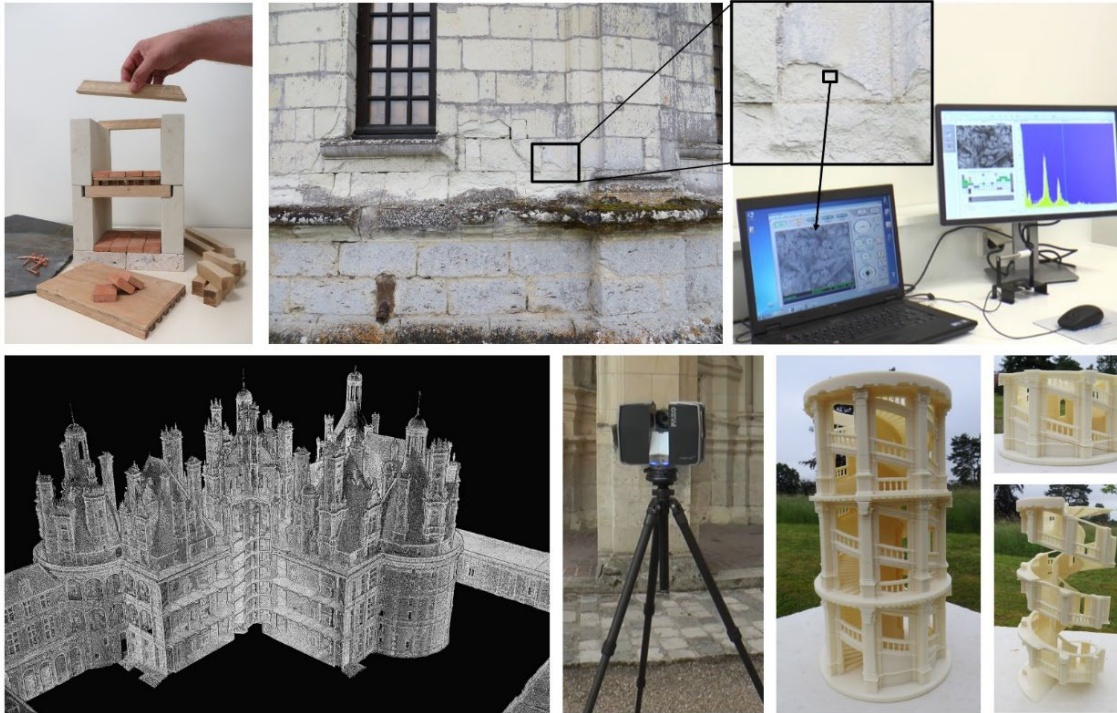


# Digital tools for built heritage: an opportunity for both teaching and research collaborations



**Xavier BRUNETAUD**  
Laboratory of Mechanics  
Gabriel Lamé  
Civil Engineering

**Sylvie Treuillet**  
PRISME Laboratory  
Image processing

**University of Orléans, France**

LE STUDIUM  
**WORKSHOP**  
ORLÉANS | 2023

19-20 April 2023

# International workshop on Digital Tools for Built Heritage diagnosis and monitoring (DT4BH)

## LOCATION

Hôtel Dupanloup  
1, rue Dupanloup  
45000 Orléans - FR

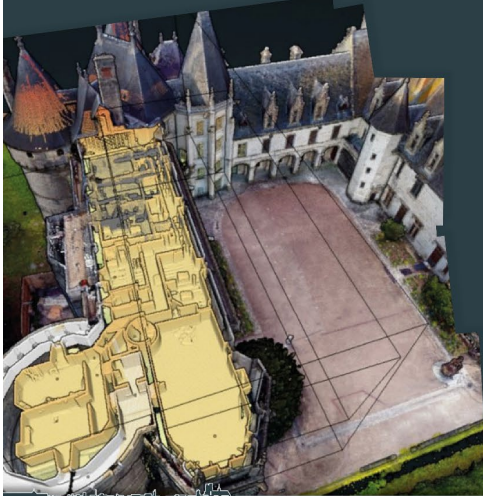
## CONVENORS

**Sylvie Treuillet**  
PRISME / University of Orléans - FR

**Xavier Brunetaud**  
LaMé / University of Orléans - FR

## PROGRAMME - REGISTRATION

registration@lestudium-ias.com  
www.lestudium-ias.com



Interdisciplinary studies:

