Reality-based 3D semantic annotation of heritage architecture
Introduction

Digital documentation of heritage artefacts

- new technologies for digitizing CH
- technical proficiency = data overload
- a mass of uninterpreted data !!!!
- using technology for knowledge purposes ?

- - - - - - -

- introducing cross-disciplinary methodologies

- 1) informative depth of digital representations
- 2) analysing architectural shapes: between geometry & semantics
- 3) morphology-driven information structuring
- 4) towards a digital continuum for gathering, analyzing and sharing semantic annotations
Informative depth of digital representations
Informative depth of digital representations

a general issue

?
Informative depth of digital representations

A critical review

scale

certainty

traceability

coherence

intelligibility

Unobservable

Less observable

Observable

Informative depth of digital representations

a critical review

3D digitization by laser scanning and automatic meshing

INFORMATIVE

scale

certainty

traceability

coherence

intelligibility

Unobservable

Less observable

Observable

First informative scale
Second informative scale
Third informative scale

Informative depth of digital representations

a critical review

Informative depth of digital representations

A critical review

Informative depth of digital representations

a critical review

Interactive Image-Based-Modeling

Analysing architectural shapes: between geometry & semantics
Intelligibility

Model
Semantics

Geometry
Instances

reality

representation

Multiplicity
Reasoning from semantics to geometry

Mouldings

- a. filet
- c. cavet
- f. ovolo
- i. astragale
- n. cyma recte
- b. fascia
- d. scotie
- g. échine
- l. ovolo renversé
- o. cyma renversée
- e. congé
- h. tore
- m. tete 3/4
- p. bec

Geometric atoms

- a1
- a2
- a3
- a4
- a5
- b1
- b2
- b3
- b4
- b5

Reasoning from semantics to geometry

1. Geometric atoms

2. Profiles

3. Surfaces

Reasoning from semantics to geometry

Library of classical elements

Reasoning from semantics to geometry

Doric capital by Andrea Palladio

Reasoning from semantics to geometry
Reasoning from semantics to geometry ??????
What do thirty-one columns say about a thirty-second? The role of similarity in the re-union, re-assembly and re-association of 3D artefacts

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morphology-driven information structuring
Giulio Camillo Delminio. *Memory Theatre.* around 1550
Interactive 3D scene

Descriptive attributes

Visual encoding of descriptive attributes

Attribute: conservation site
- Musée lapidaire de Saint-Guilhem-le-Désert
- The Cloisters, New York
- Société archéologique de Montpellier

1° experience, 2004 - linking information to 3D entities

Morphology-driven information structuring

Reality-based 3D semantic annotation of heritage architecture
Reality-based 3D semantic annotation of heritage architecture

2° experience, 2006 - linking information to a description model

morphology-driven information structuring
2° experience, 2006 - linking information to a description model

NUBES project [2005-2012]

3° experience, 2008 - managing temporal events

PhD Chiara Stefani [2006 - 2010]

**3° experience, 2008 - managing temporal events**

PhD Chiara Stefani [2006 - 2010]

projection-based Image segmentation according to the morphology description
4° experience, 2009 - propagating information from 3D to 2D

Locus Imaginis Project [2009 - 2010]

4° experience, 2009 - propagating information from 3D to 2D

Locus Imaginis Project [2009 - 2010]

5° experience, 2011 - linking 3D representation to conceptual descriptions
ANR Sinetomb Project [2008 - 2012]


morphology-driven information structuring

6° experience, 2012 - embedding annotations into layered textures
SACRE Project [2010 - 2012]

towards a digital continuum for gathering, analyzing and sharing semantic annotations
Filippo Brunelleschi. *Perspectiva artificialis*, around 1415
automotive image processing for generating 2D/3D images

TAPENADE Project [2011-2013]

• image acquisition protocols

• tie point extraction from non oriented images

• camera calibration and orientation

• Multi-view correlation for dense point cloud generation

Corrélation multi-stéréo

towards a digital continuum for gathering, analyzing and sharing semantic annotations

automatic image processing for generating 2D/3D images
towards a digital continuum for gathering, analyzing and sharing semantic annotations

