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## **MONUMENTUM: Digital 3D modeling and data management for the conservation of decorated stone buildings**

Livio De Luca, Jean-Marc Vallet, Philippe Bromblet, Marc Pierrot-Deseilligny, Xavier Brunetaud, Frédéric Dubois, Marine Bagnéris, Muzahim Al-Mukhtar, Fabien Cherblanc, Odile Guillon, et al.

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# MONUMENTUM: Digital 3D modeling and data management for the conservation of decorated stone buildings

L. De Luca<sup>1</sup>, J.-M. Vallet<sup>2</sup>, P. Bromblet<sup>2</sup>, M. Pierrot-Deseilligny<sup>3</sup>, X. Brunetaud<sup>4</sup>, F. Dubois<sup>5</sup>, M. Bagnéris<sup>1</sup>, M. Al Mukhtar<sup>4</sup>, F. Cherblanc<sup>5</sup>, O. Guillon<sup>2</sup>, J. Tugas<sup>6</sup>

## ➤ MONUMENTUM on-going research project (2013-2017)

The investigations that are made on a building for conservation purposes need an important work that is transcribed in a lot of kind of numerical and printed data: surveying data and scientific imagery, damage mapping, photographic collections, historical archives, physical and chemical data etc. Given the difficulty to collect, compare, analyze and validate data prior to restoration, the presented approach aims to mobilize various disciplines (architecture, conservation, mechanics, and computer sciences) to define a novel information processing chain including metric surveys, analysis of surfaces, geometric models of structures, heterogeneous documentary sources management, temporal data, etc.

## ➤ Objective

- Designing and development of an open and extensible web platform for the capitalization and the management of knowledge needed for the understanding and analysis of degradation phenomena affecting historic buildings.
- It requires the definition of a common and continuous process that establish a technological and conceptual interconnection between the stages of 3D digitization, semantic annotation and structuring of the geometric model (including multi-layers analysis of surfaces), characterization of the state of the building and management of restoration actions.
- it concerns the image-based-modeling of architectural heritage, the development of a 3D information system for the management of conservation data and also a numerical modeling tool (FEM-DEM) for the physical and structural analysis.