- Conservation science
- Material science
- Humanities: history, architecture
- 3D survey, image processing
- Electrical/electronic Engineering
- Civil engineering
- Structural/mechanical Engineering

Objectives:

Provide digital tools for the dissemination,  
monitoring and conservation of built heritage



## Confirmed speakers

- Dr Frédéric Bosché, The University of Edinburgh - UK
- Prof. Xavier Brunetaud, University of Orléans - FR
- Prof. Andreas Kolb, University of Siegen - DE
- Prof. Emmanuel Maravelakis, Hellenic Mediterranean University - GR
- Prof. El Mustapha Mouaddib, University of Picardie Jules Verne - FR
- Dr Belén Riveiro, University of Vigo - ES
- Roxane Roussel, Map Laboratory - FR
- Dr Barthélemy Serres, University of Tours - FR
- Dr Sylvie Treuillet, University of Orléans - FR



Château of Chaumont-sur-Loire

At the heart of the  
Loire Valley  
UNESCO World  
Heritage



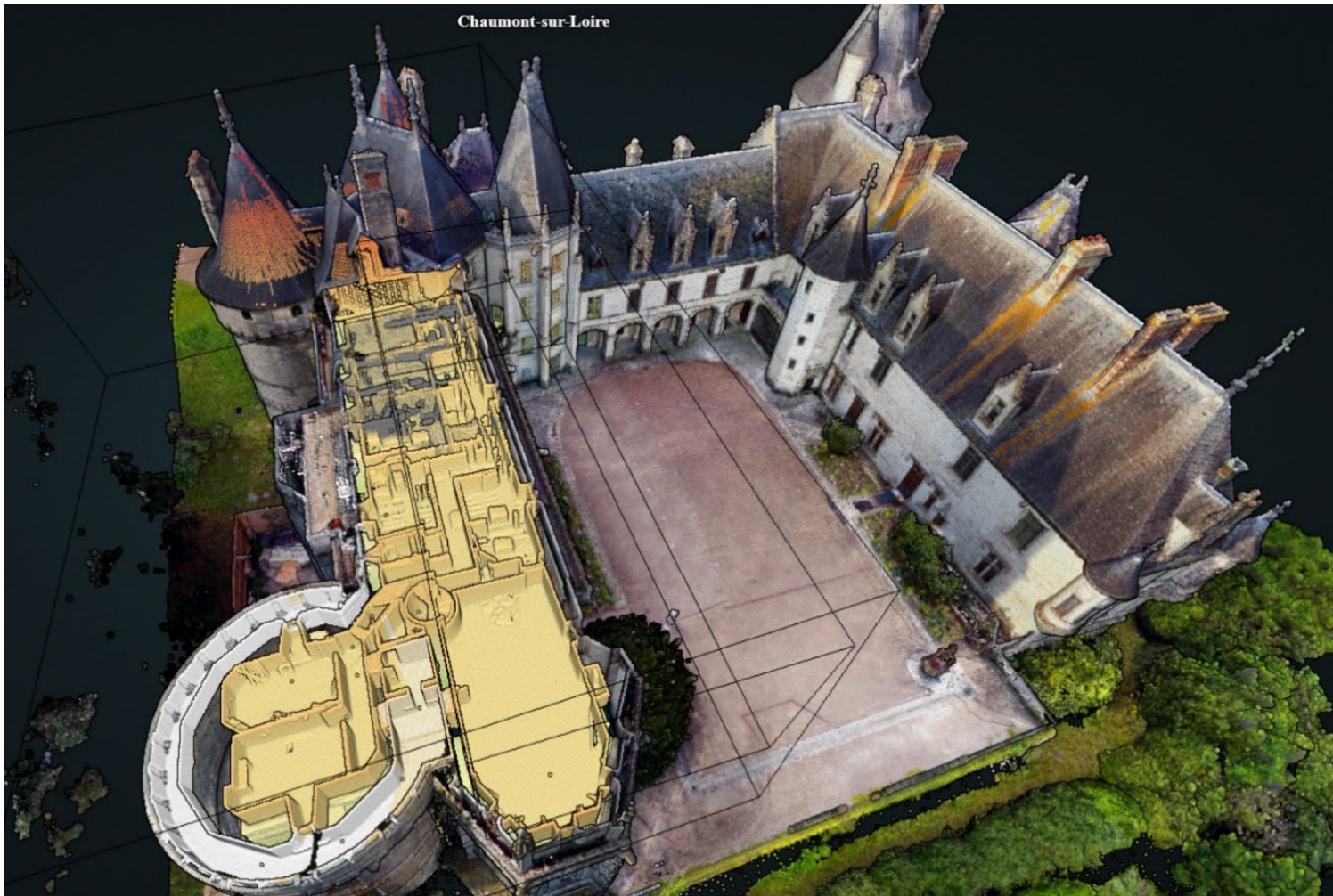
# Photogrammetric survey of the castle of Chaumont-sur-Loire

