

3D Modeling and Semantic Enrichment in Cultural Heritage

Livio De Luca



Centre National de la Recherche Scientifique
Ministère de la Culture et de la Communication
**Modèles et simulations pour
l'Architecture et le Patrimoine**

Introduction | 3D-Monuments project

Digitization Plan of the French Ministry of Culture



Château Comtal, Carcassonne



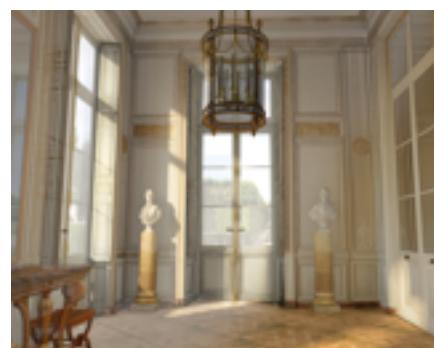
Cloître de l'abbaye de Gellone
Saint-Guilhem-le-Désert



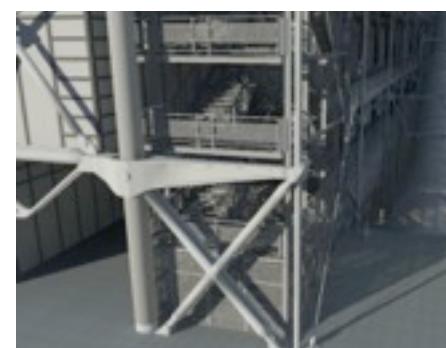
Trophée des Alpes, La Turbie



Chartreuse de
Villeneuve-lez-Avignon



Petit Trianon, Versailles



Centre Pompidou, Paris



3D Modeling and Semantic Enrichment in Cultural Heritage
54th Photogrammetric Week _ 9-13 September, 2013 Stuttgart

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Triangulation scanners



TOF scanners



Digital cameras



UAV



Human brains

Introduction | 3D-Monuments project

Digitization Plan of the French Ministry of Culture



Château

Chartres
Villeneuve

Human brains



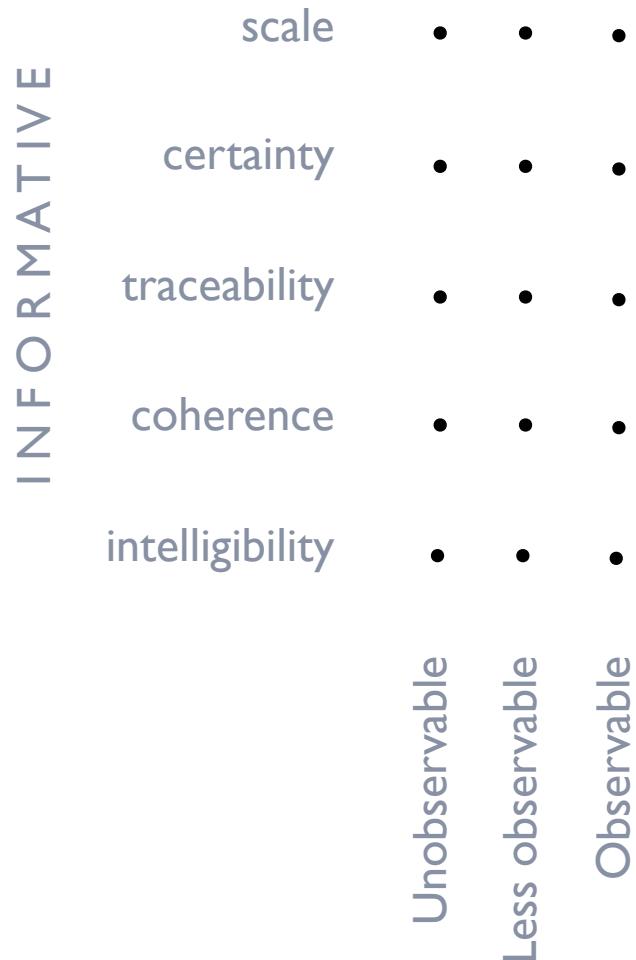
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54th Photogrammetric Week _ 9-13 September, 2013 Stuttgart



Informative depth of 3D architectural representations

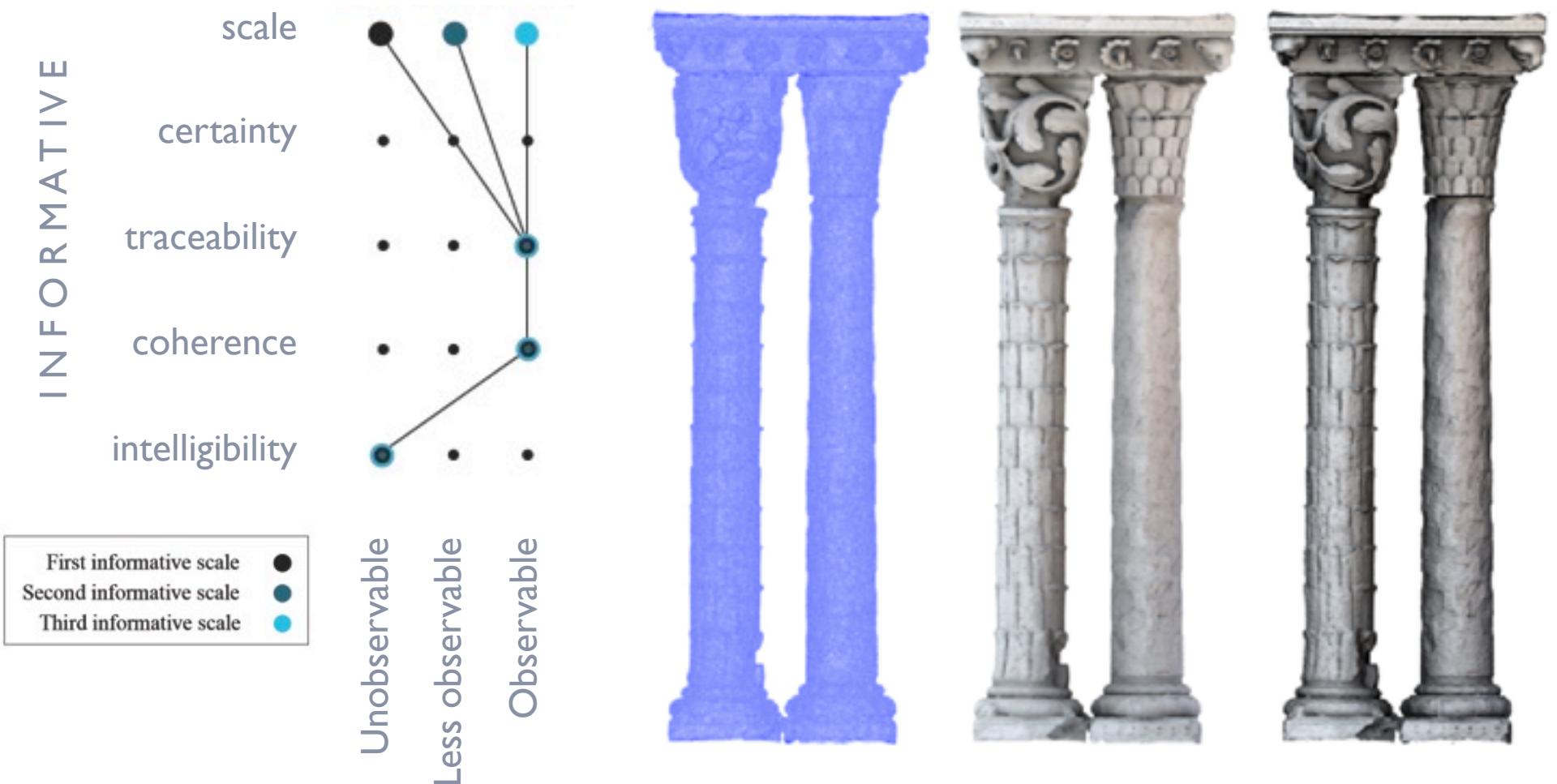
Informative depth of 3D architectural representations



Lo Buglio D., De Luca L. **Critical review of 3D digitization methods and techniques applied to the field of architectural heritage: methodological and cognitive issues.**
Proceedings of VAST 2011 - International Symposium on Virtual Reality, Archaeology and Cultural Heritage. Prato, Tuscany, Italy, October 18th-21st 2011.

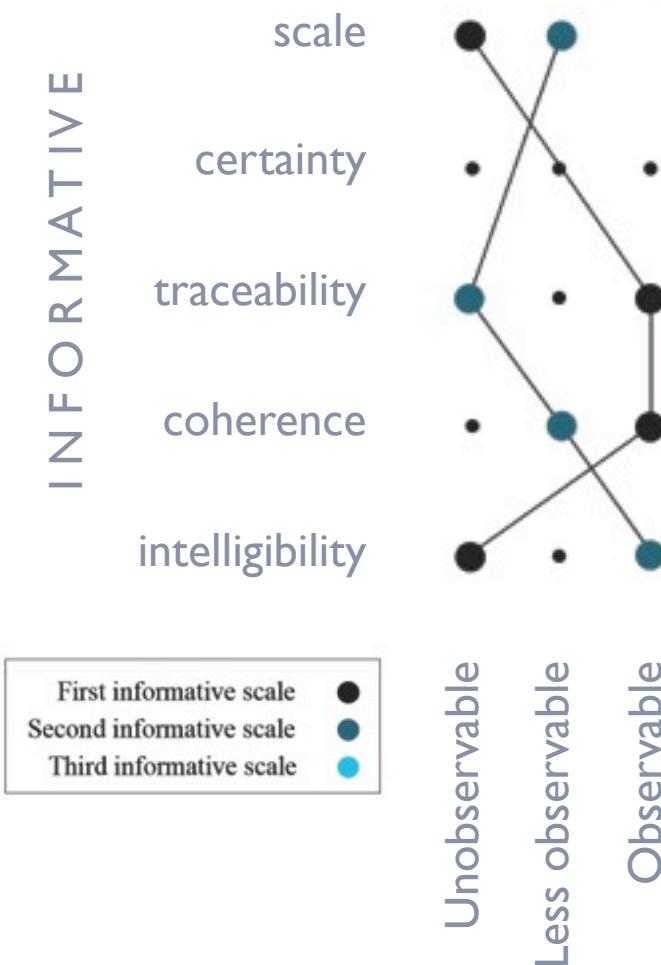
Informative depth of 3D architectural representations

3D digitization by laser scanning and automatic meshing

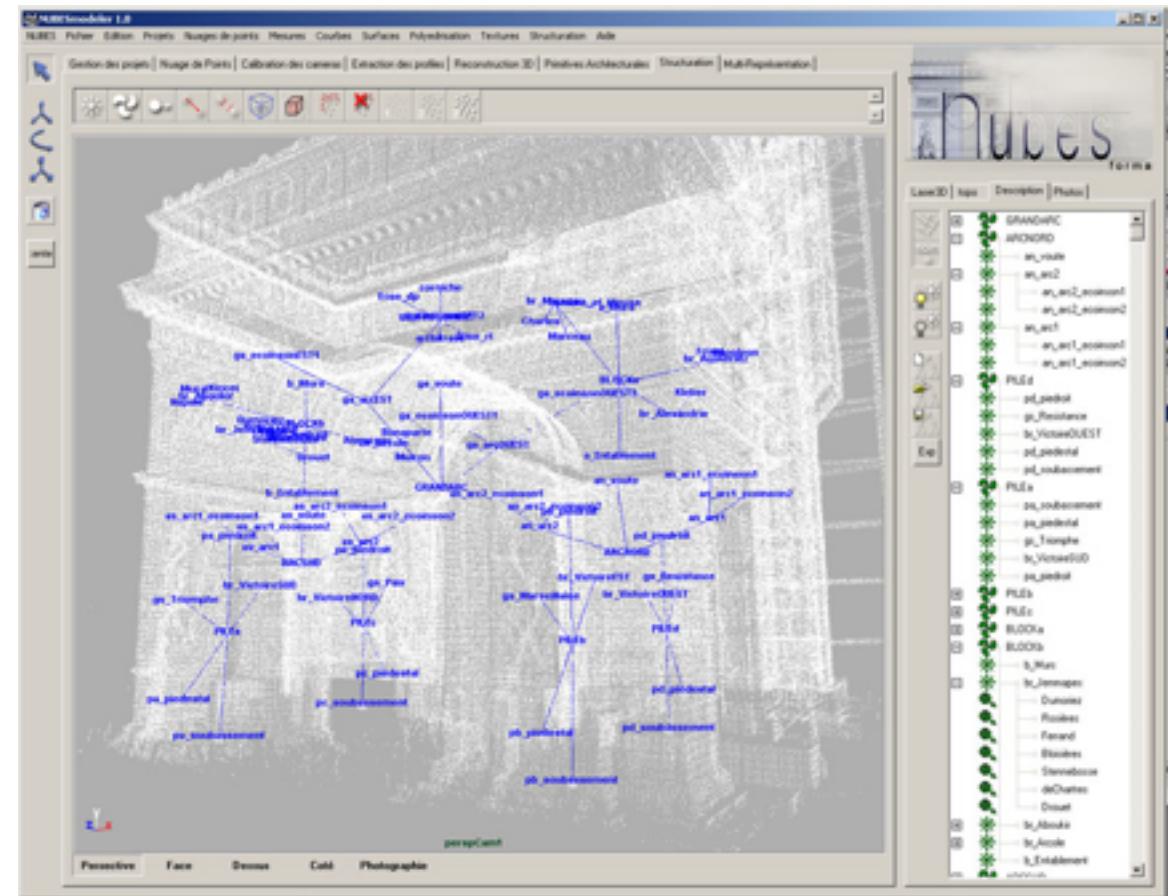


Lo Buglio D., De Luca L. **Critical review of 3D digitization methods and techniques applied to the field of architectural heritage: methodological and cognitive issues.**
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Informative depth of 3D architectural representations

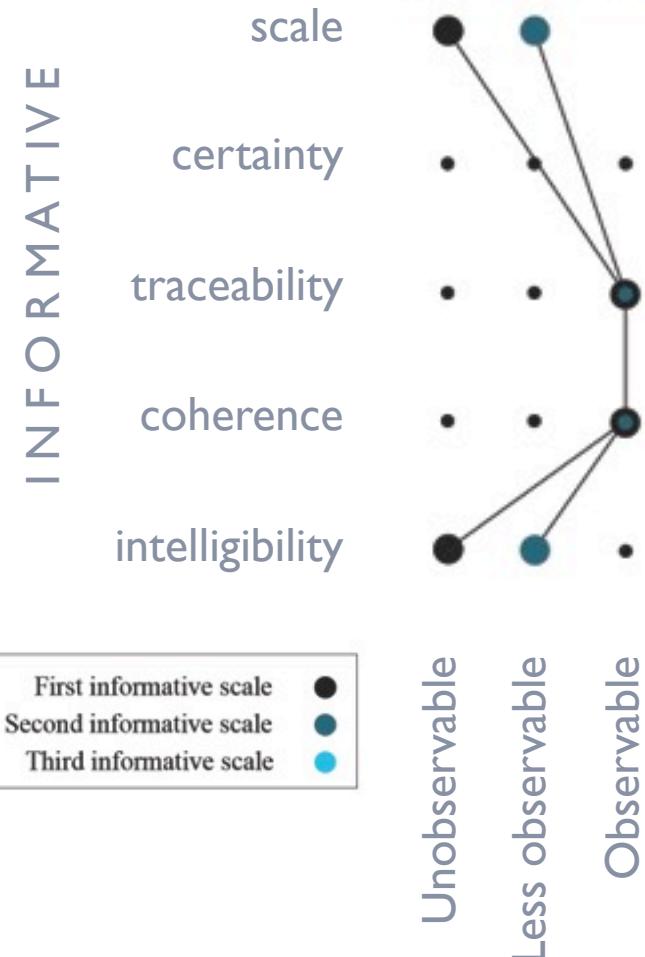


3D digitization and semantic annotation

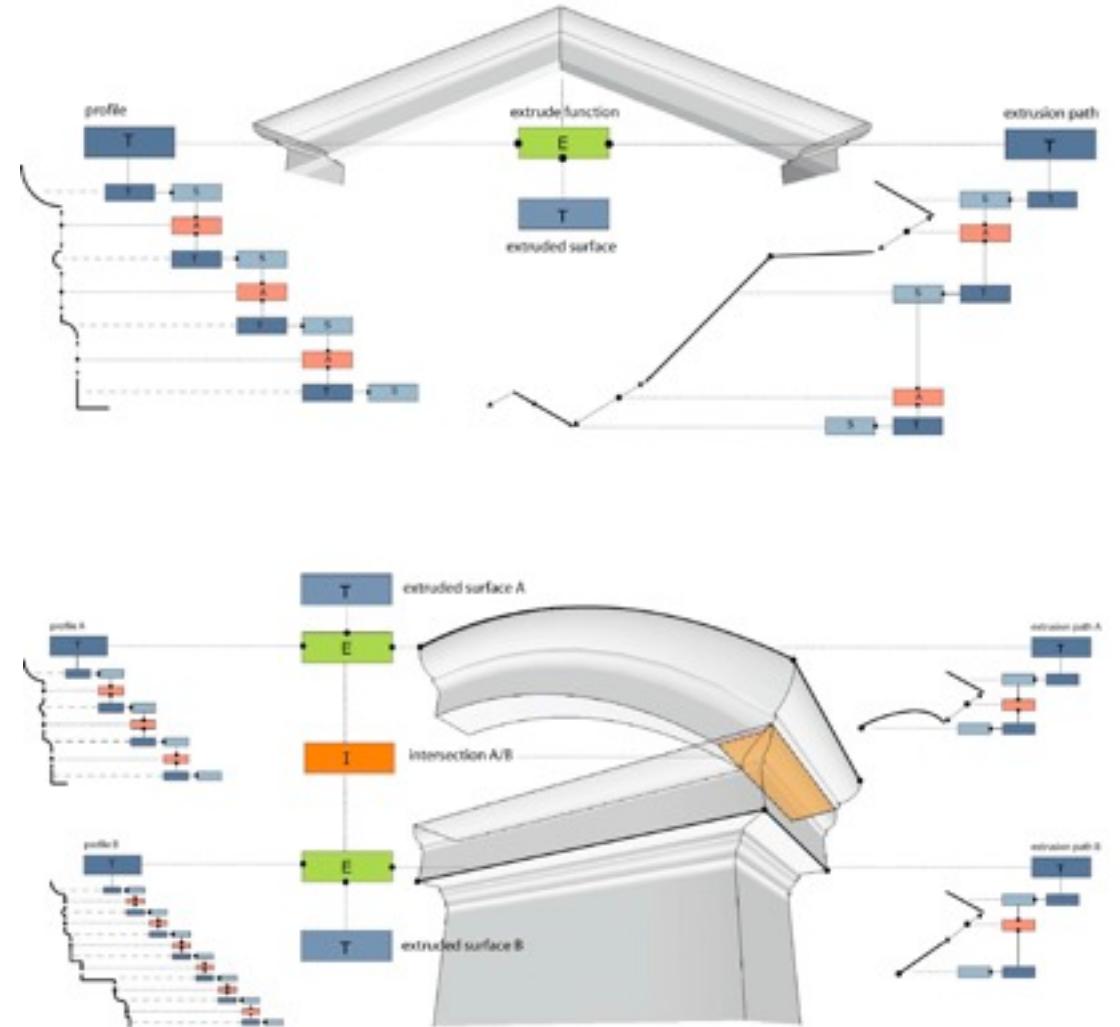


Lo Buglio D., De Luca L. **Critical review of 3D digitization methods and techniques applied to the field of architectural heritage: methodological and cognitive issues.**
Proceedings of VAST 2011 - International Symposium on Virtual Reality, Archaeology and Cultural Heritage. Prato, Tuscany, Italy, October 18th-21st 2011.