## ➤ Sites

3 French cases studies that present conservation issues on:

- stones, Castle of Chambord and Caromb's church,

- wall paintings, Notre-Dame des Fontaines' chapel

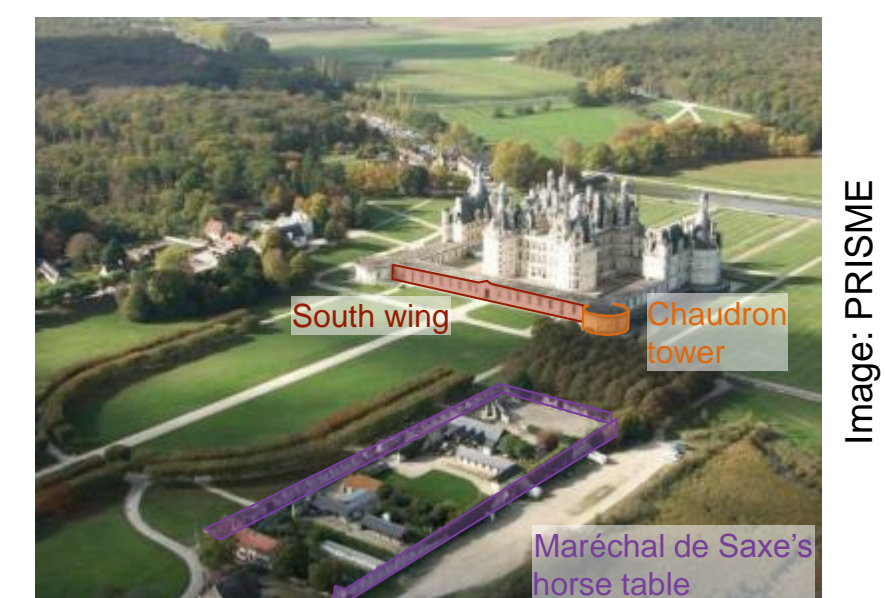


Image: PRISME



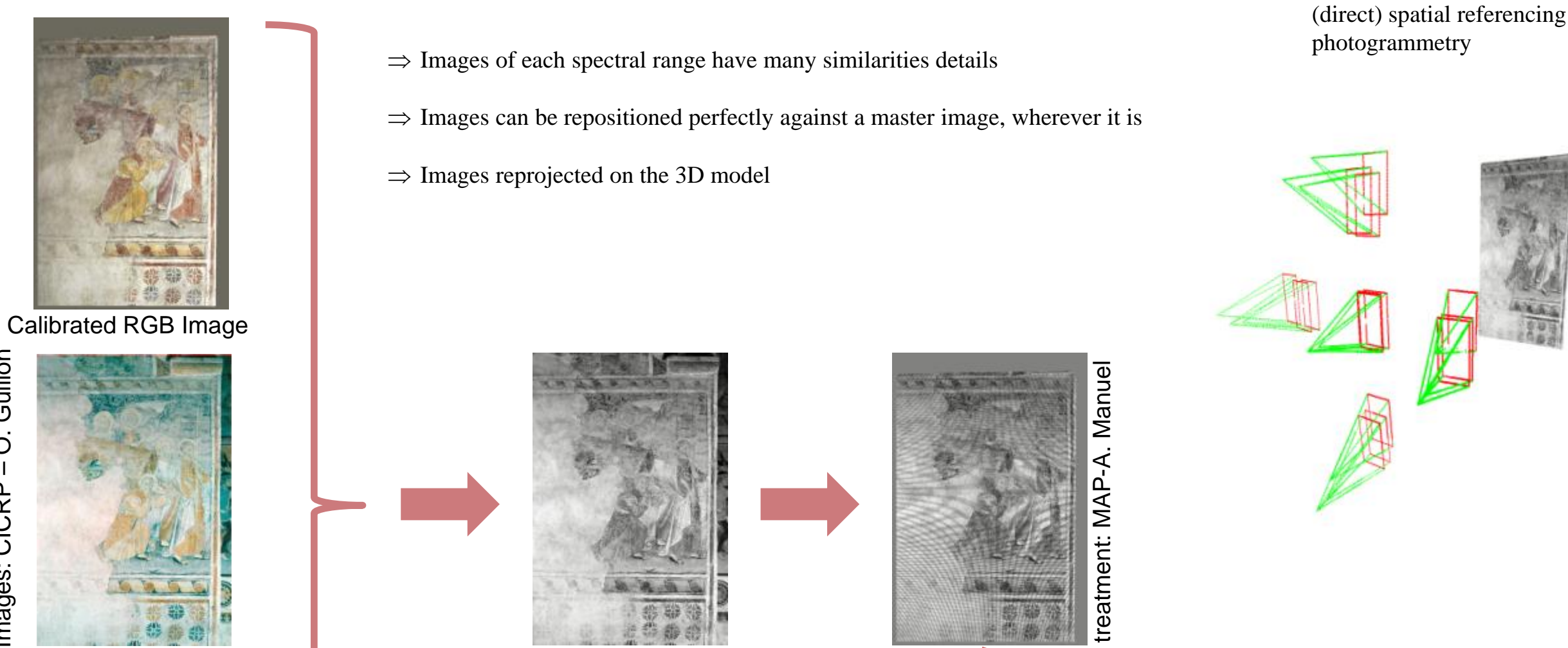
Images et scans: MAP - E. Gattet & T. Messaoudi

## Fusion of multi-band imaging

- ⇒ Images of each spectral range have many similarities details
- ⇒ Images can be repositioned perfectly against a master image, wherever it is
- ⇒ Images reprojected on the 3D model