4000 photos by drone



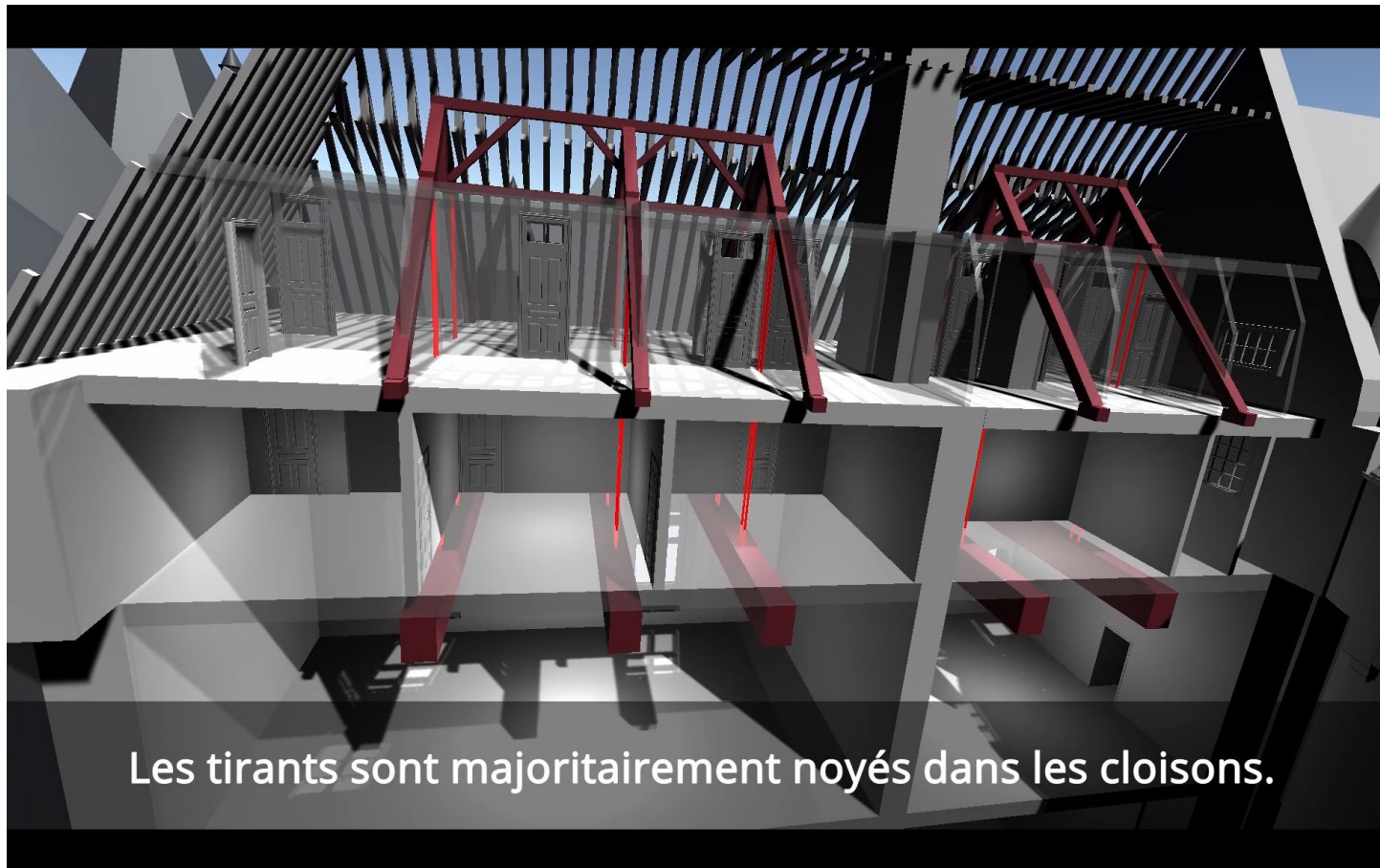
# Laser scanning registration

800 laser scanning stations



## Video of the restoration phases of the East Wing

Made from a staging of a BIM model from the 3D survey



# Mapping support

## Mapping of stone degradation on a SIG (orthophotos)

CARTOGRAPHIE D'ALTERATION

Château de Chaumont sur Loire