Informative depth of 3D architectural representations



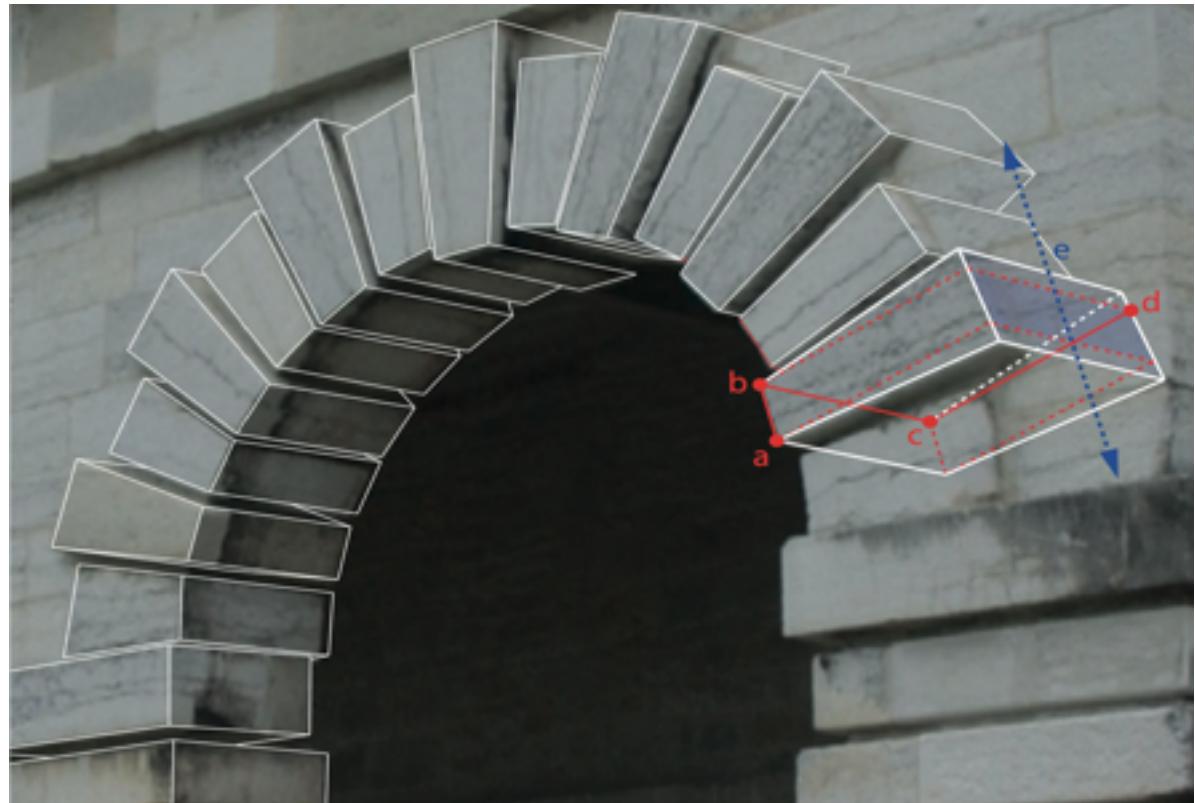
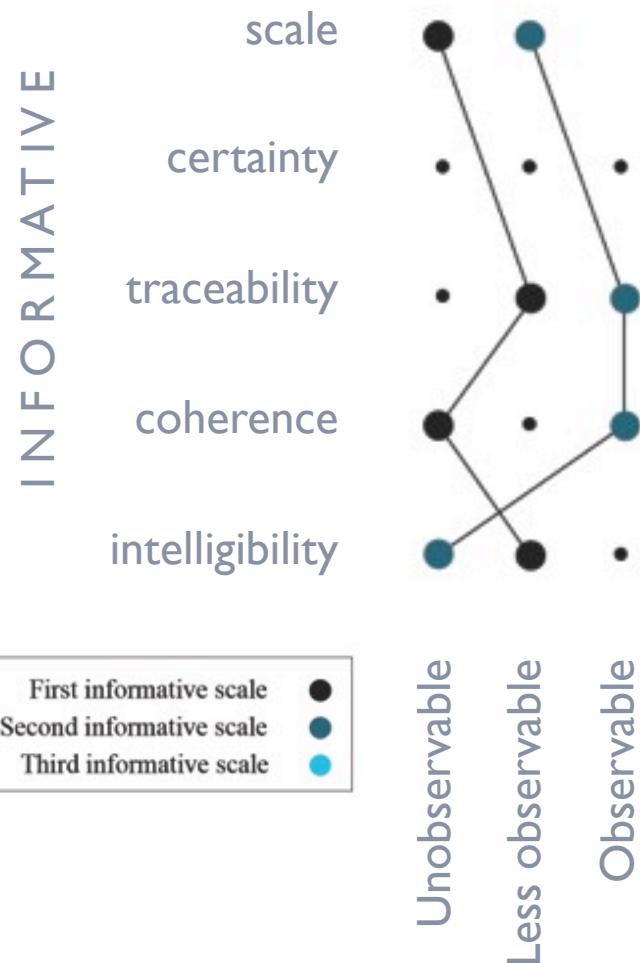
Parametric modeling



Lo Buglio D., De Luca L. **Critical review of 3D digitization methods and techniques applied to the field of architectural heritage: methodological and cognitive issues.** Proceedings of VAST 2011 - International Symposium on Virtual Reality, Archaeology and Cultural Heritage. Prato, Tuscany, Italy, October 18th-21st 2011.

Informative depth of 3D architectural representations

Interactive Image-Based-Modeling

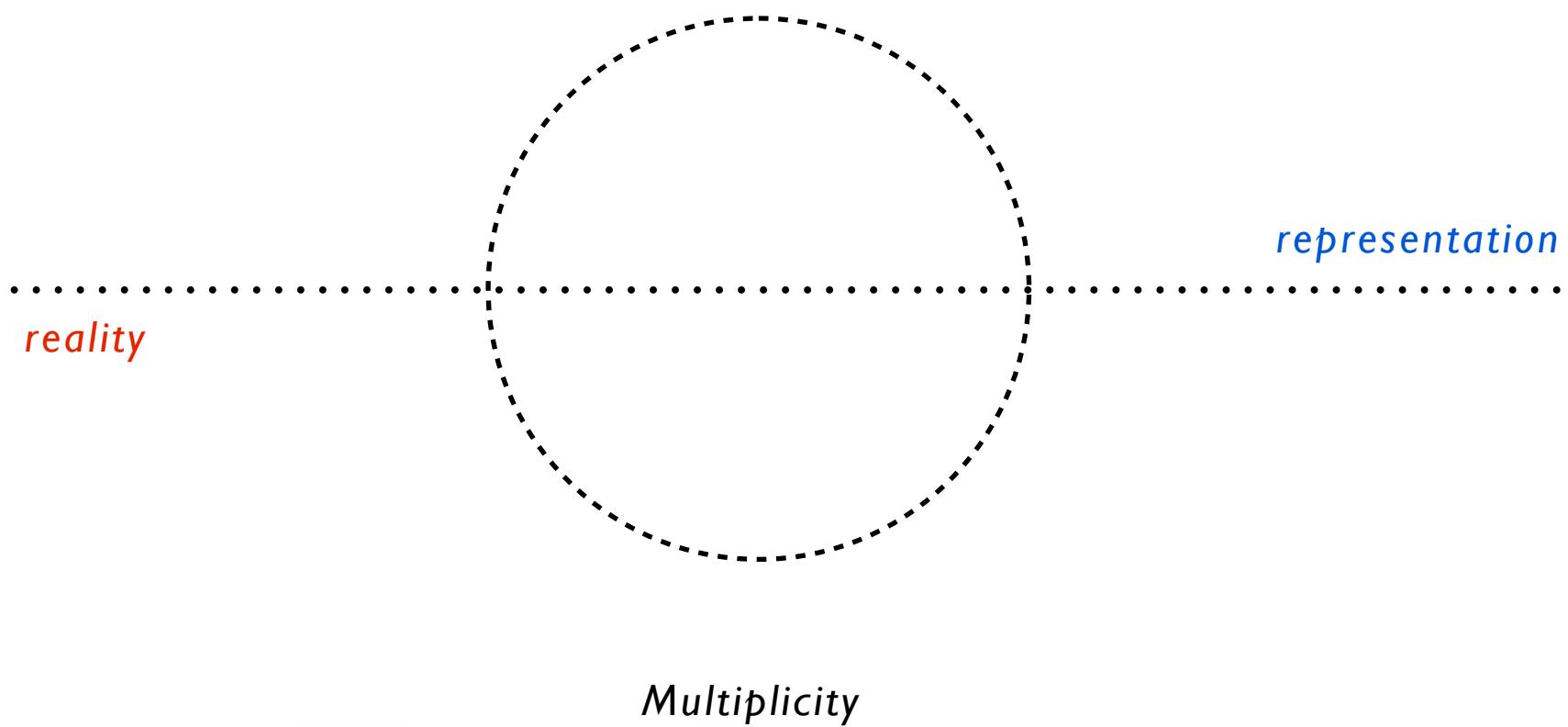


Lo Buglio D., De Luca L. **Critical review of 3D digitization methods and techniques applied to the field of architectural heritage: methodological and cognitive issues.**
Proceedings of VAST 2011 - International Symposium on Virtual Reality, Archaeology and Cultural Heritage. Prato, Tuscany, Italy, October 18th-21st 2011.

Geometry Vs Semantics



Intelligibility

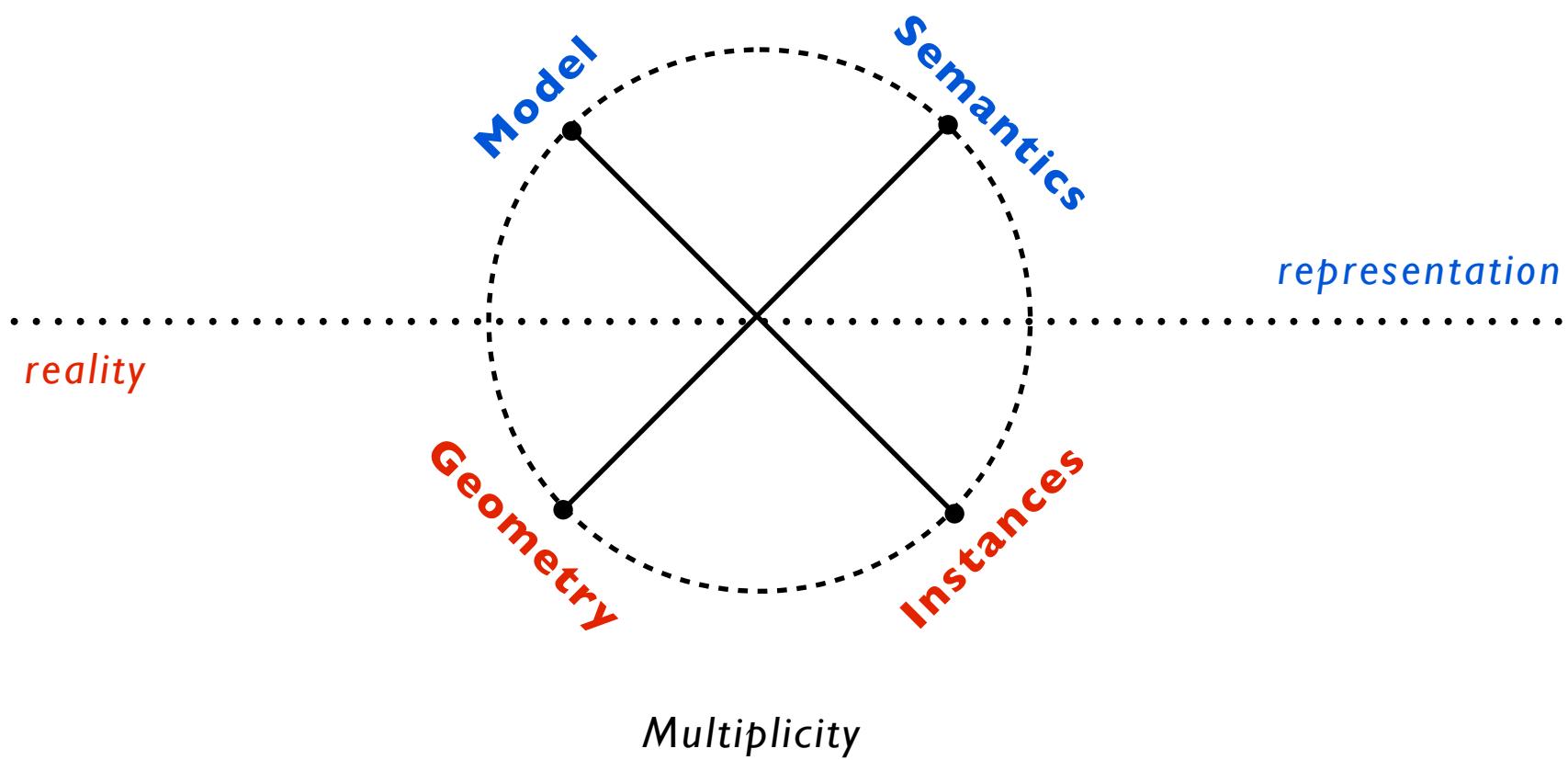


Multiplicity

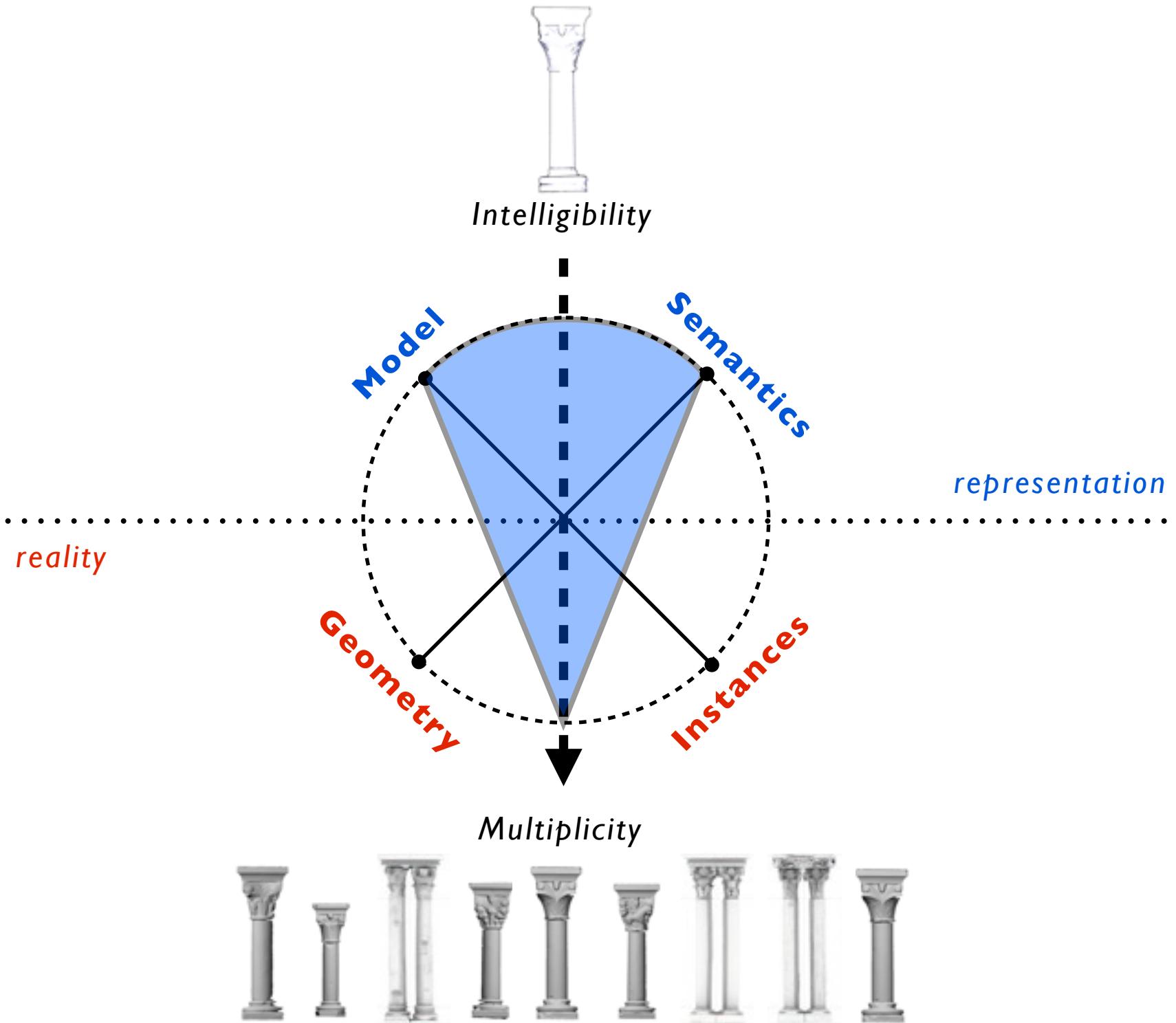




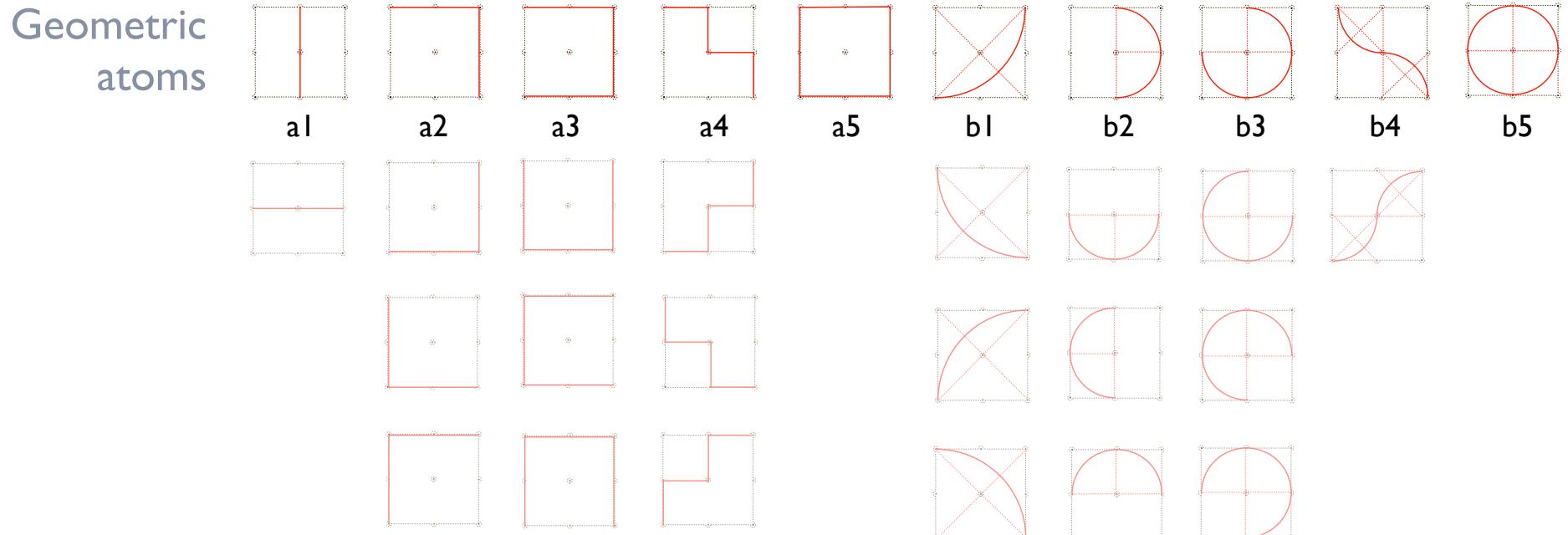
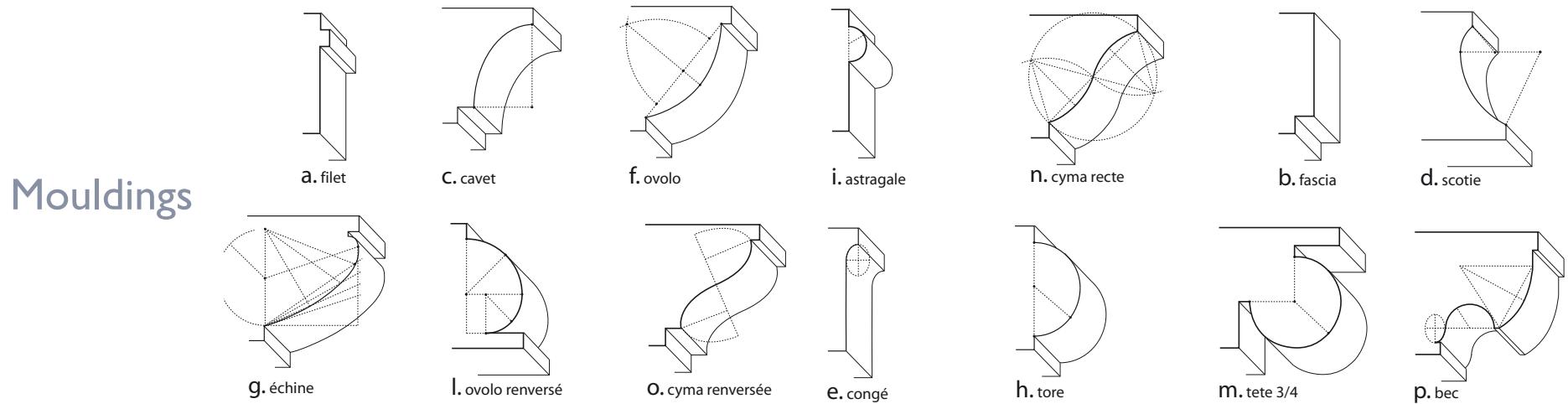
Intelligibility