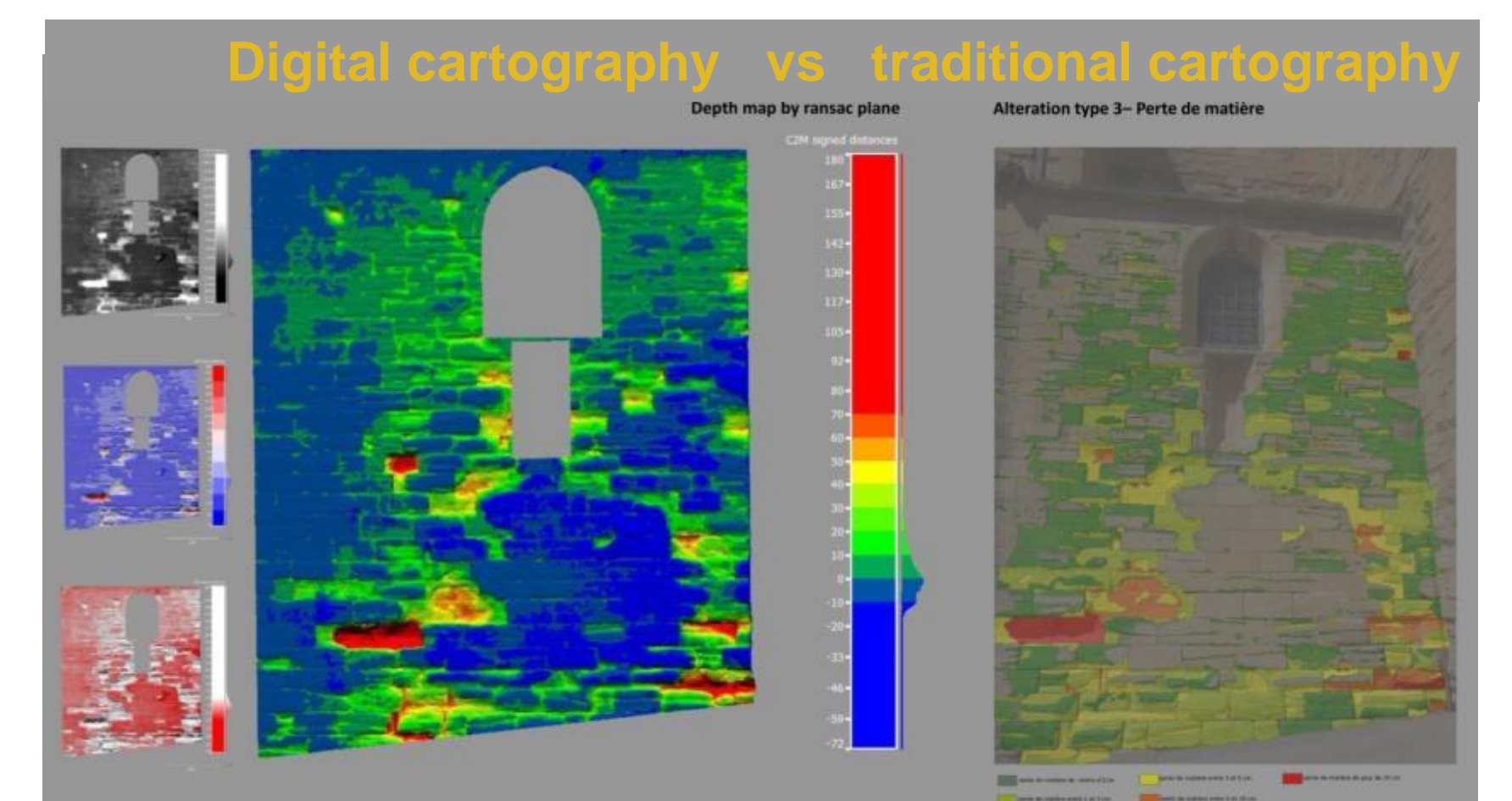
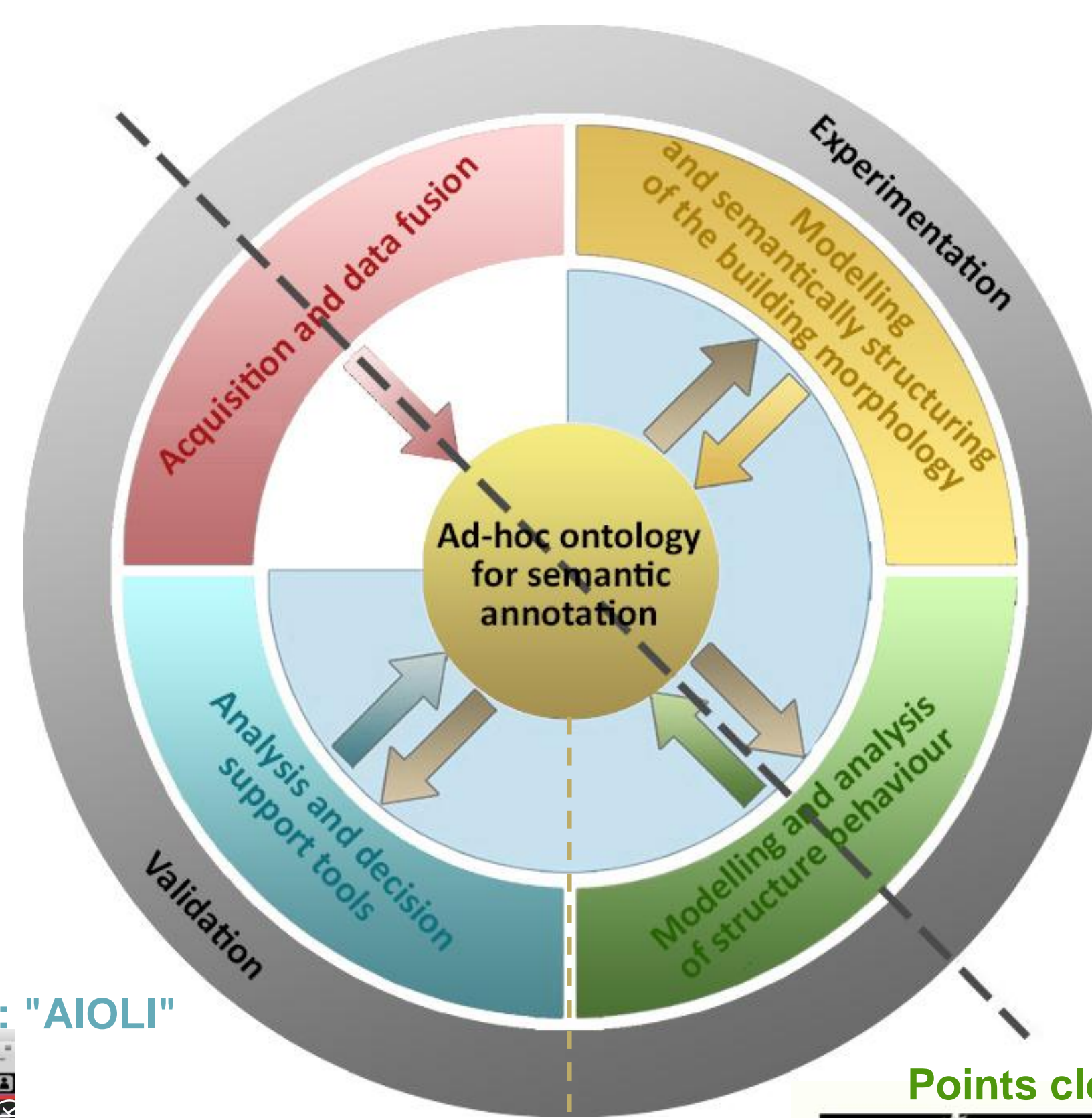
## AND/OR