Automatic image processing for generating 2D/3D images
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Automatic image processing for generating 2D/3D images
Projection-based 2D/3D semantic propagation
PhD Adeline Manuel, [2012 - 2015]

towards a digital continuum for gathering, analyzing and sharing semantic annotations

Liste de (i,j) :
i_{an1}j_{an1}
...
i_{ank}j_{ank}

Liste de (X,Y,Z) :
X_{an1} Y_{an1} Z_{an1}
...
X_{ank} Y_{ank} Z_{ank}

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Reality-based 3D semantic annotation of heritage architecture
Projection-based 2D/3D semantic propagation
PhD Adeline Manuel, [2012 - 2015]

Manuel A., Stefani C., De Luca L., Véron P. A hybrid approach for the semantic annotation of spatially oriented images.
ontology-driven 2D/3D annotation for multi-layers analysis
PhD Tommy Messaoudi, [2013 - 2016]

A hybrid approach for the semantic annotation of spatially oriented images.
Ontology-driven 2D/3D annotation for multi-layers analysis

PhD Tommy Messaoudi

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**Ontology-driven 2D/3D annotation for multi-layers analysis**

PhD Tommy Messaoudi, [2013 - 2016]

Messaoudy T., Véron P., De Luca L. *A domain ontology model for the reality-based 3D annotation of heritage building conservation state.*
towards a digital continuum for gathering, analyzing and sharing semantic annotations

**Ontology-driven 2D/3D annotation for multi-layers analysis**

PhD Tommy Messaoudi, [2013 - 2016]


**Reality-based 3D semantic annotation of heritage architecture**
Ontology-driven 2D/3D annotation for multi-layers analysis

PhD Tommy Messaoudi, [2013 - 2016]

aioli

Image-based 3D annotation cloud service for cultural heritage documentation

...... 2017
What do thirty-one columns say about a thirty-second?
The role of similarity in the re-unification, re-assembly and re-association of 3D artefacts 
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reasoning from geometry to semantics?
Intelligibility

Model
Semantics

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reality
representation

Multiplicity

Geometry
Semantics
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Reasoning from geometry to semantics?

Identifying relevant descriptors by morphological cross-analysis

General approach

Reasoning from geometry to semantics?

Identifying relevant descriptors by morphological cross-analysis

Extracting relevant descriptors: shape transitions

Reasoning from geometry to semantics?

**Identifying relevant descriptors by morphological cross-analysis**

Extracting relevant descriptors: shape transitions

Reasoning from geometry to semantics?

**Identifying relevant descriptors by morphological cross-analysis**

Analyzing the collection

Reasoning from geometry to semantics?

Identifying relevant descriptors by morphological cross-analysis

Analyzing the collection

Reasoning from geometry to semantics?

**Identifying relevant descriptors by morphological cross-analysis**

Analyzing the collection

Reasoning from geometry to semantics?

Identifying relevant descriptors by morphological cross-analysis

Extracting relevant descriptors: shape transitions

Reasoning from geometry to semantics?

Identifying relevant descriptors by morphological cross-analysis

Reprojecting the extracted descriptors into simplified and intelligible 3D representation
Identifying relevant descriptors by morphological cross-analysis

Reprojecting the extracted descriptors into simplified and intelligible 3D representation

Reasoning from geometry to semantics?

Reasoning from geometry to semantics?

Identifying relevant descriptors by morphological cross-analysis
comparative analysis: looking for similarities and exceptions

Reasoning from geometry to semantics?

Identifying relevant descriptors by morphological cross-analysis

Comparative analysis: looking for similarities and exceptions

Reasoning from geometry to semantics?

**Identifying relevant descriptors by morphological cross-analysis**

comparative analysis: looking for similarities and exceptions

Reasoning from geometry to semantics?

Embedding shape descriptors into signals

Reasoning from geometry to semantics?

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Embedding shape descriptors into signals

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The role of similarity in the re-unification, re-assembly and re-association of 3D artefacts

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