Multiplicity

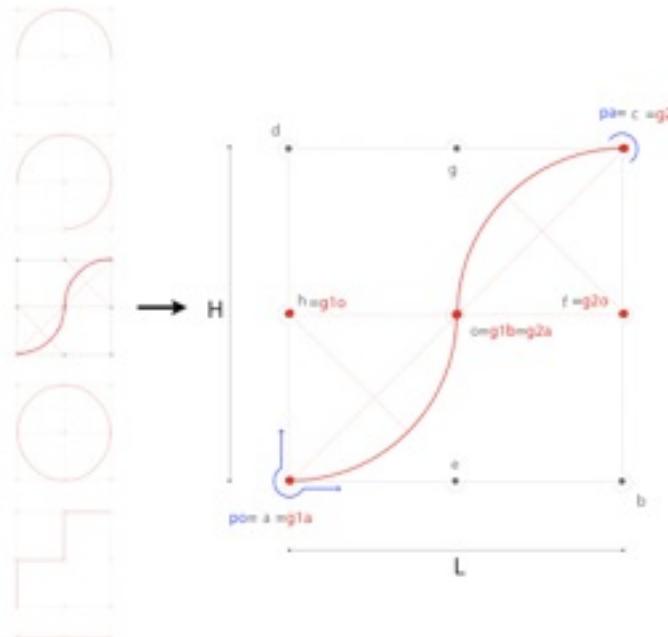


Reasoning from semantics to geometry

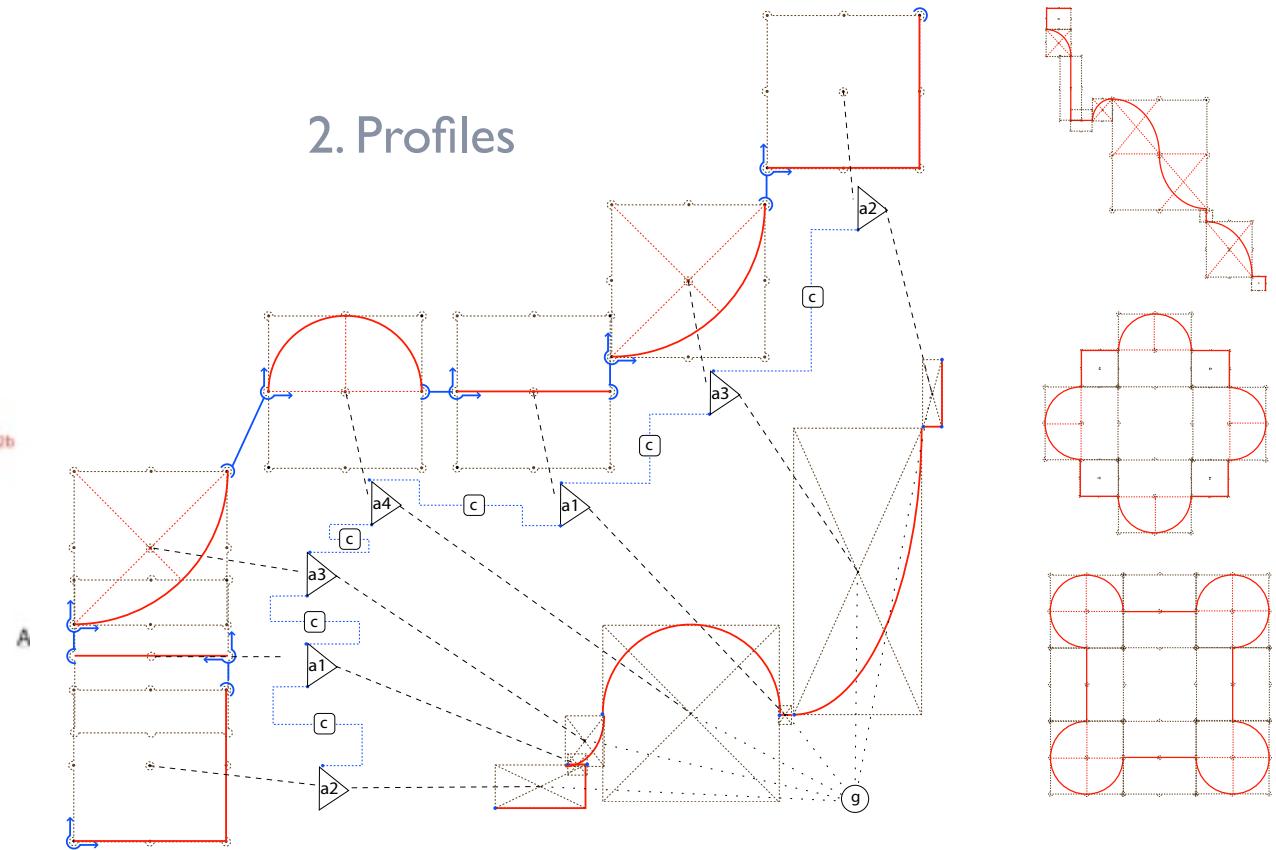


Reasoning from semantics to geometry

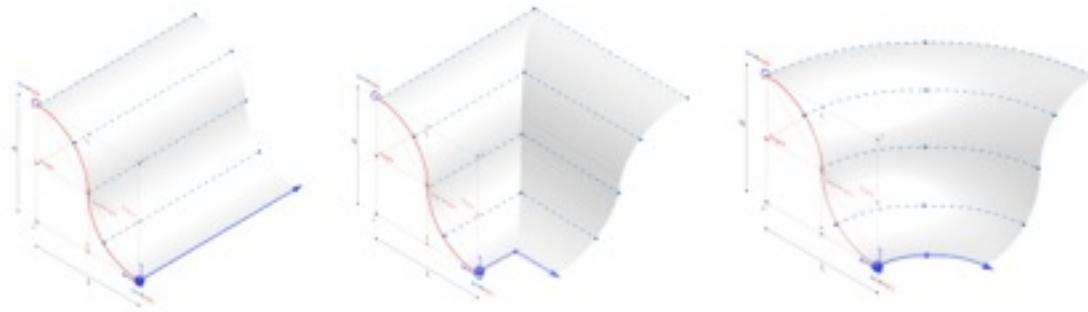
I. Geometric atoms



2. Profiles



3. Surfaces



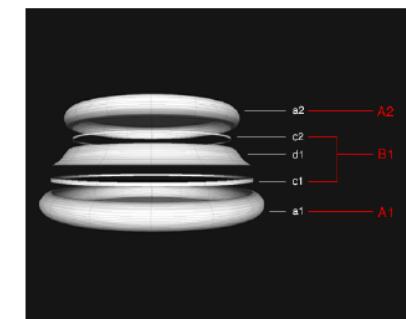
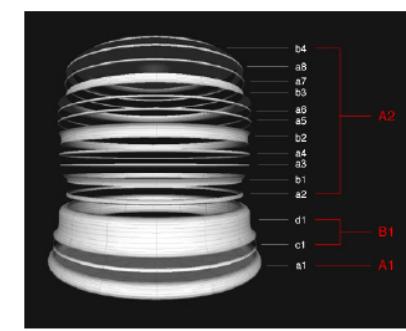
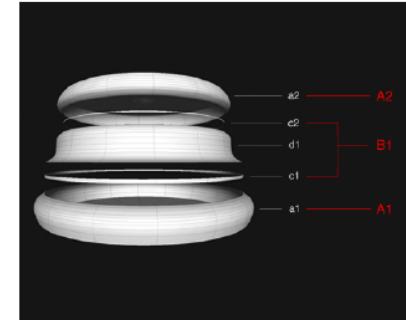
De Luca L., Véron P., Florenzano M. A generic formalism for the semantic modeling and representation of architectural elements.
The Visual Computer . Volume 23, Number 3. Pages 181-205. Springer Berlin / Heidelberg. March 2007

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Reasoning from semantics to geometry

Library of classical elements



De Luca L., Véron P., Florenzano M. **A generic formalism for the semantic modeling and representation of architectural elements.**

The Visual Computer . Volume 23, Number 3. Pages 181-205. Springer Berlin / Heidelberg. March 2007

Base à doucine
Corinthe, Great -Bath

A1. Tore inférieur

B1. Doucine renversée sur Listel

A2. Tore supérieur

Base à doucine
Delphes, Portique des Athéniens

A1. Tore inférieur

B1. Doucine renversée

A2. Tore supérieur à cannelures horizontales

Base à doucine
Corinthe, Remple de Tyché

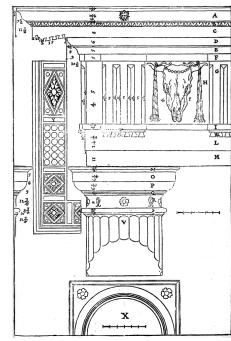
A1. Tore inférieur

B1. Doucine (à feuilles imbriquées verticales)

A2. Tore supérieur

Livio De Luca

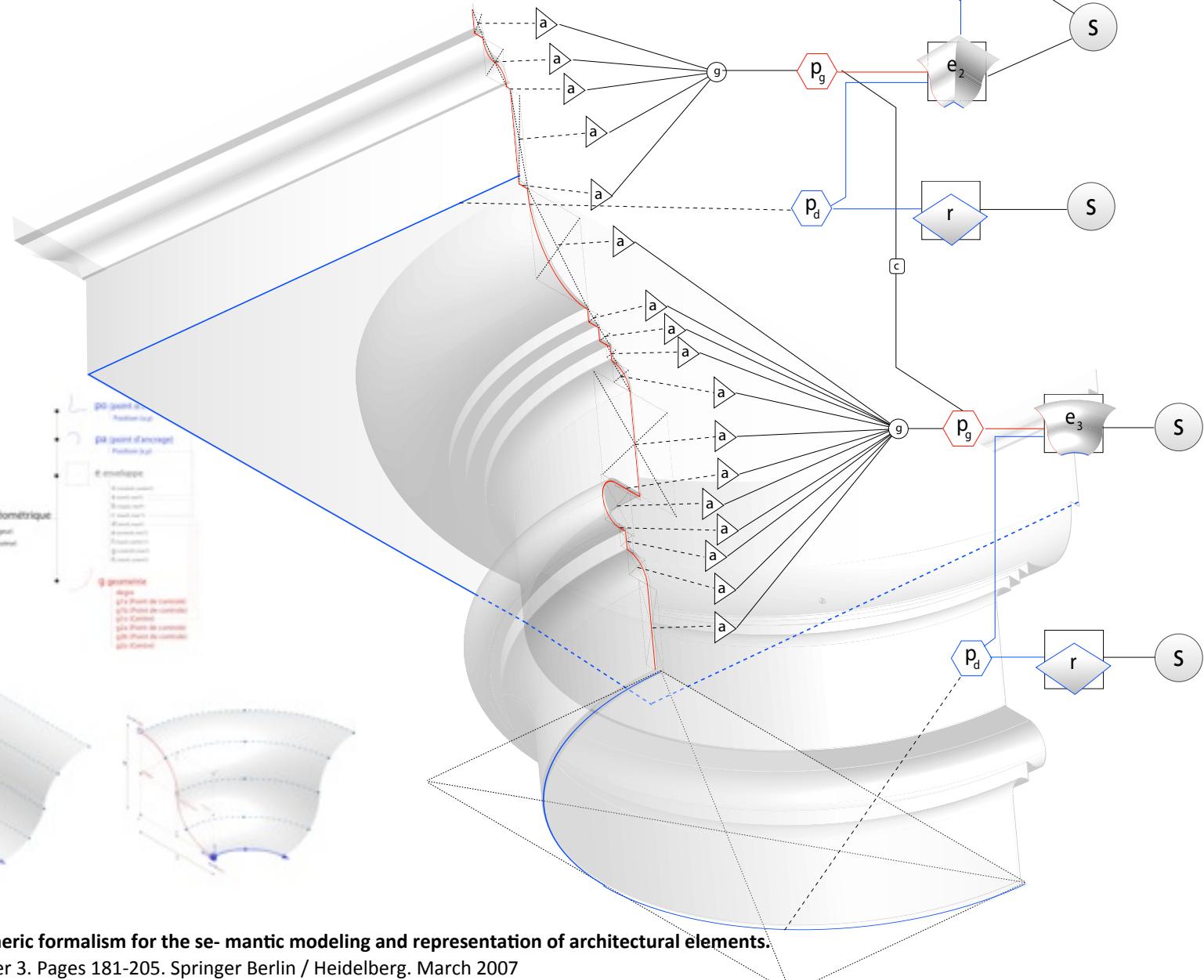
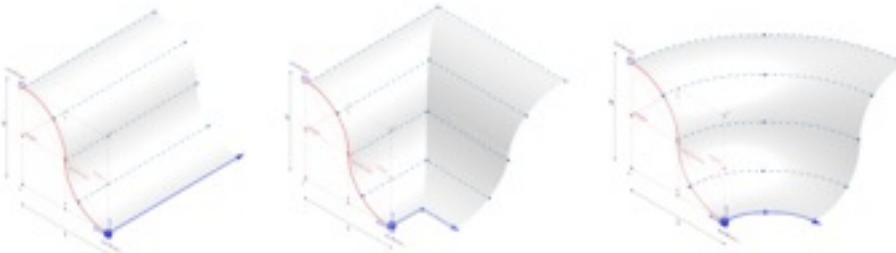
Reasoning from semantics to geometry



Doric capital
by Andrea Palladio



COHO

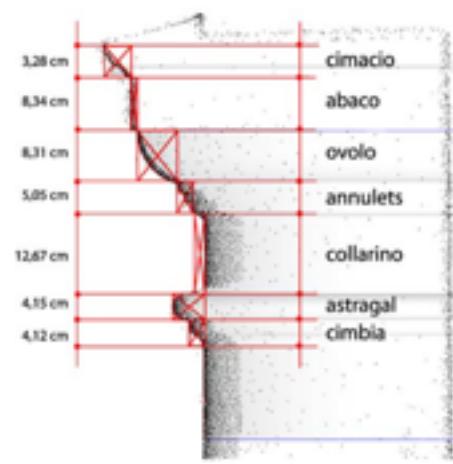
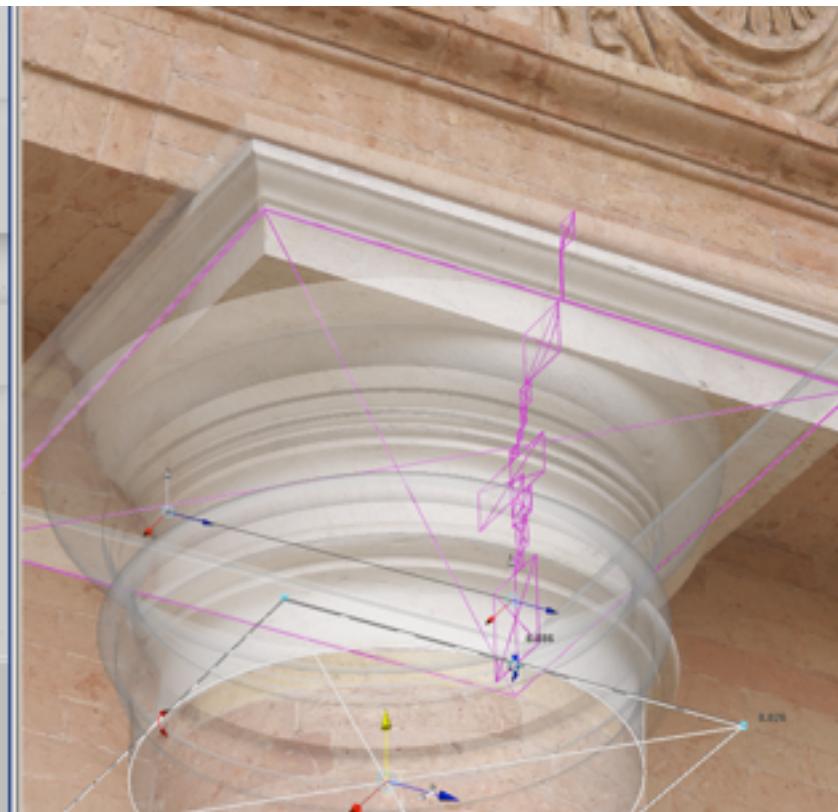
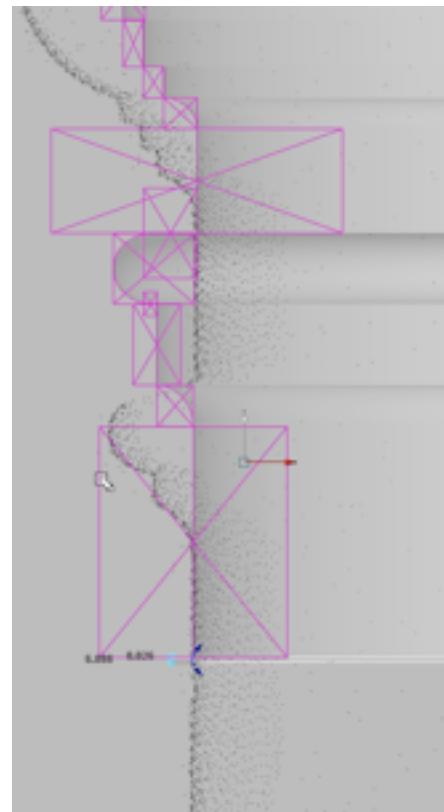
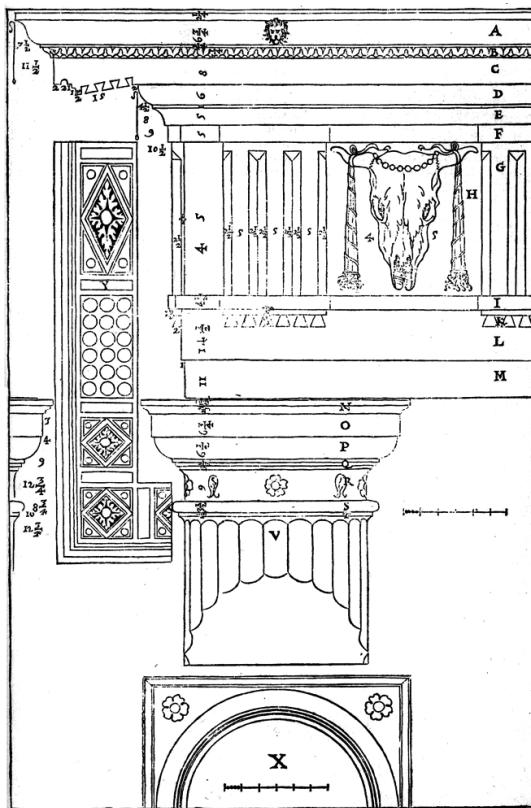


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Reasoning from semantics to geometry