(direct) spatial referencing using photogrammetry



Images et scan: MAP - E. Gattet & T. Messaoudi

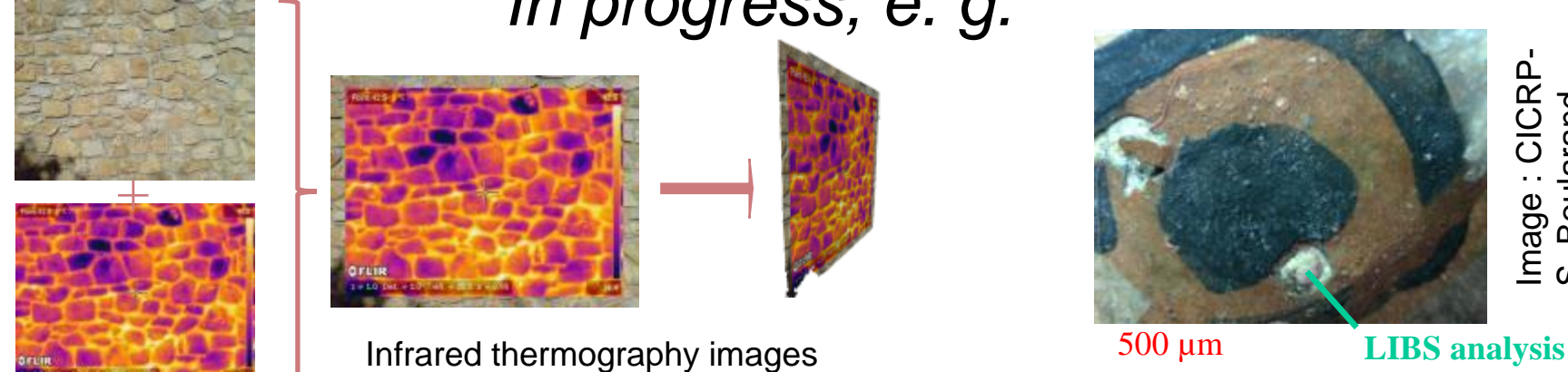
## Use of thesaurii as:



Modeling - MAP, univ. Polytech. Delle Marche R. Nespeca

Mapping - CICRP, A. Benard

## In progress, e. g.



Infrared thermography images

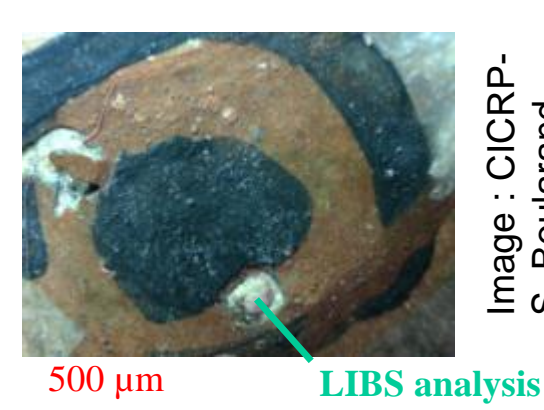
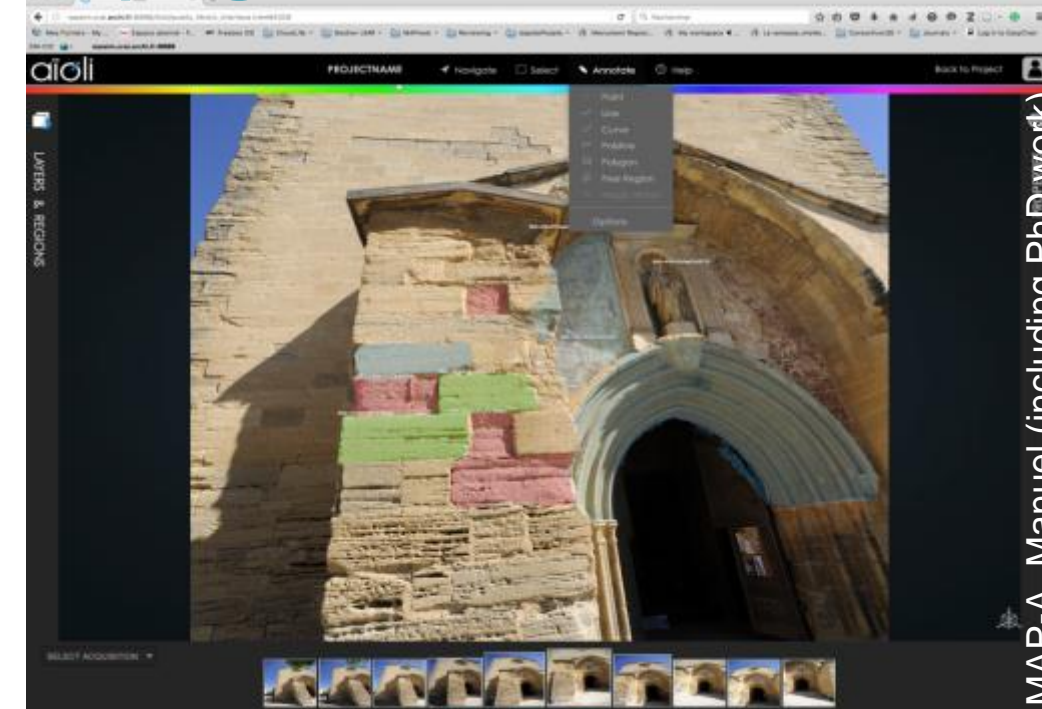