**Altération**

- Desquamations en plaques
- Desquamations en feuillets
- Pelage
- Désagrégrations sableuses
- Erosion





# Stone surface degradation (spalling)

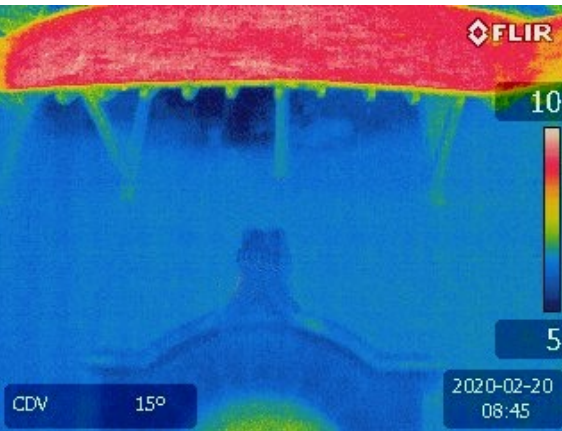


Photo monitoring

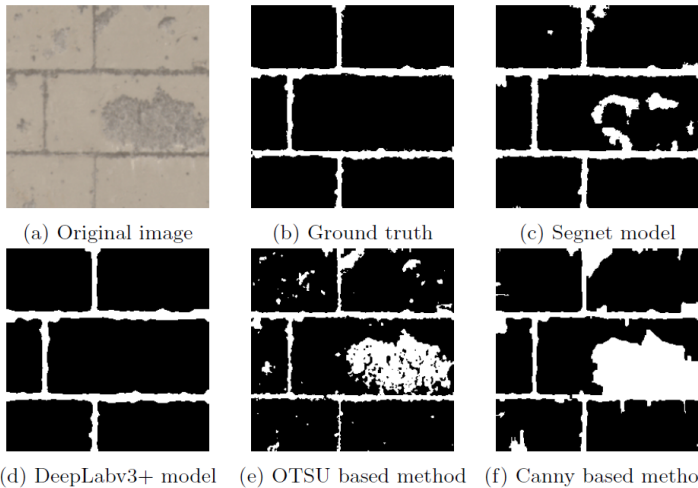
Chemical analysis

Thermal imaging

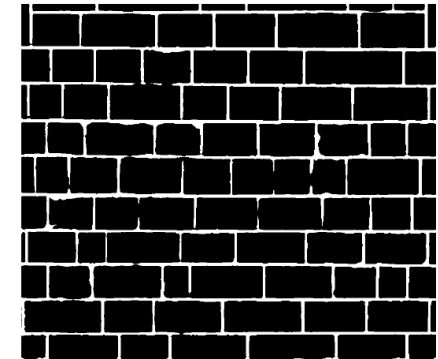
# Development of artificial intelligence (1)