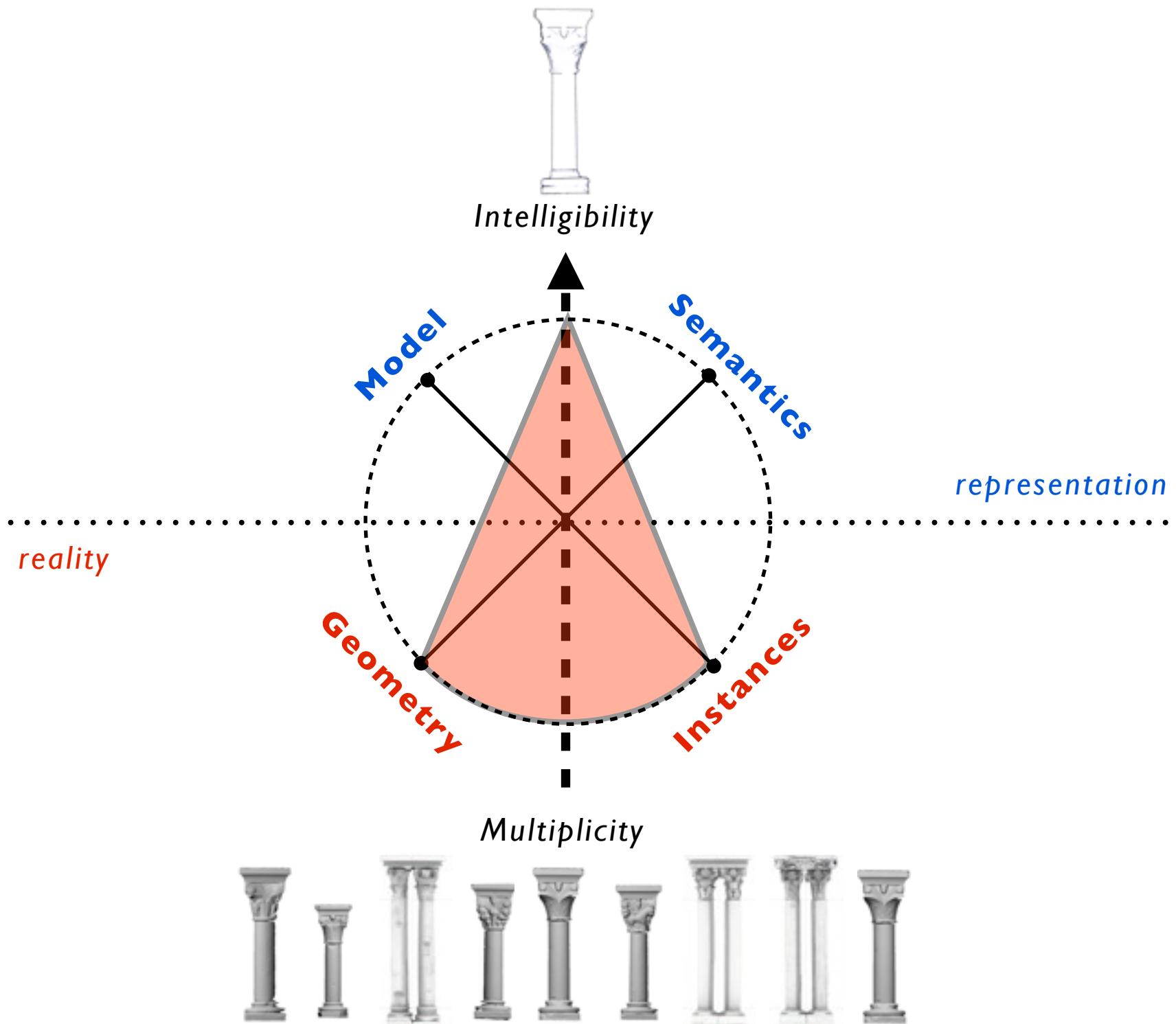


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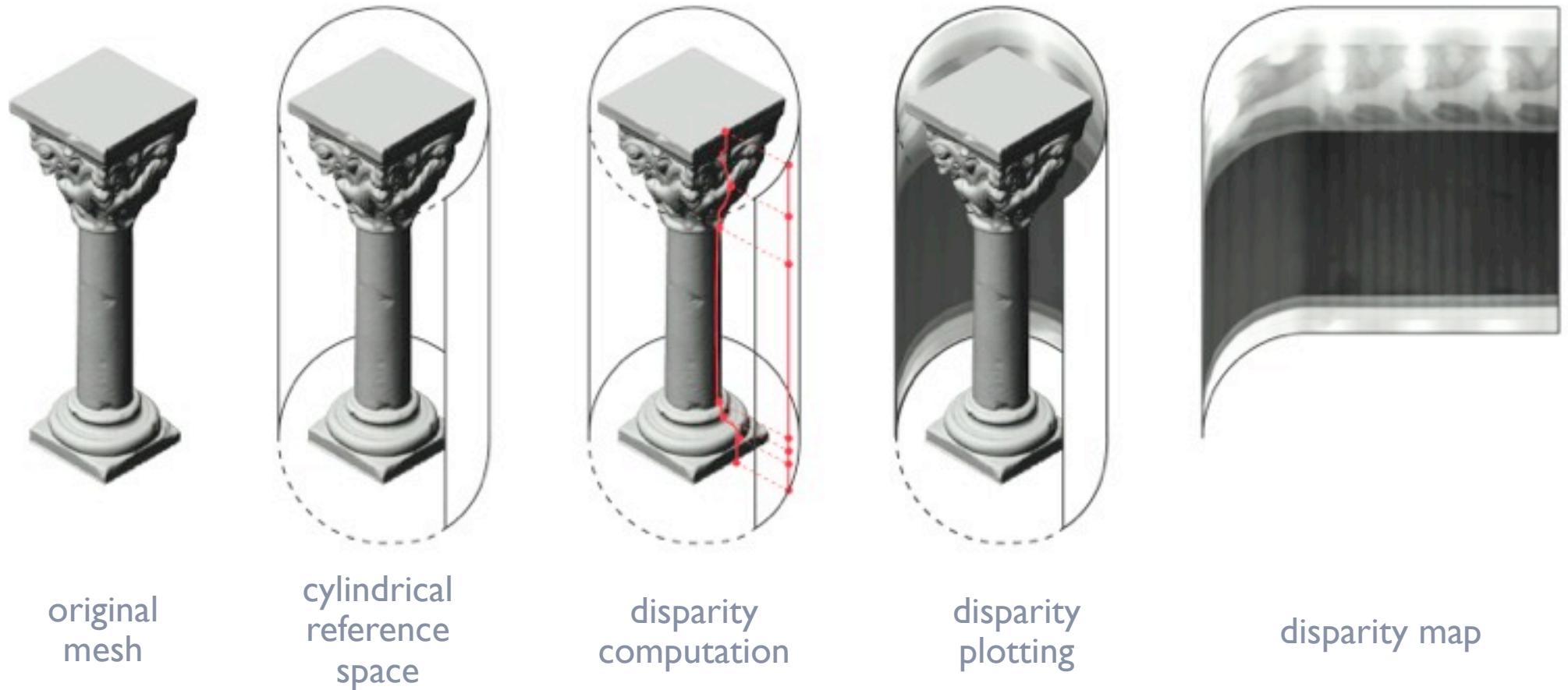
Reasoning from semantics to geometry



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Reasoning from geometry to semantics



original
mesh

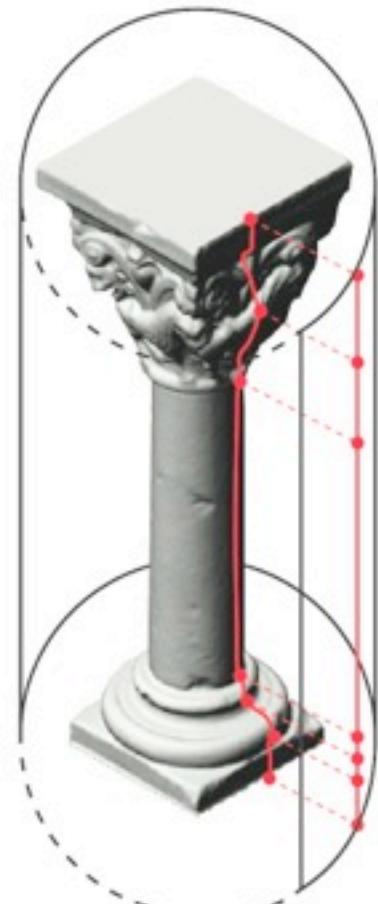
cylindrical
reference
space

disparity
computation

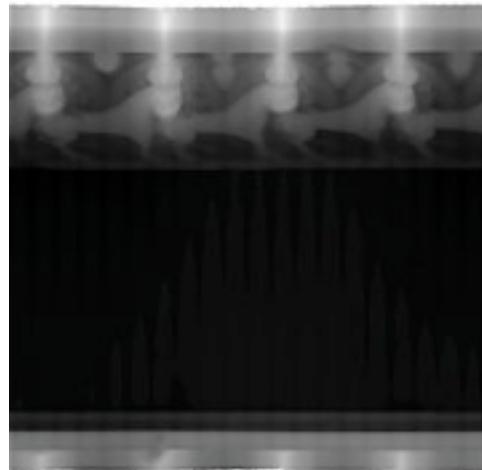
disparity
plotting

disparity map

Reasoning from geometry to semantics



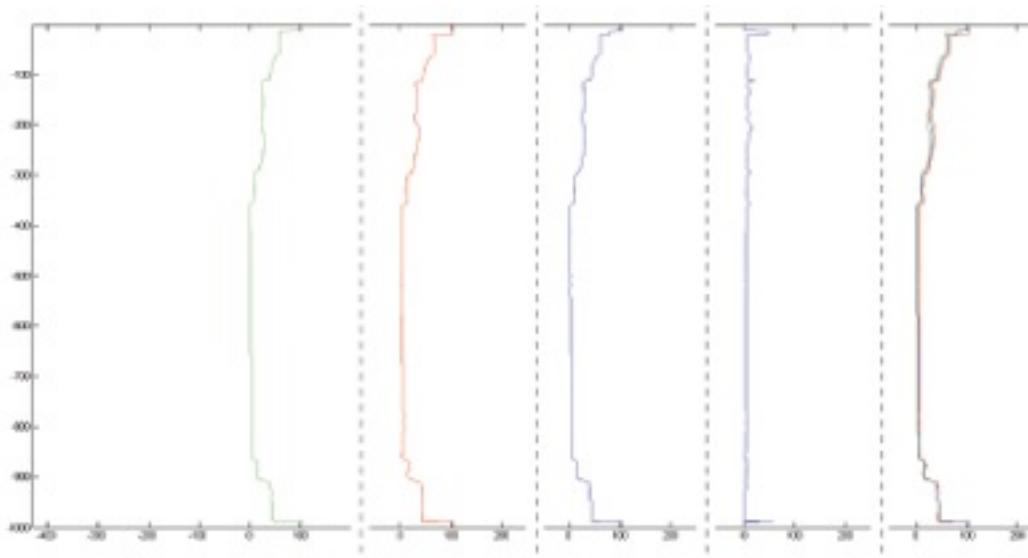
disparity
computation



disparity map (color ramp)

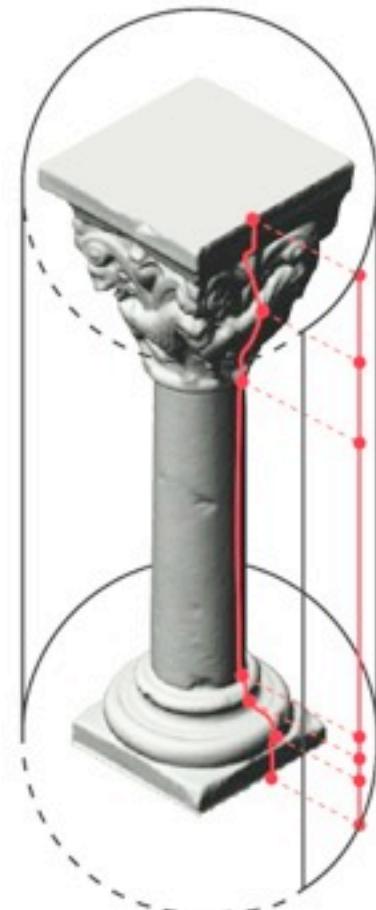


contours

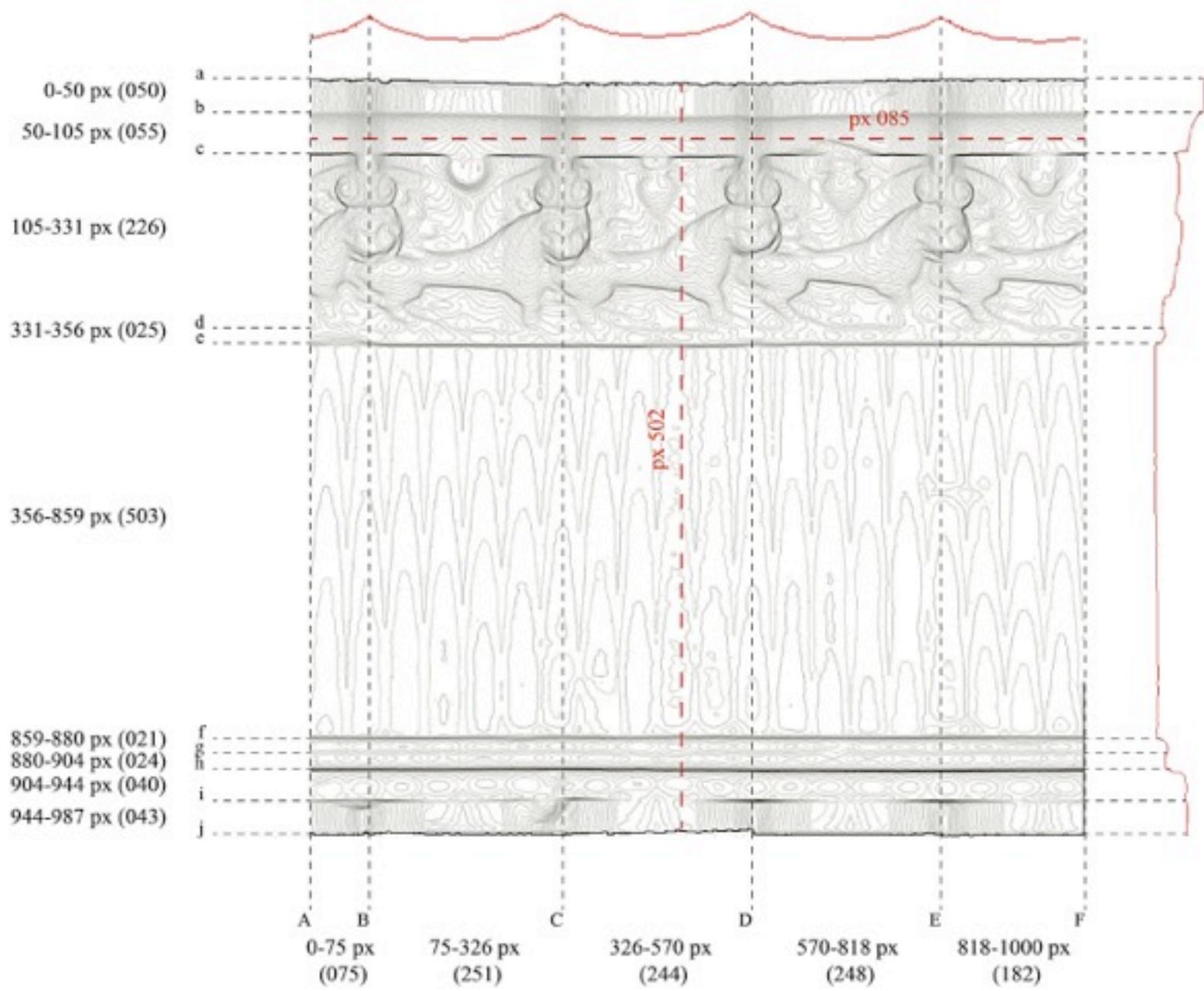


profiles

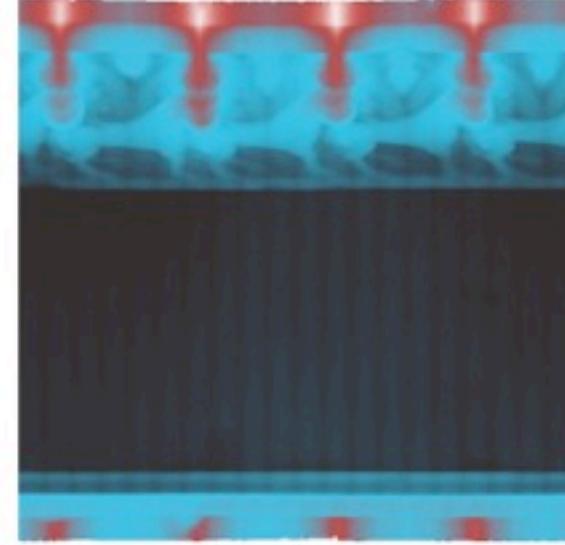
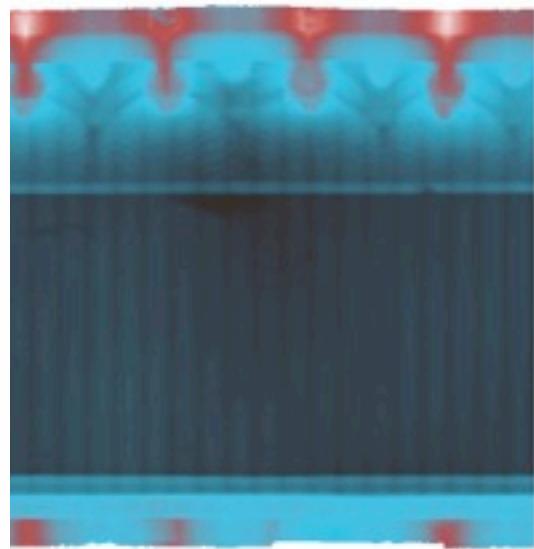
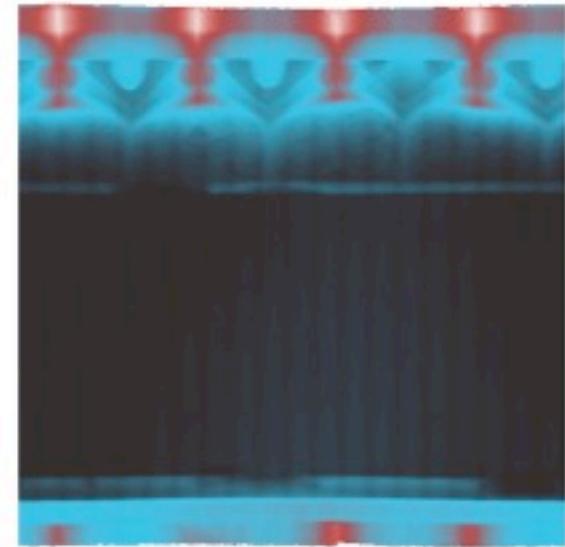
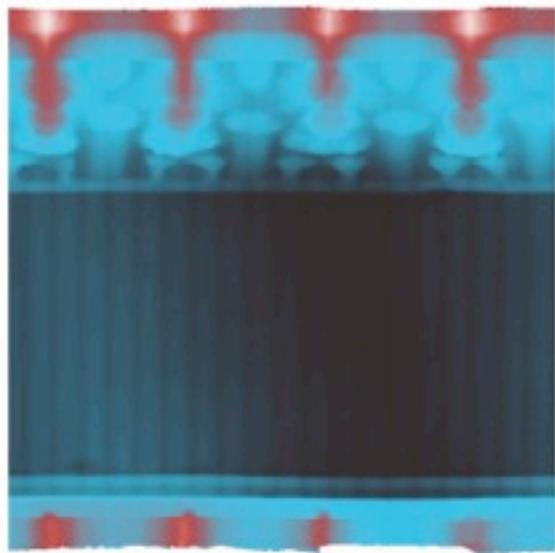
Reasoning from geometry to semantics