Image: CICRP - S. Boularand  
500 µm LIBS analysis

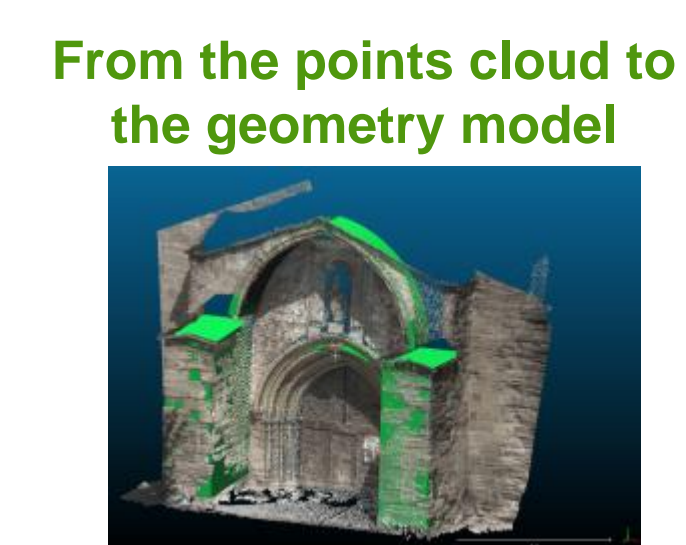
## On progress "Monumentum tool": "AIOLI"



MAP-A. Manuel (finalisation PhD work)

## ➤ Results

- **Scientific advances:** Identification of a continuum of spatial information structured around a domain ontology, new protocols to acquire spatialized data, to analyze them
- **Technical advances:** 3D scanning using images, data fusion, 3D information system for cultural heritage.
- **On-going computer platform:** Cloud service; some calculation moduli already inserted, web interfaces concerning the interaction 2D/3D, 2<sup>nd</sup> beta testing cycle in progress