## Automatic segmentation of stone joints

Algorithm trained in Chambord and tested in Chaumont-sur-Loire



(a) Original image

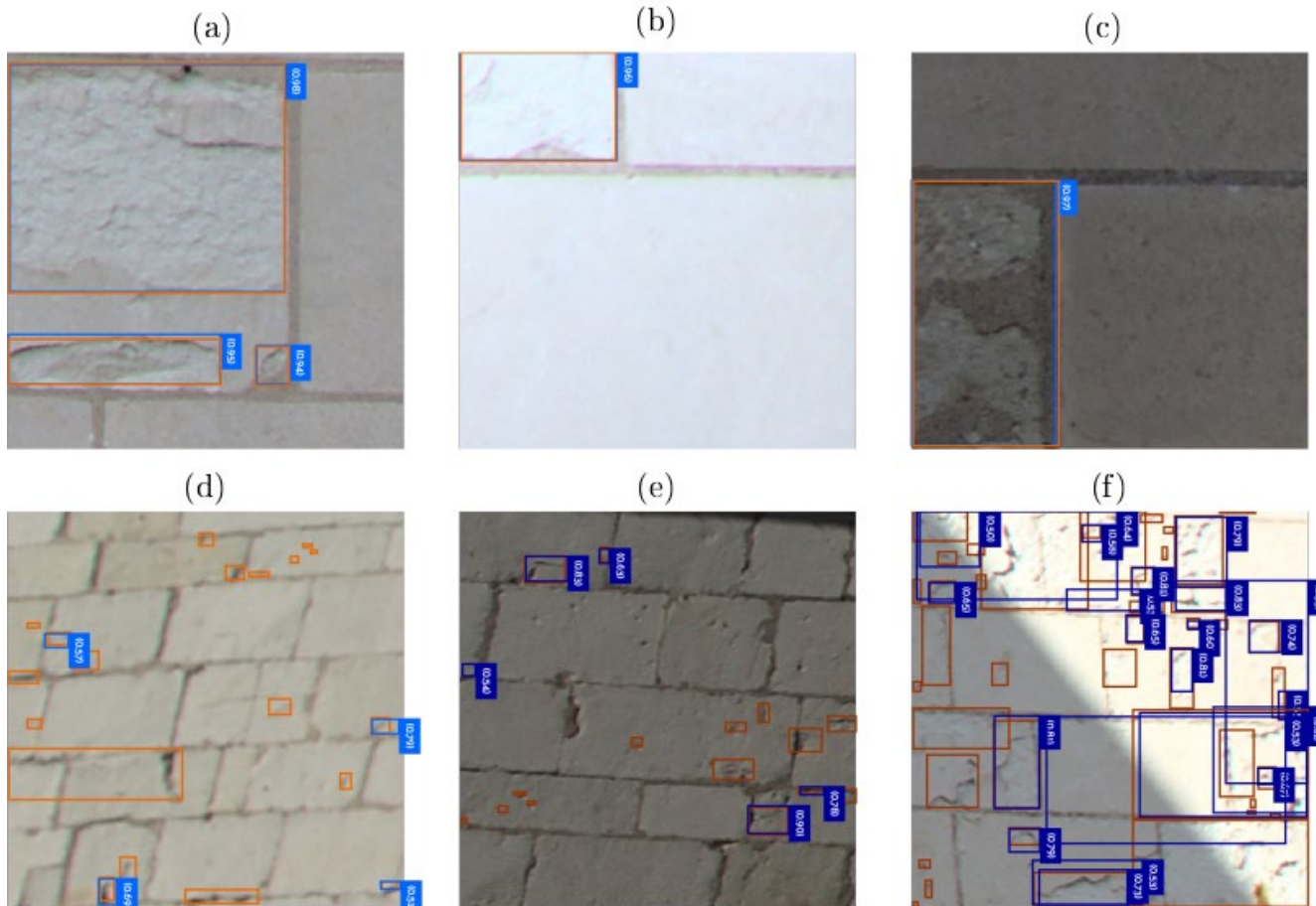


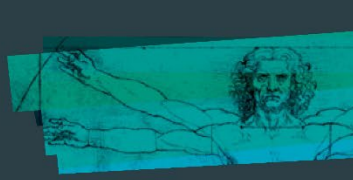
(b) DeepLabv3+ model segmentation

Fig. 6: DeepLabv3+ model segmentation on château de Chaumont-sur-Loire.