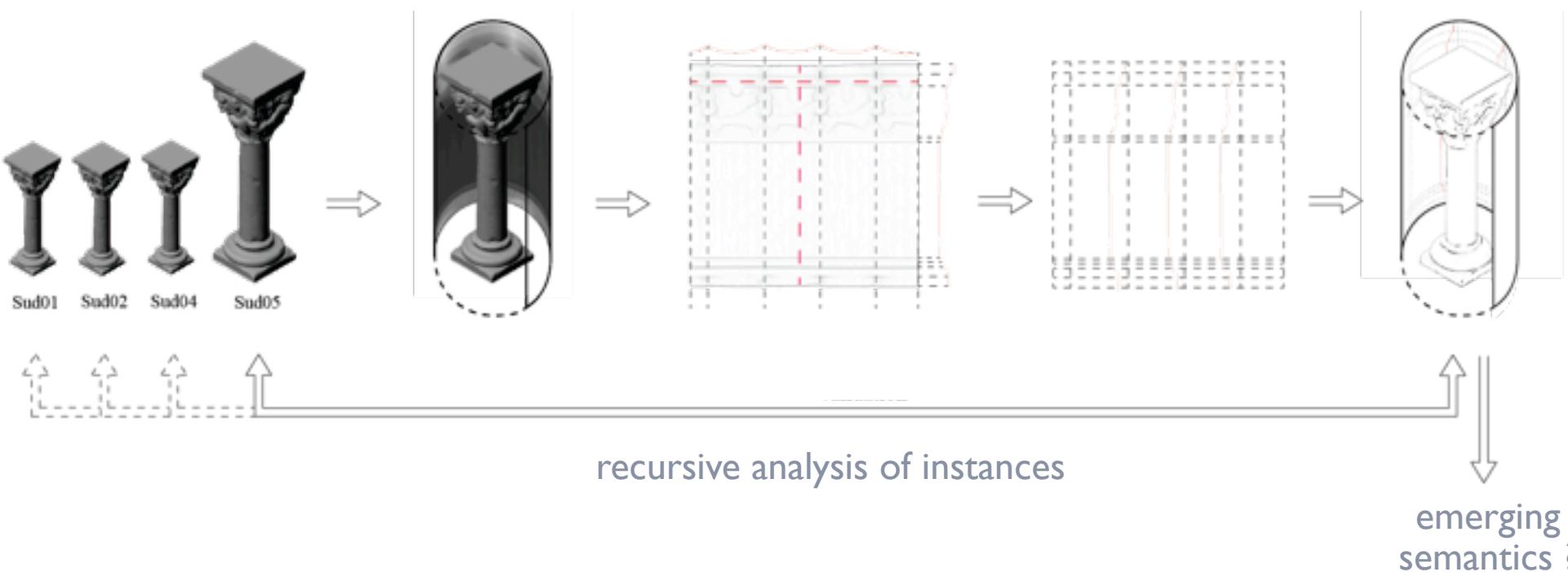
disparity
computation

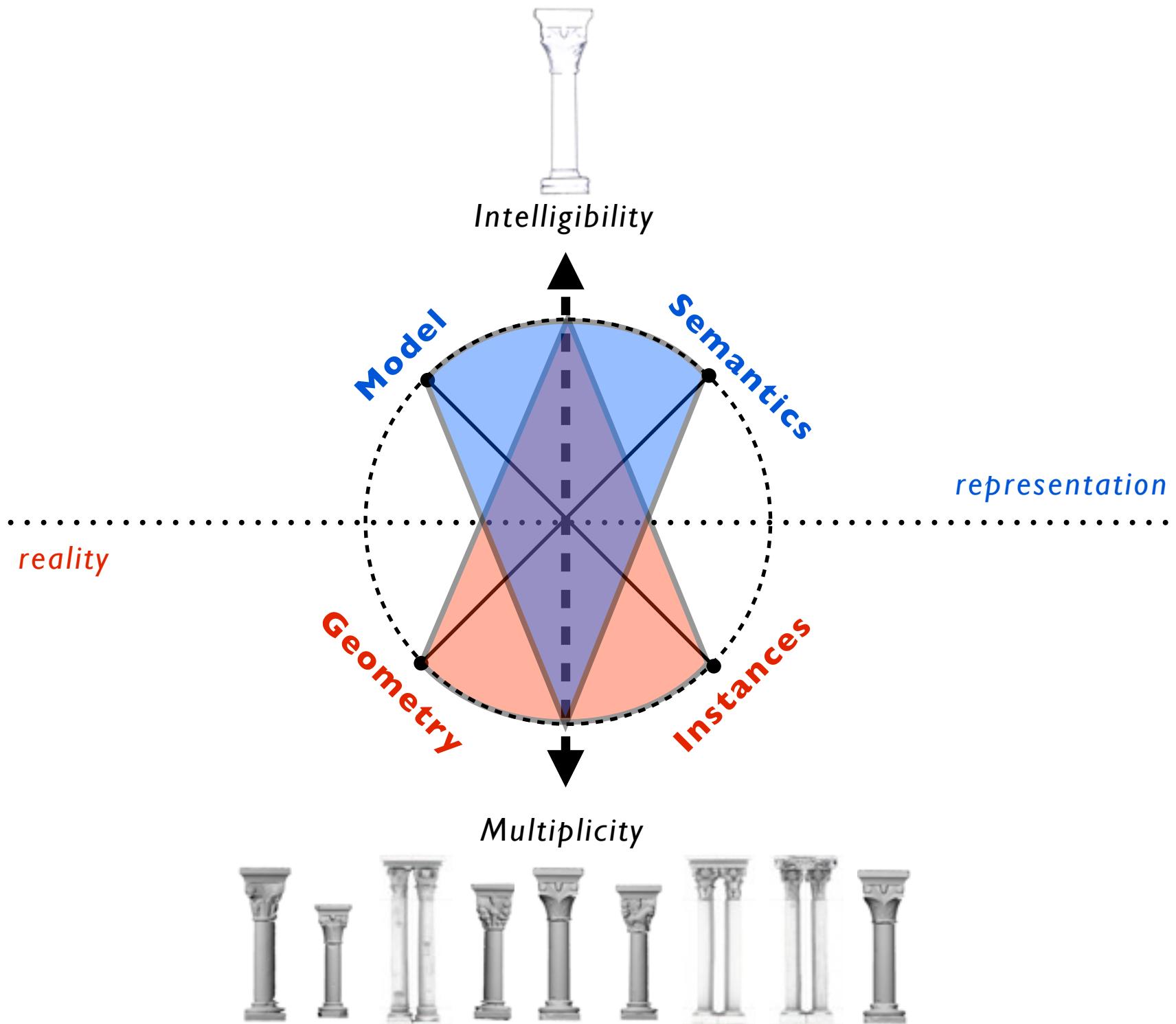


Reasoning from geometry to semantics

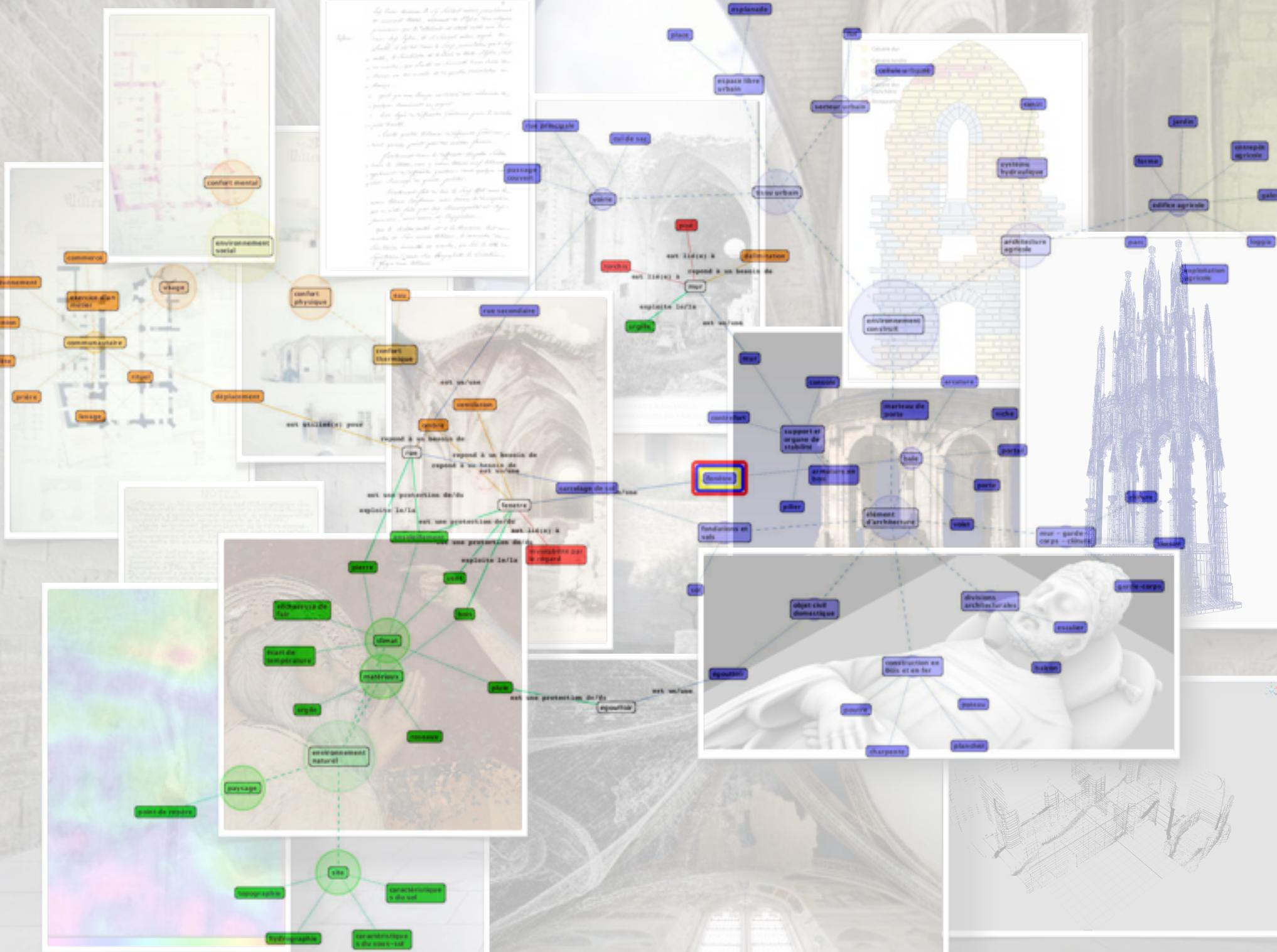


Reasoning from geometry to semantics

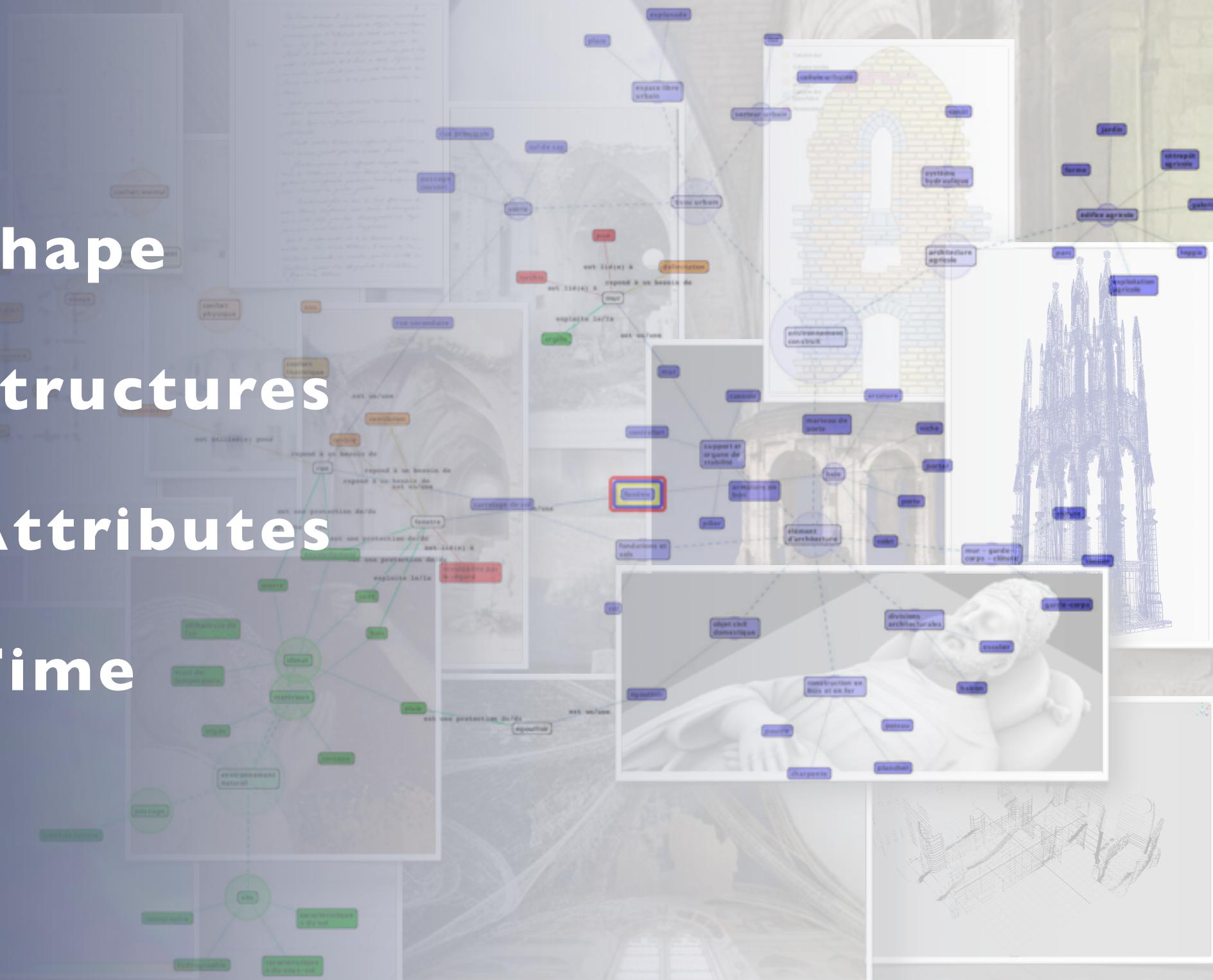




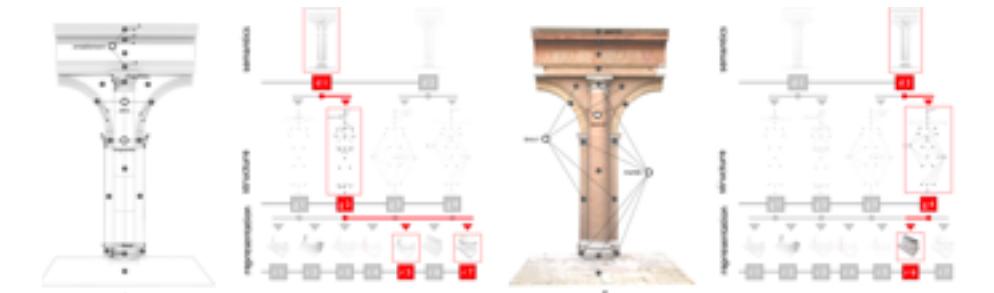
Semantic enrichment of 2D/3D/4D representations



Shape Structures Attributes Time



Semantic Enrichment | General approach



- Managing multiple representations of buildings according to different analysis needs

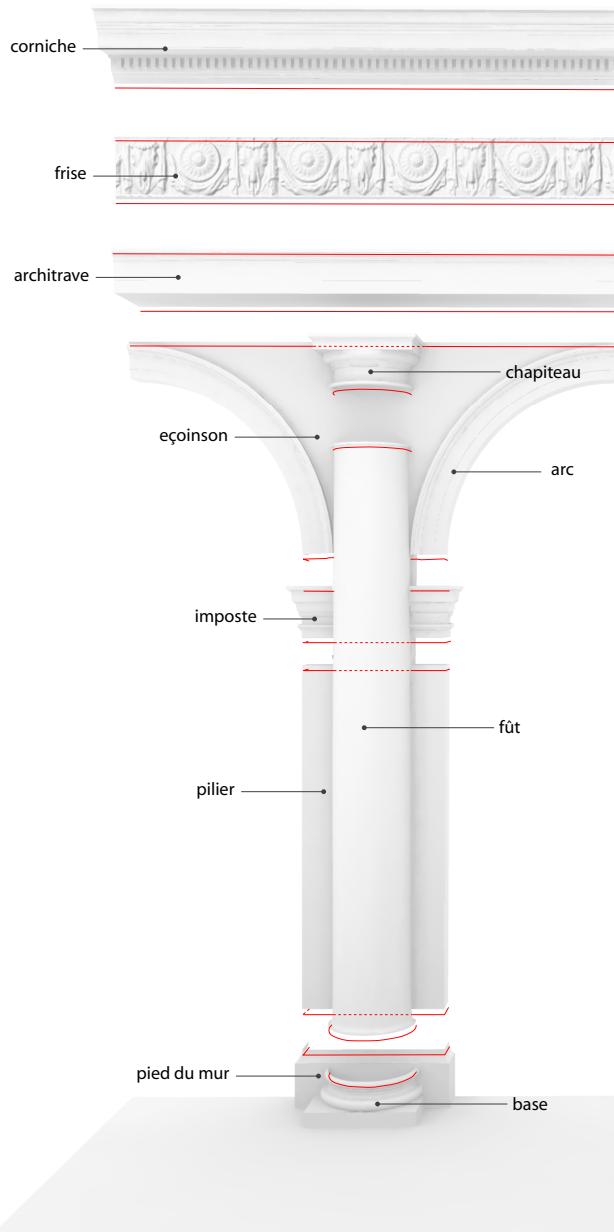


- Analyzing and representing building transformations overtime

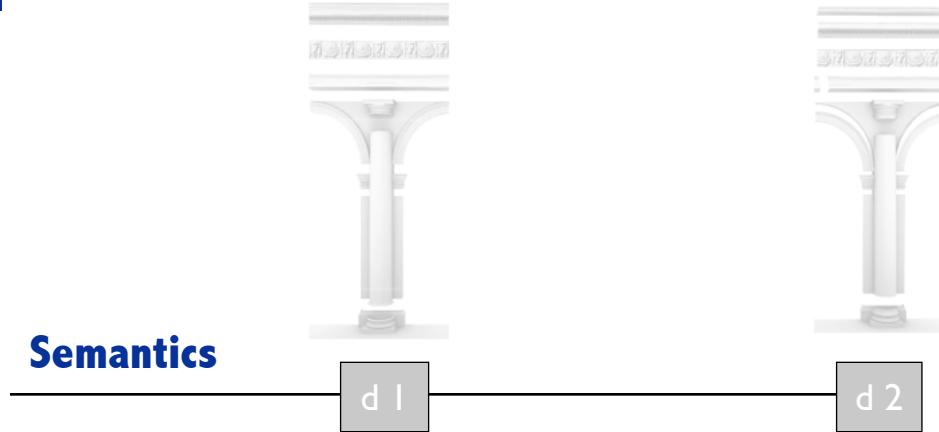


- Establishing links between the 3D morphology and collections of 2D iconographic sources