From the points cloud to the geometry model

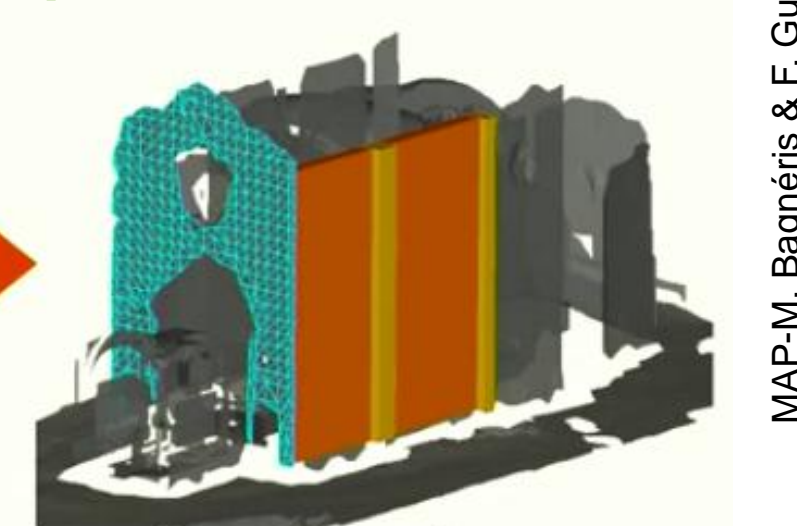


Points cloud



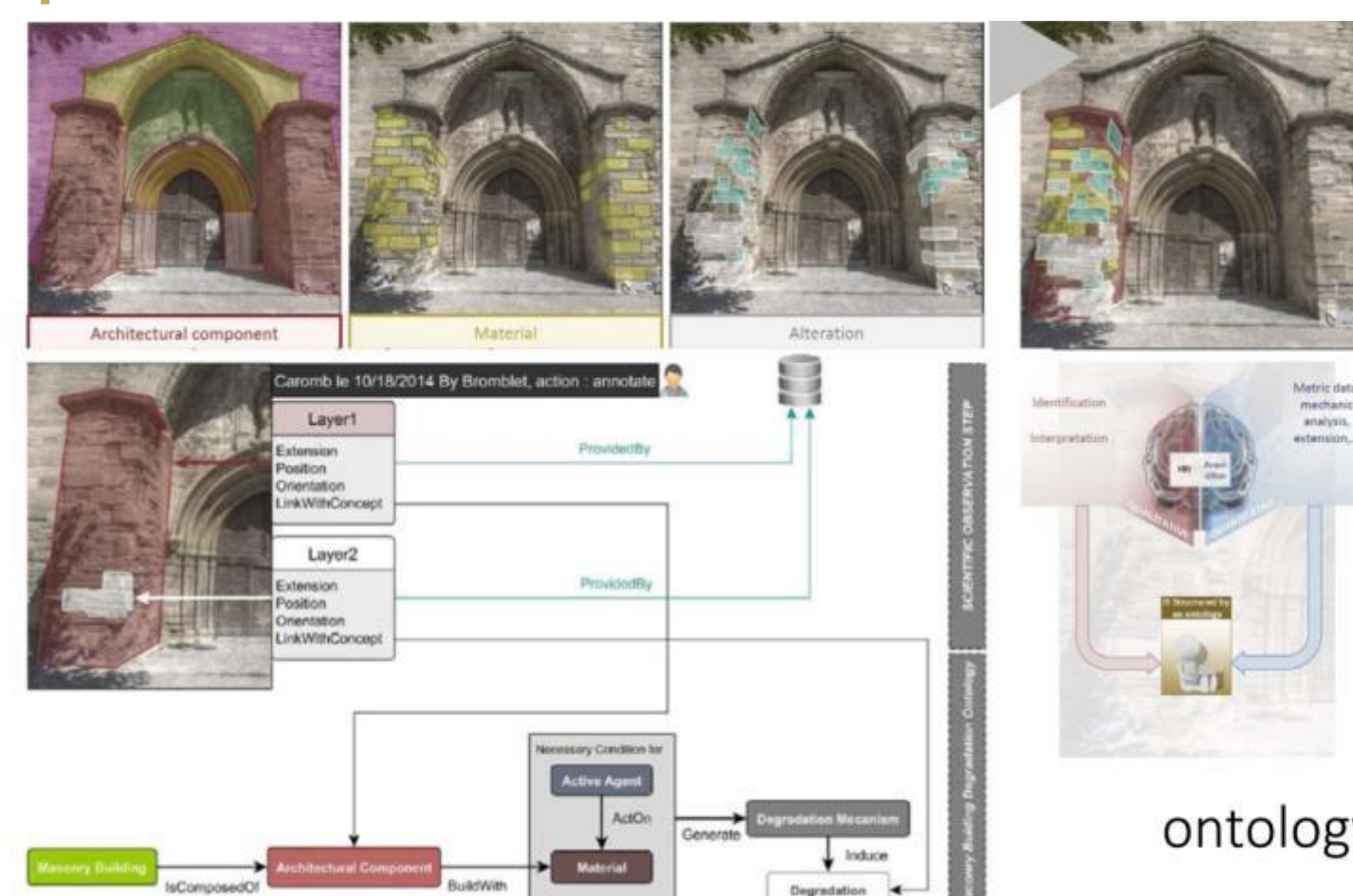
Segmentation

## Construction of parameterized volume



⇒ Parametric model in development

## Towards an ontology for annotating degradation phenomena



MAP-T. Messaoudi (PhD work)

ontology ▶ data + information

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## Contacts

**M. Bagnéris & L. De Luca**  
MAP, UMR 3495, Campus CNRS Joseph Aiguier, Bât. Z', 31 chemin Joseph Aiguier, 13402 Marseille cedex 20, France  
livio.deluca@map.archi.fr, marine.bagneris@map.archi.fr

**P. Bromblet, O. Guillon & J.-M. Vallet**  
CICRP, 21, rue Guibal, 13003 Marseille, France  
philippe.bromblet@cicrp.fr, odile.guillon@cicrp.fr, jean-marc.vallet@cicrp.fr

**M. Pierrot-Deseilligny**  
ENSG, 6 et 8 Avenue Blaise Pascal, Cité Descartes - Champs-sur-Marne 77455 Marne la Vallée Cedex 2, France  
marc.pierrot-deseilligny@ign.fr



**X. Brunetaud & M. Al Mukhtar**  
PRISME, Université d'Orléans, Château de la Source, Avenue du Parc Floral, BP 6749 45067 Orléans Cédex 2, France  
xavier.brunetaud@univ-orleans.fr, muzahim.al-mukhtar@univ-orleans.fr

**F. Dubois & F. Cherblanc**  
LMGC, UMR 5508, Université de Montpellier, CC048, 163 rue Auguste Broussonnet, 34090 Montpellier, France  
frederic.dubois@umontpellier.fr, fabien.cherblanc@umontpellier.fr

**J. Tugas**  
DRAC-PACA, 23, boulevard du Roi René, 13617 Aix-en-Provence Cedex 1, France  
julie.tugas@culture.gouv.fr