## Development of artificial intelligence (2)

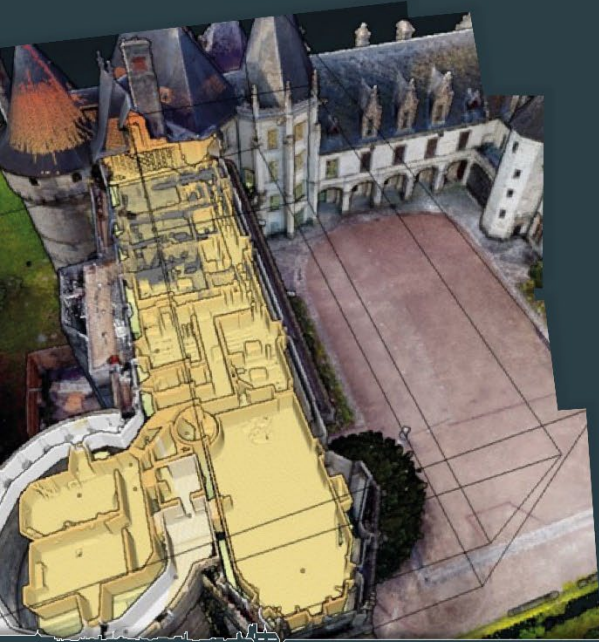
Automatic detection of spalling, trained on degradation mappings





20-21 June 2023

# International tutorials on Digital Tools for Built Heritage diagnosis and monitoring (DT4BH)



## LOCATION

Polytech Orléans  
8, rue Leonard de Vinci  
45100 Orléans

## CONVENORS

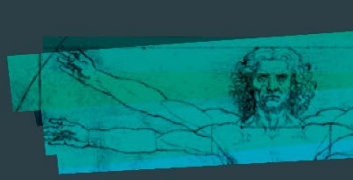
**Sylvie Treuillet**  
PRISME / University of Orléans - FR

**Xavier Brunetaud**  
LaMé / University of Orléans - FR

## PROGRAM - REGISTRATION

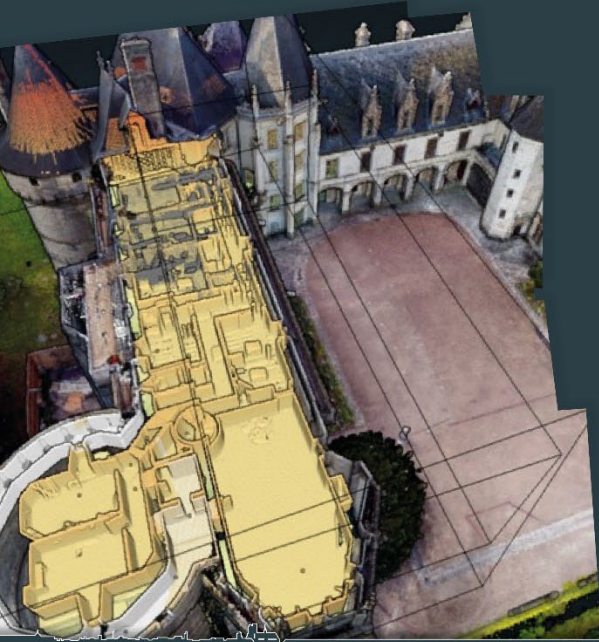
registration@lestudium-ias.fr  
www.lestudium-ias.fr

- Laser scanning acquisition
- Photos (terrestrial / drone) acquisition
- 3D survey from laser and/or photos
- GIS for mappings on orthophotos
- AI for degradation detection



20-21 June 2023

# International tutorials on Digital Tools for Built Heritage diagnosis and monitoring (DT4BH)



## LOCATION

Polytech Orléans  
8, rue Leonard de Vinci  
45100 Orléans

## CONVENORS

**Sylvie Treuillet**  
PRISME / University of Orléans - FR

**Xavier Brunetaud**  
LaMé / University of Orléans - FR

## PROGRAM - REGISTRATION

registration@lestudium-ias.fr  
www.lestudium-ias.fr

Still some places left (around 8)  
PhD and graduate students

Full cost cover for ATHENA partners

- Registration fees
- Travel costs
- Accommodation costs

Application:

CV and motivation emailed to:

[Sylvie.Treuillet@univ-orleans.fr](mailto:Sylvie.Treuillet@univ-orleans.fr)

[xavier.brunetaud@univ-orleans.fr](mailto:xavier.brunetaud@univ-orleans.fr)

# Thank you for your attention