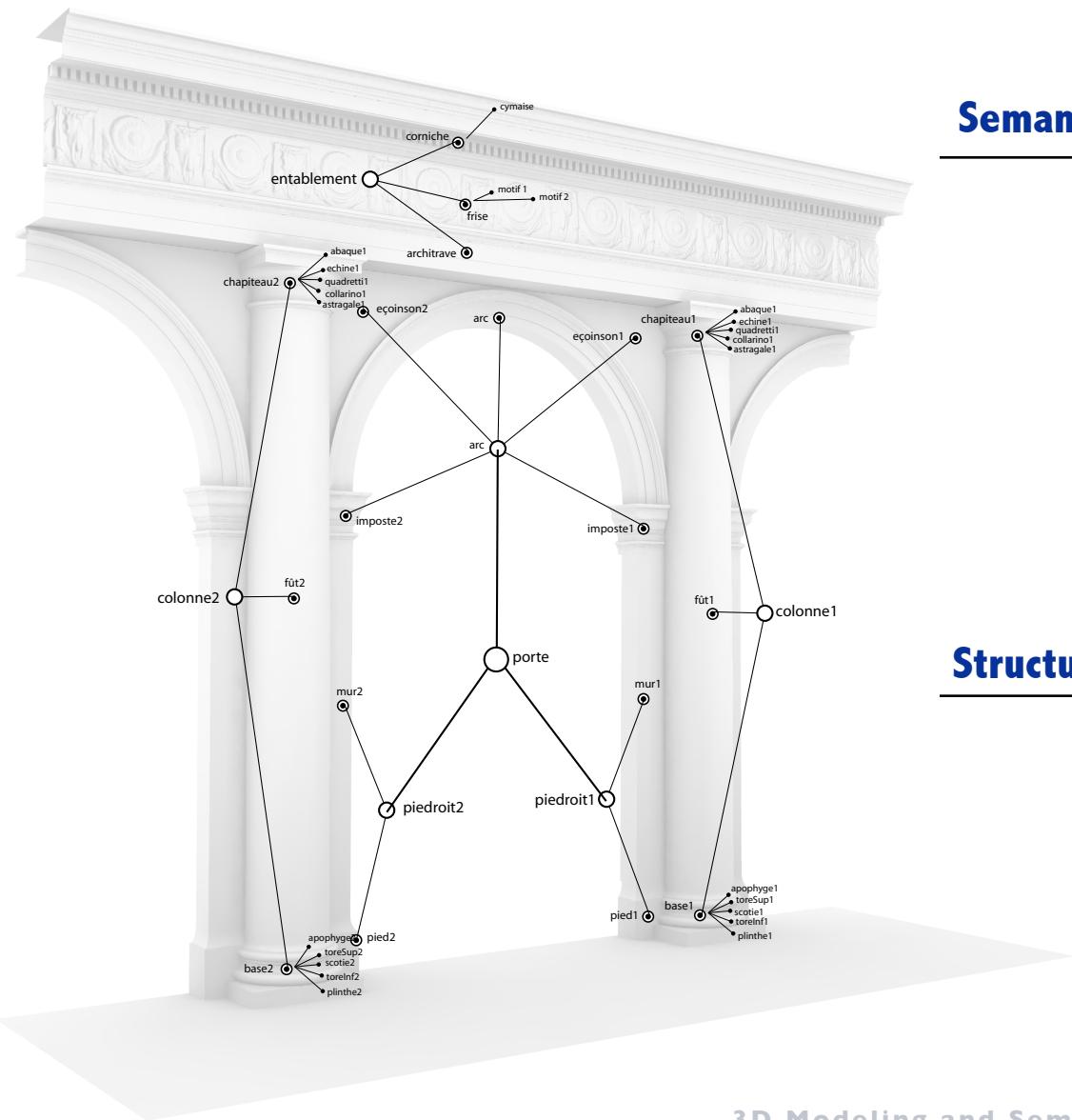
Semantic description | Model



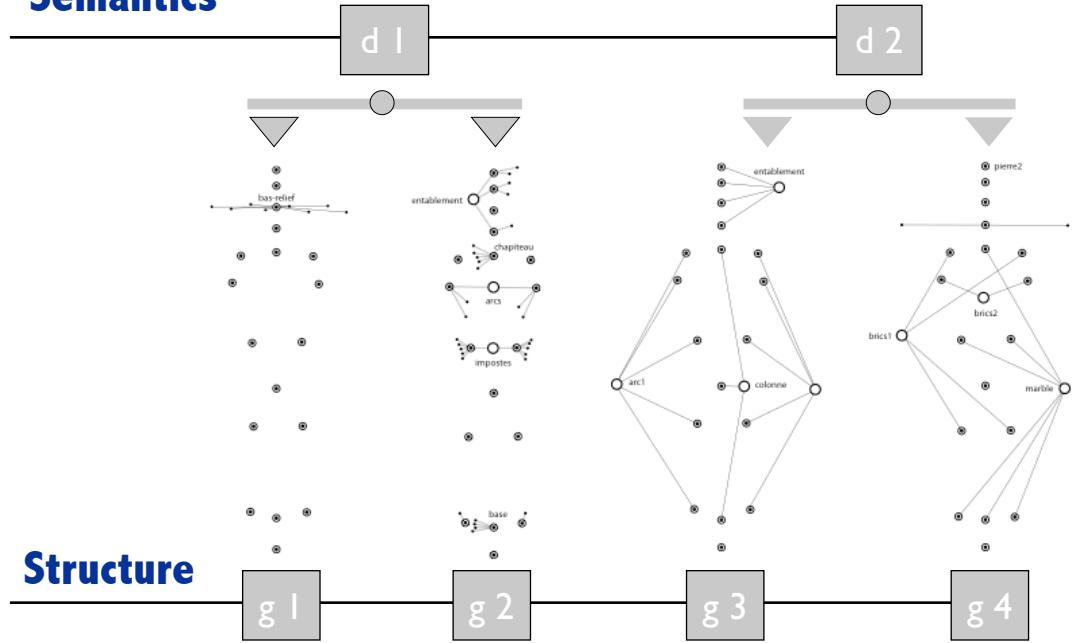
Semantics



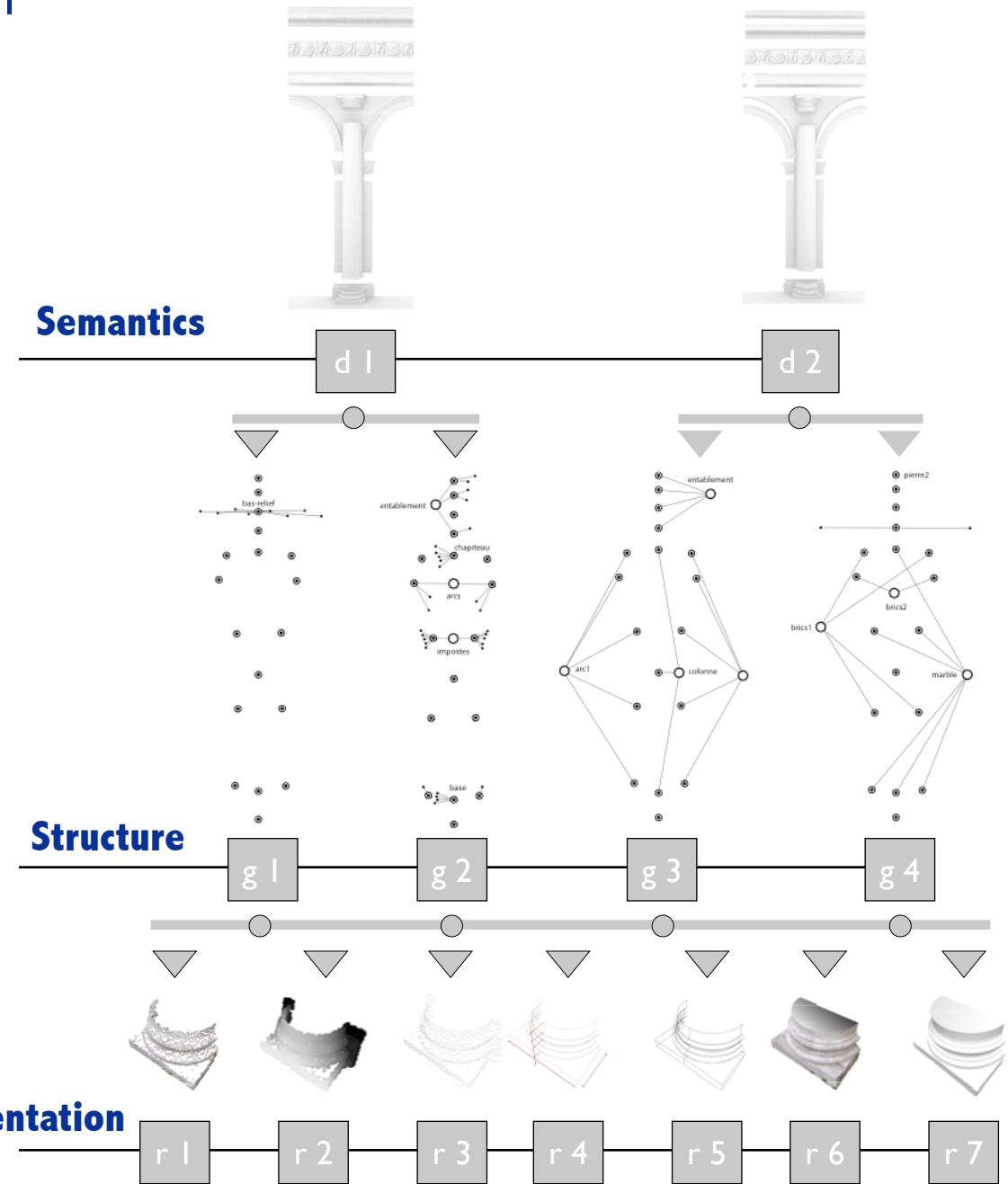
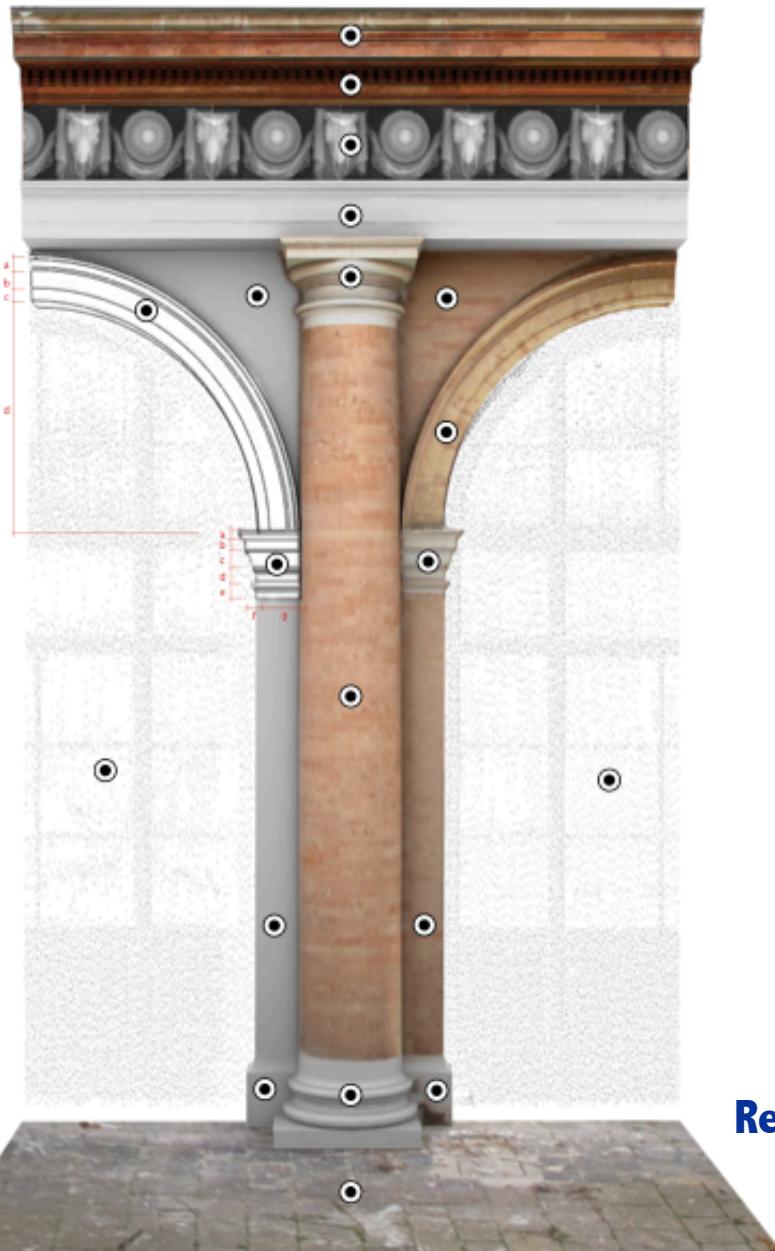
Semantic description | Model



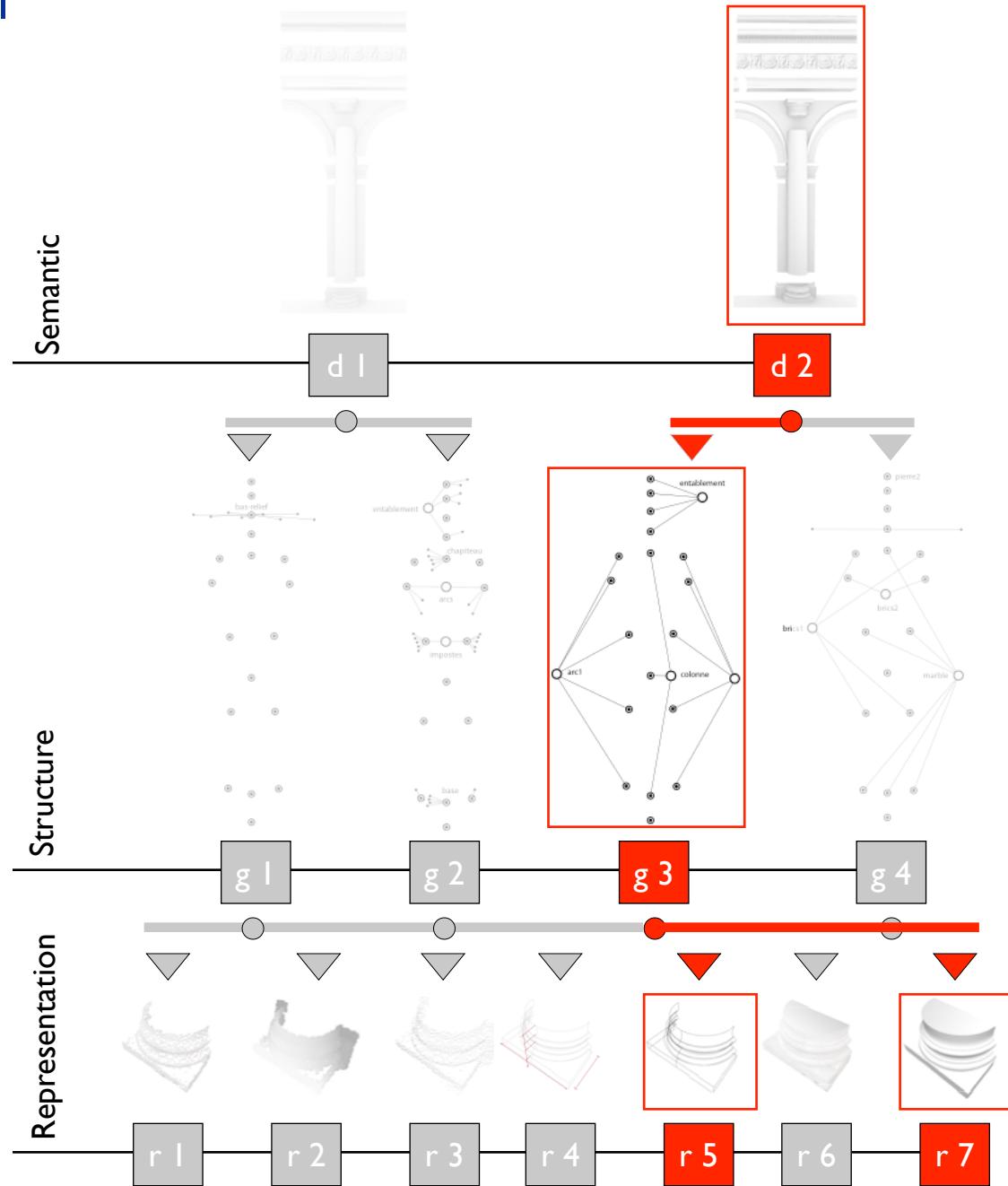
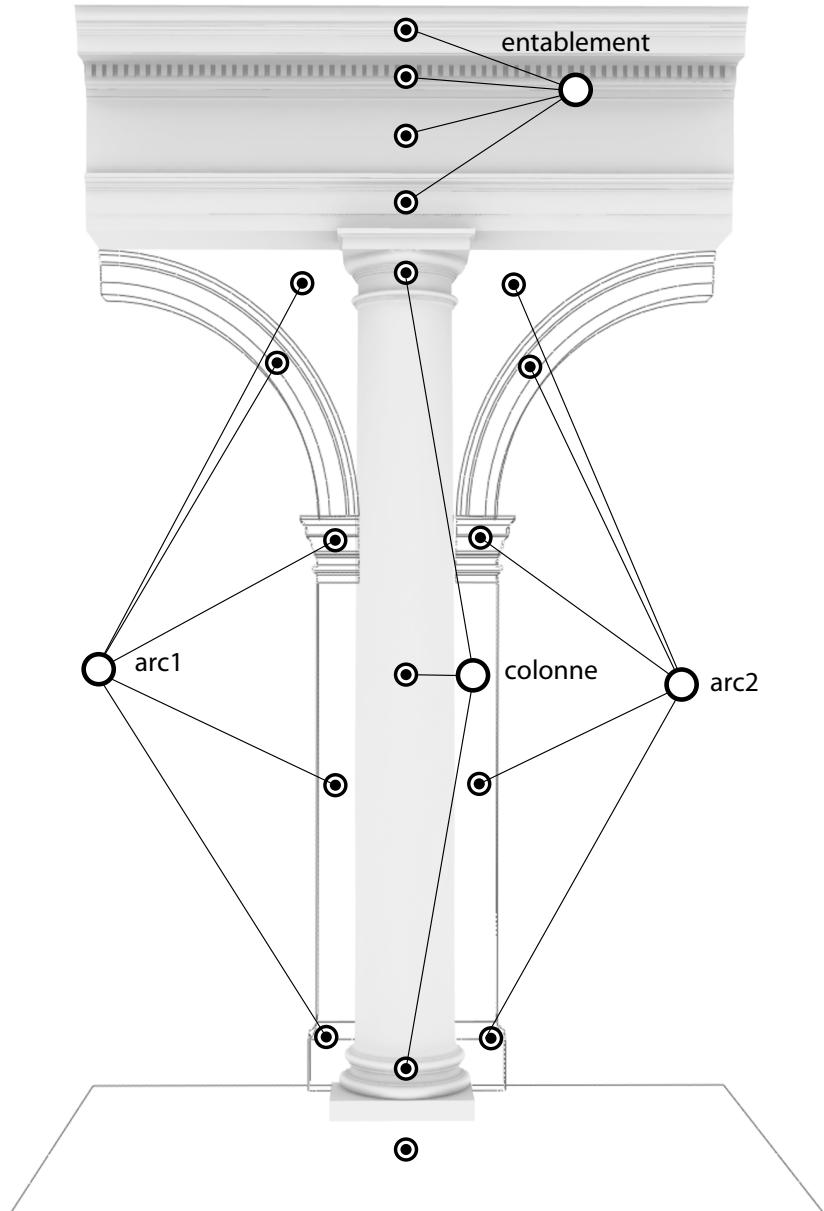
Semantics



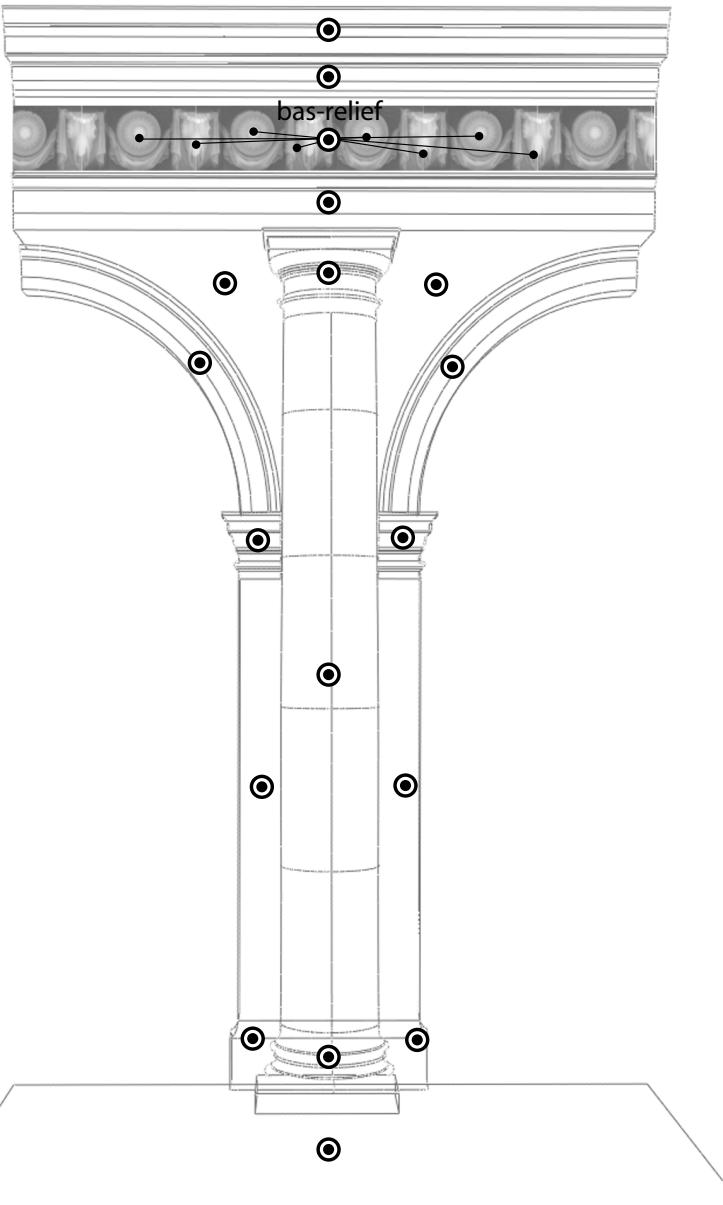
Semantic description | Model



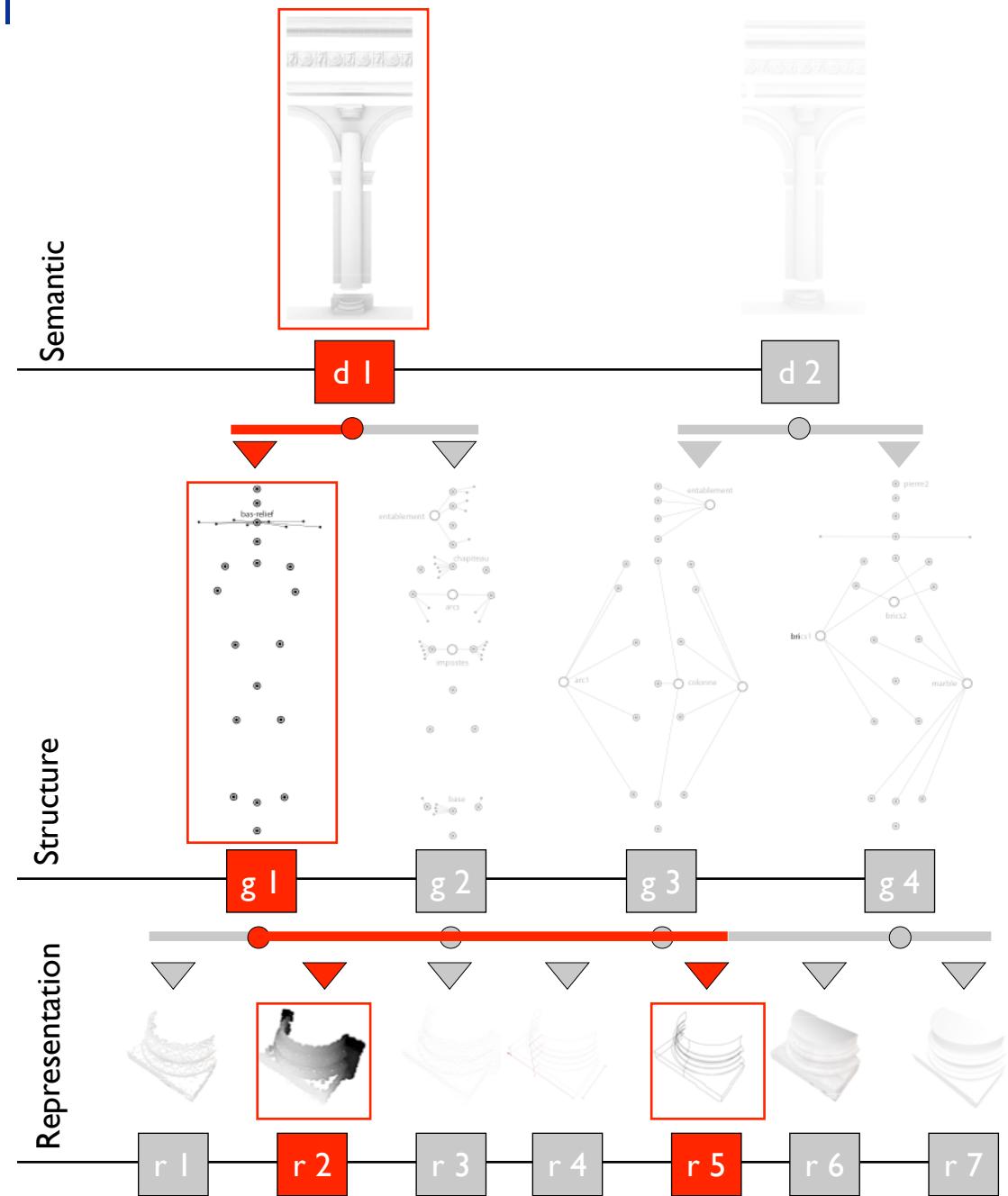
Semantic description | Model



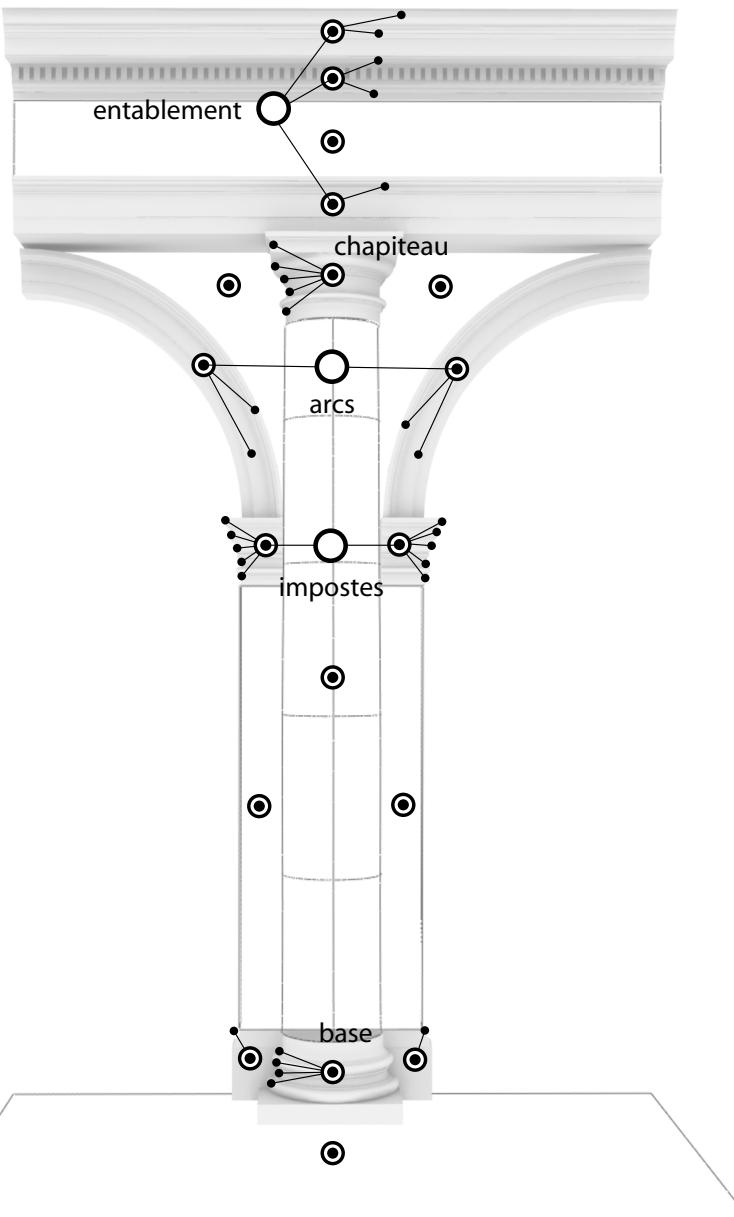
Semantic description | Model



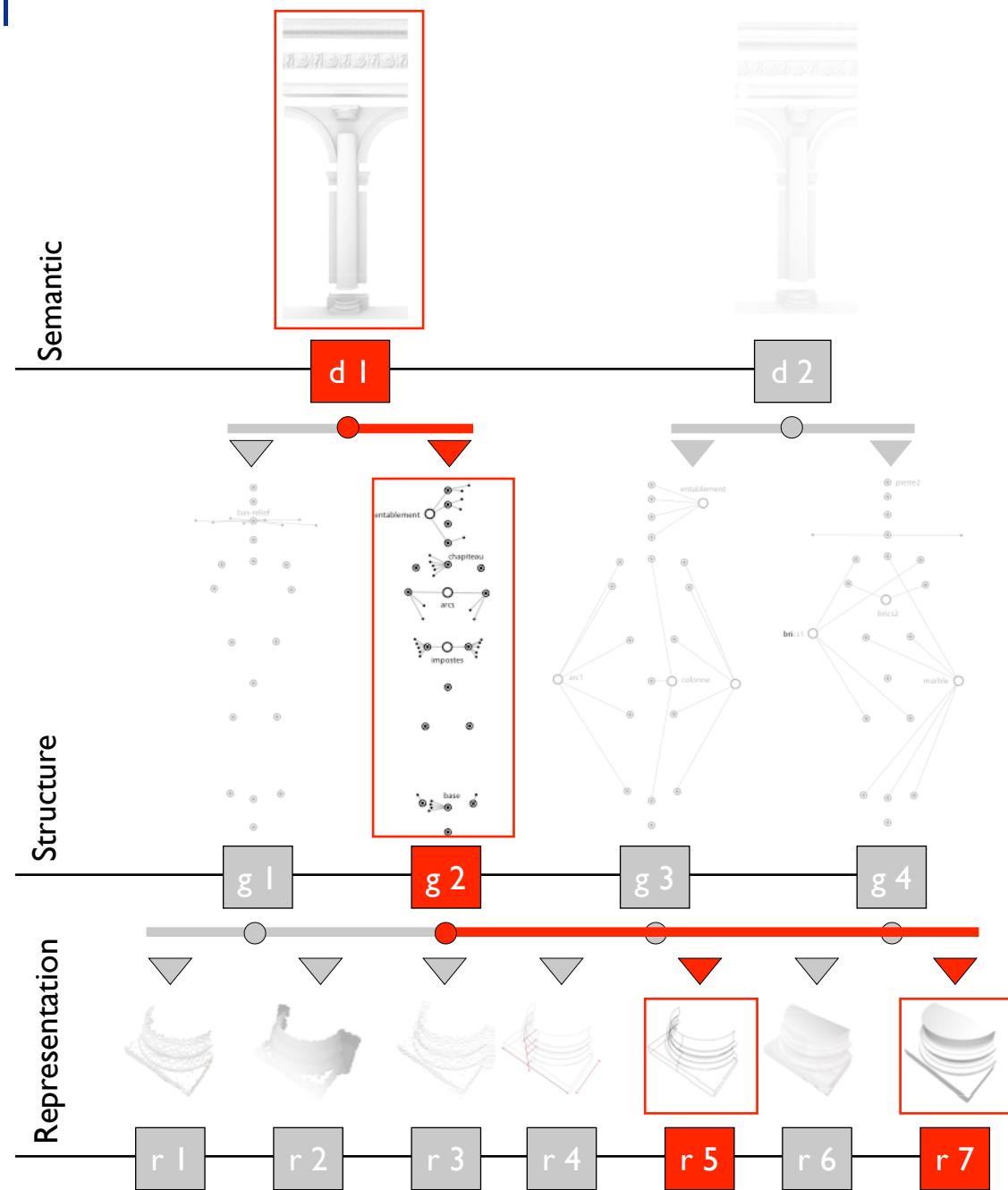
Analysis of sculpted elements



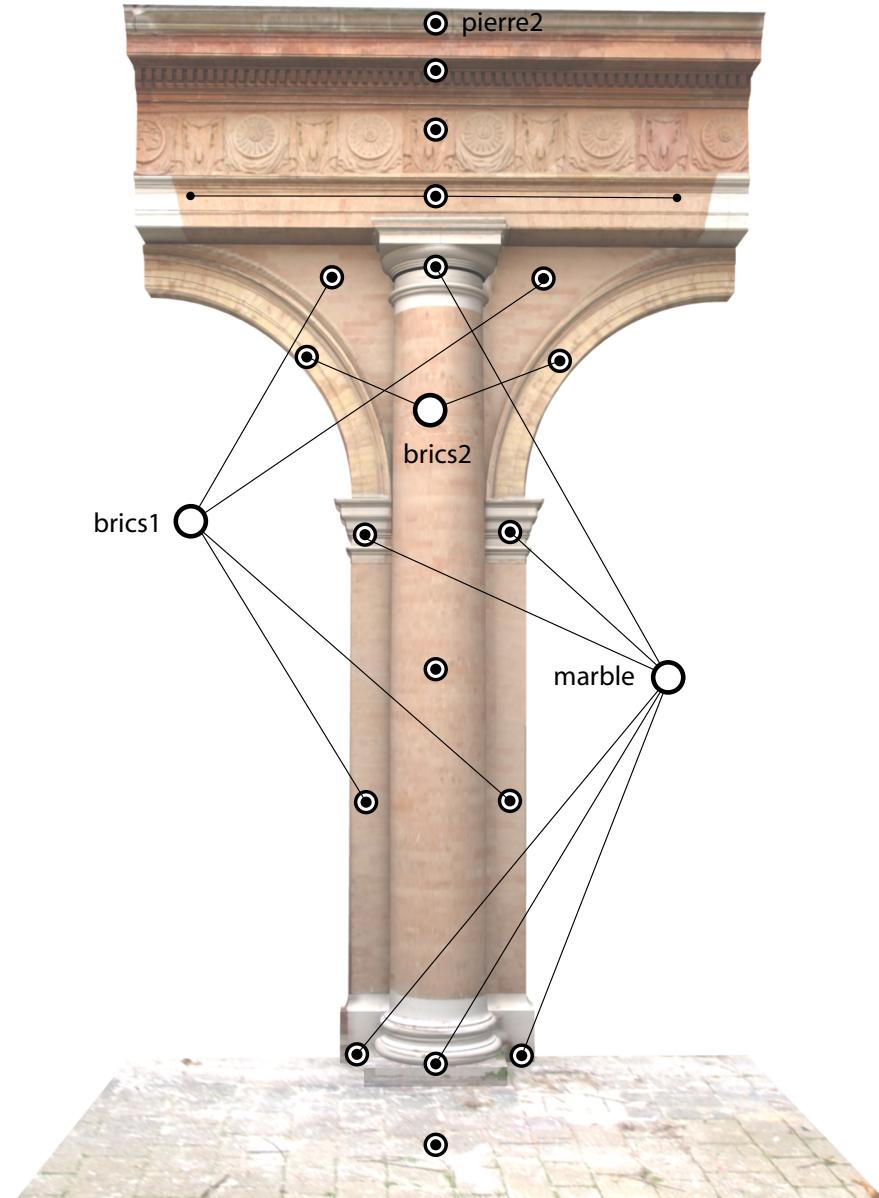
Semantic description | Model



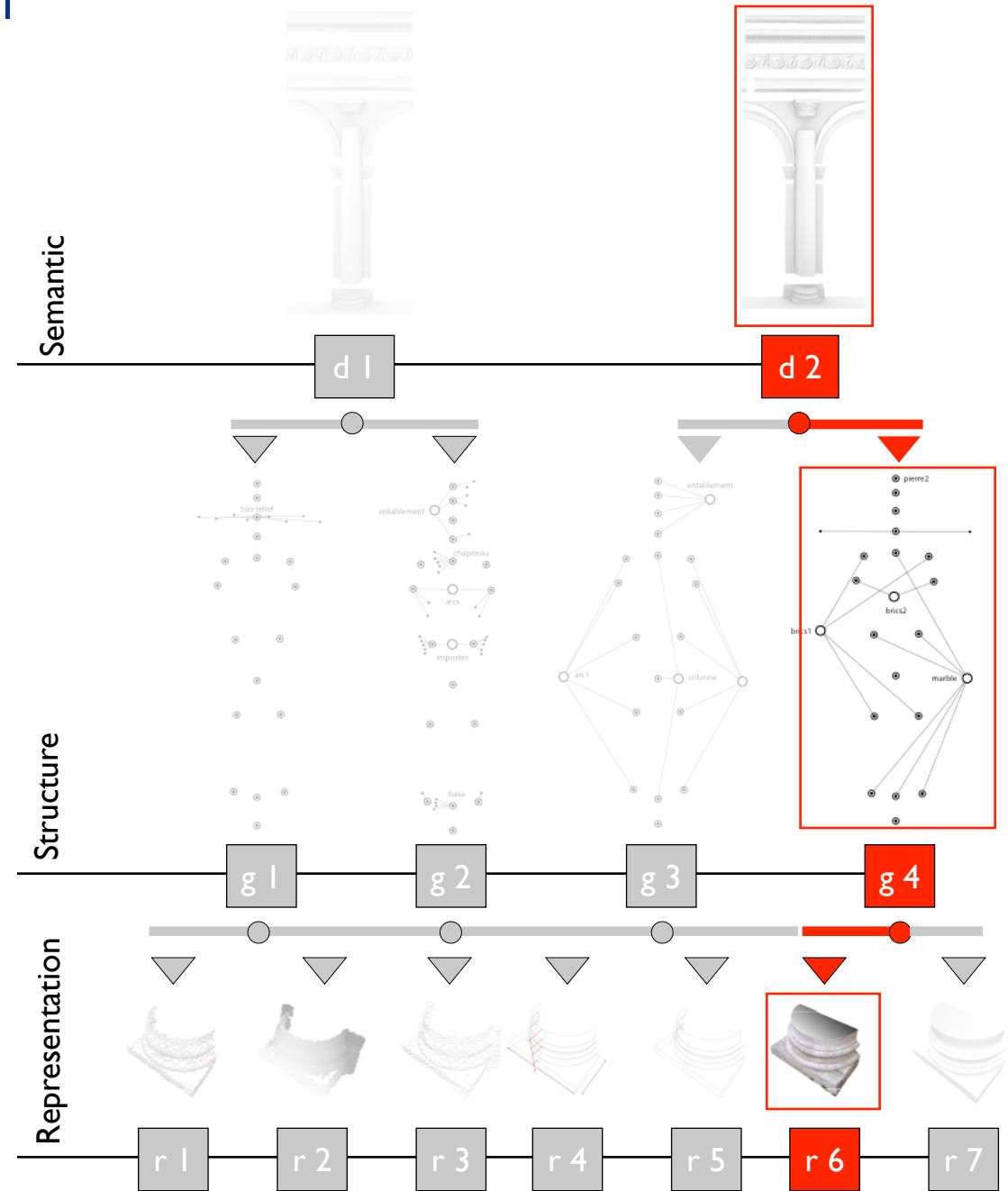
Analysis of the mouldings



Semantic description | Model

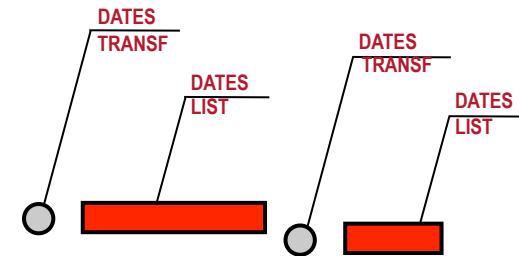


Analysis of materials

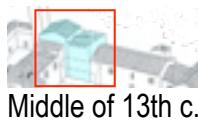


Spatio-temporal modeling

PhD Thesis of Chiara Stefani, MAP-Gamsau (2006-2010)



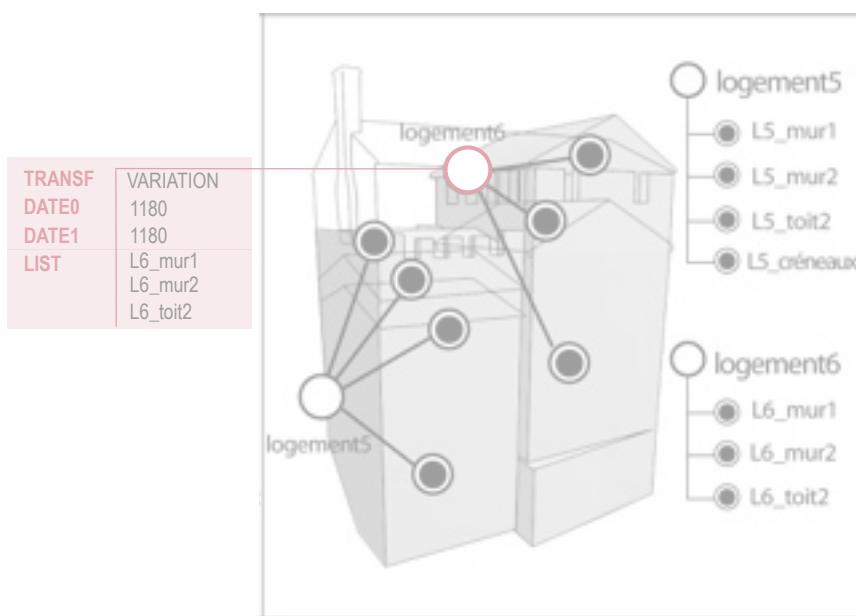
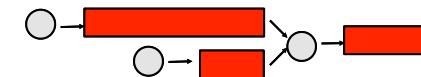
union



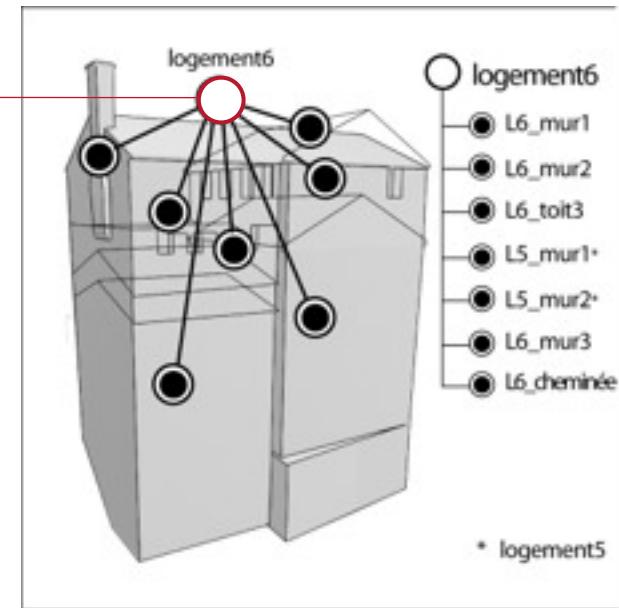
Middle of 13th c.



Middle of 14 c.



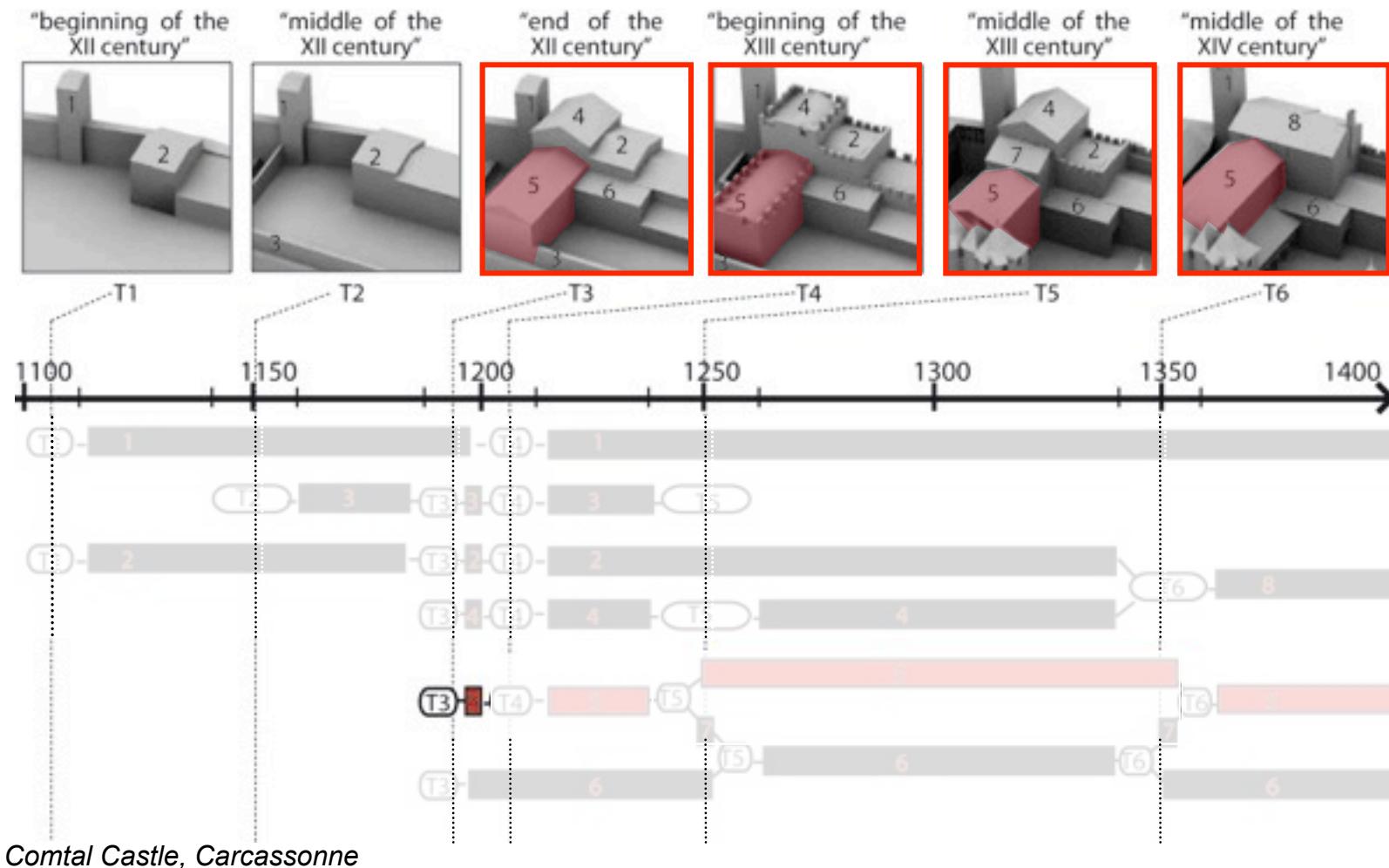
TRANSF	UNION
DATE0	1340
DATE1	1340
LIST	L6_mur1 L6_mur2 L6_toit3 L5_créneaux



Spatio-temporal modeling

PhD Thesis of Chiara Stefani, MAP-Gamsau (2006-2010)

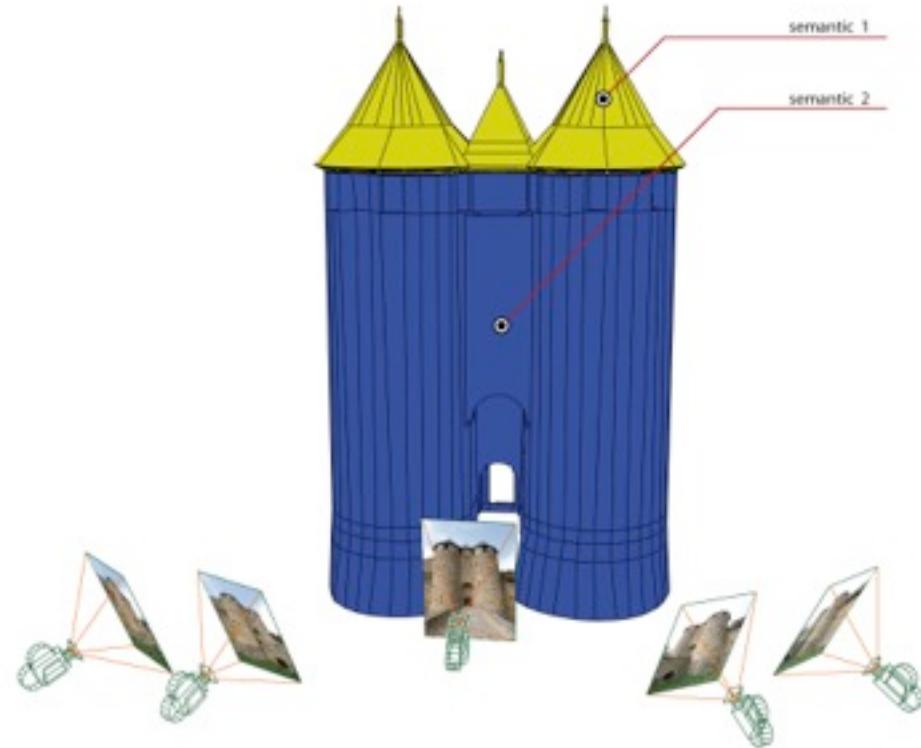
The historic graphs



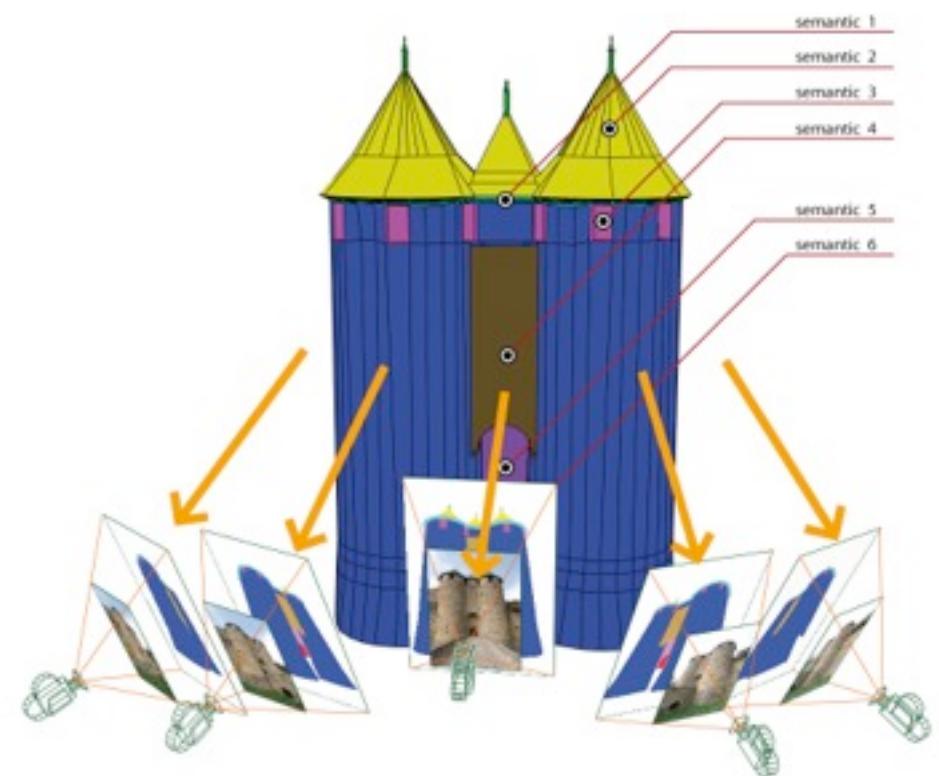
2D/3D semantic annotation

PhD Thesis of Chawee Bussarayat, MAP-Gamsau (2006-2010)

Using the 3D morphology as a source to project semantic attributes onto 2D iconography



Spatial referencing

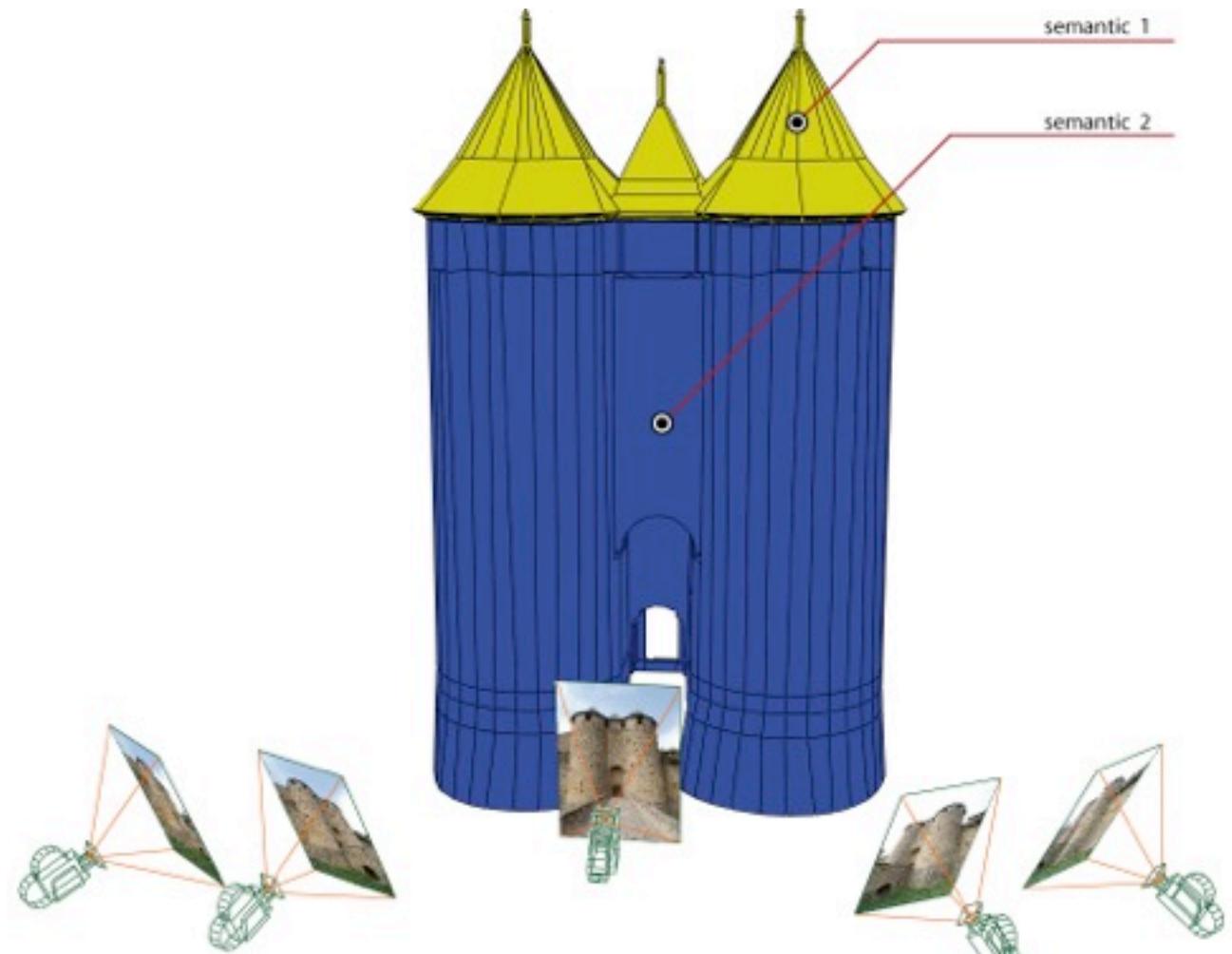


Semantic annotation

2D/3D semantic annotation

PhD Thesis of Chawee Bussarayat, MAP-Gamsau (2006-2010)

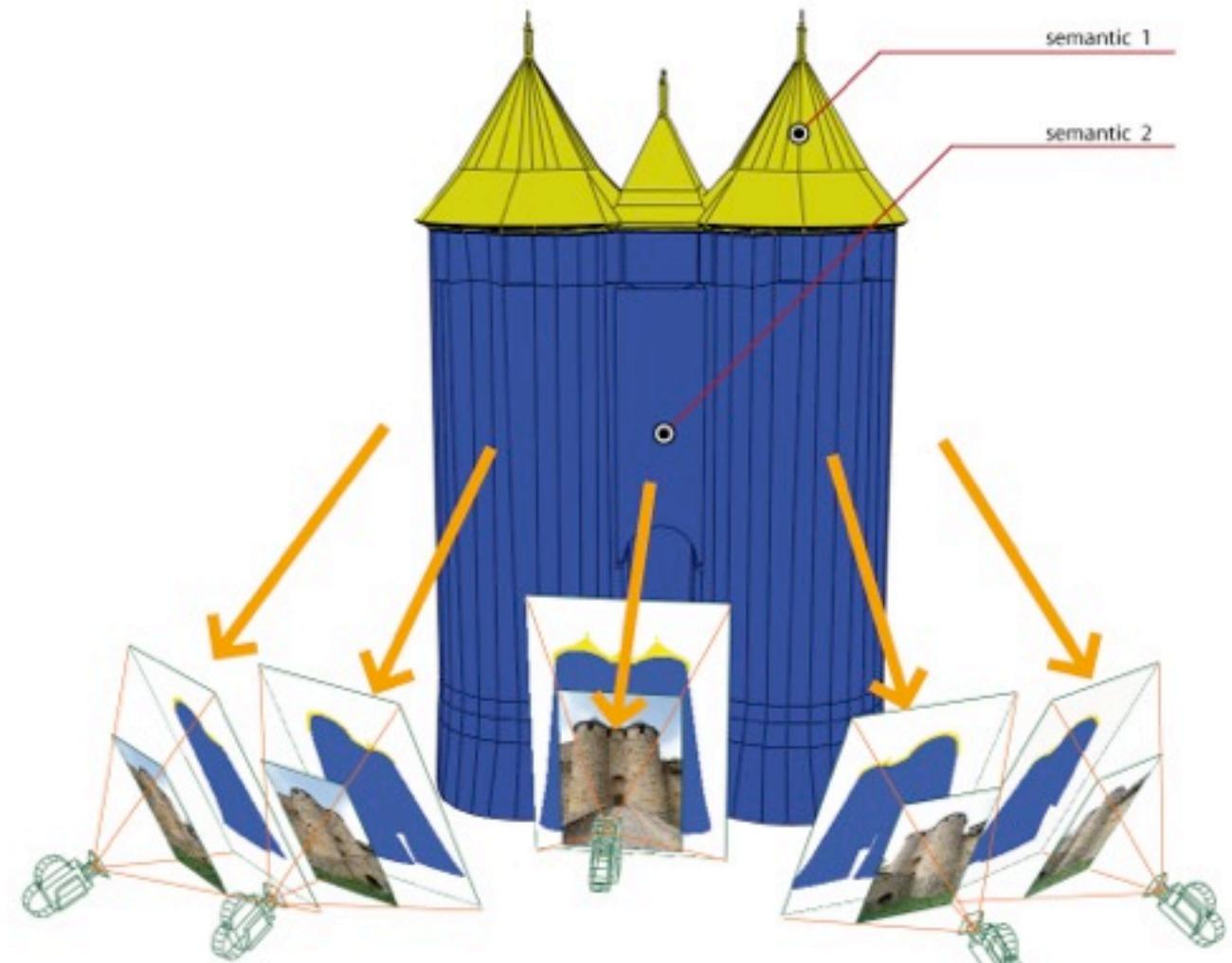
Image segmentation according to the morphology description



2D/3D semantic annotation

PhD Thesis of Chawee Bussarayat, MAP-Gamsau (2006-2010)

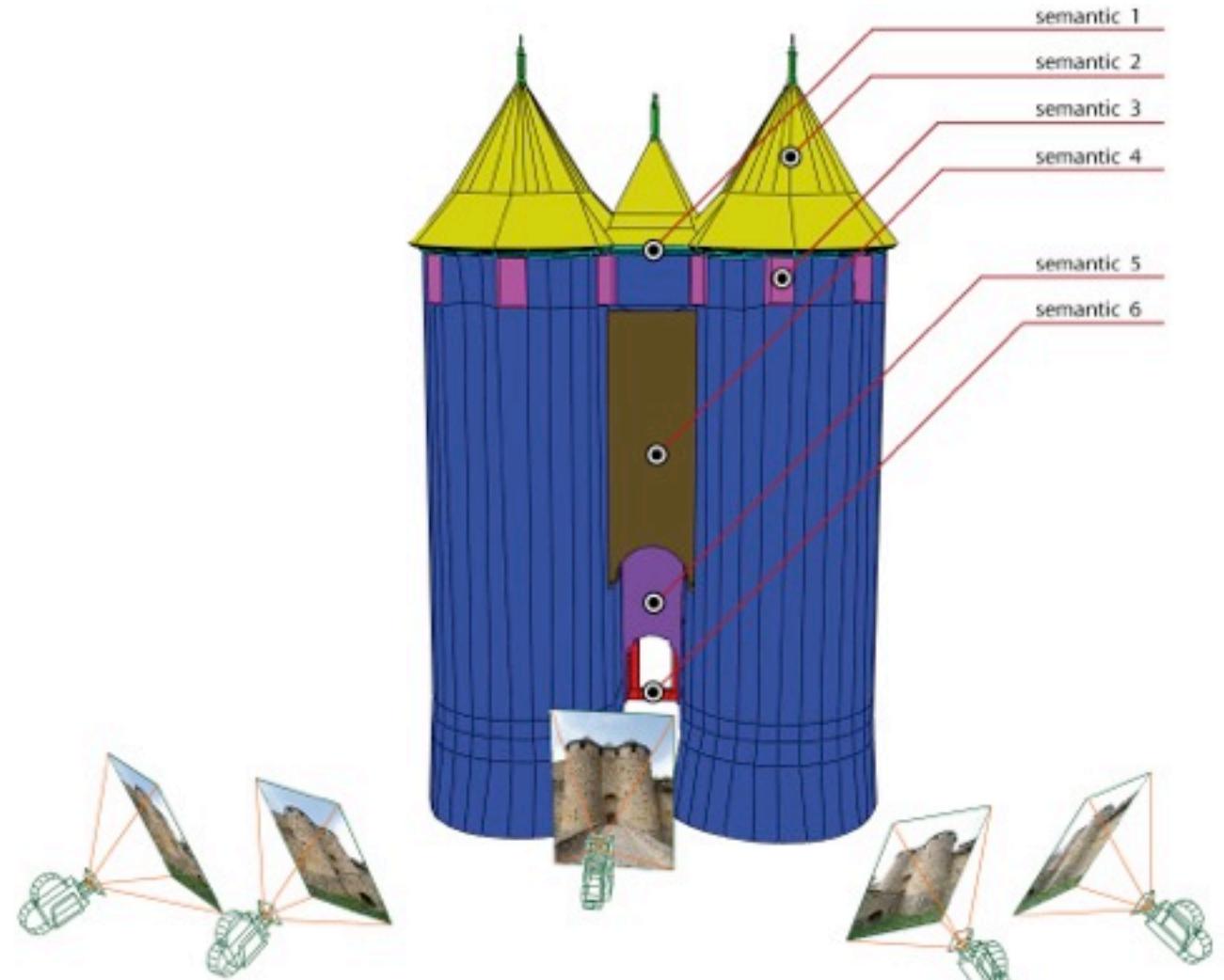
Image segmentation according to the morphology description



2D/3D semantic annotation

PhD Thesis of Chawee Bussarayat, MAP-Gamsau (2006-2010)

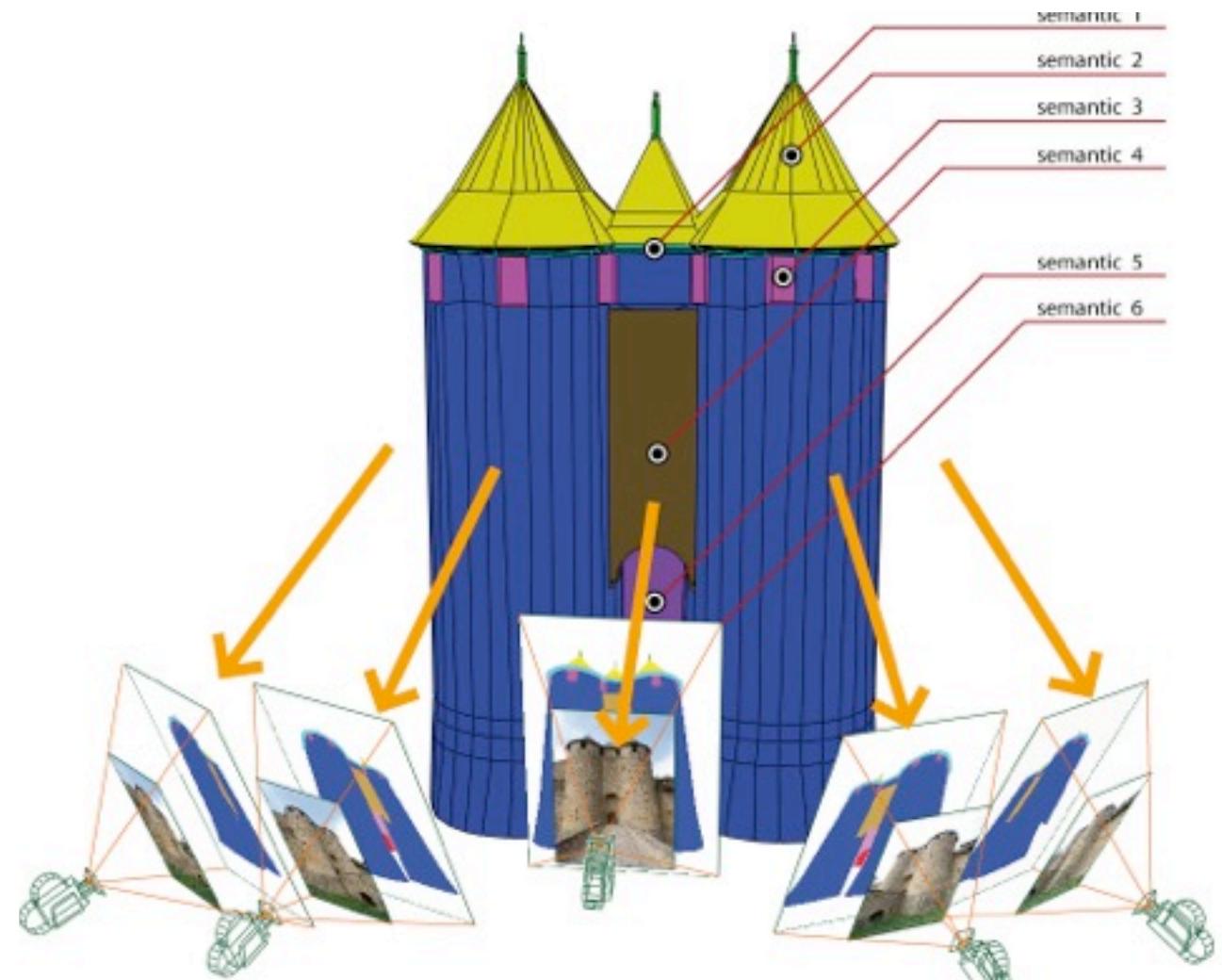
Image segmentation according to the morphology description



2D/3D semantic annotation

PhD Thesis of Chawee Bussarayat, MAP-Gamsau (2006-2010)

Image segmentation according to the morphology description





An integrated platform for describing, analysing, documenting and sharing digital representations of heritage buildings

De Luca L., Bussayarat C., Stefani C., Véron P., Florenzano M. **A semantic-based platform for the digital analysis of architectural heritage**
Computers & Graphics. Volume 35, Issue 2, April 2011, Pages 227-241. Elsevier, april 2011

NUBES Web-based platform | Enriching 3D models



General 3D scene

A screenshot of a web-based application showing a detailed 3D model of a capital and its corresponding qualitative description table.

Chapiteau SGD0010
Délégué: Chapiteau
N° Inventaire: SGD0010
Dépositaire: ICN INCA
Protection: propriété de la commune
Démonstrations: n = 28 , l = 24 , pr = 45
Matériau: Calcaire Blanc
Uso de conservation:
Description: Chapiteau en calcaire blanc provenant d'une église de l'abbaye. Il servait à l'ancienne église de l'abbaye de Saint-Guilhem-le-Désert. Il est conservé dans un bâtiment dédié au Musée lapidaire de Saint-Guilhem-le-Désert. Il fait partie d'un ensemble de deux chapiteaux de la nef de l'église abbatiale.

Qualitative description

Querying for
qualitative attributes
in the 3D scene

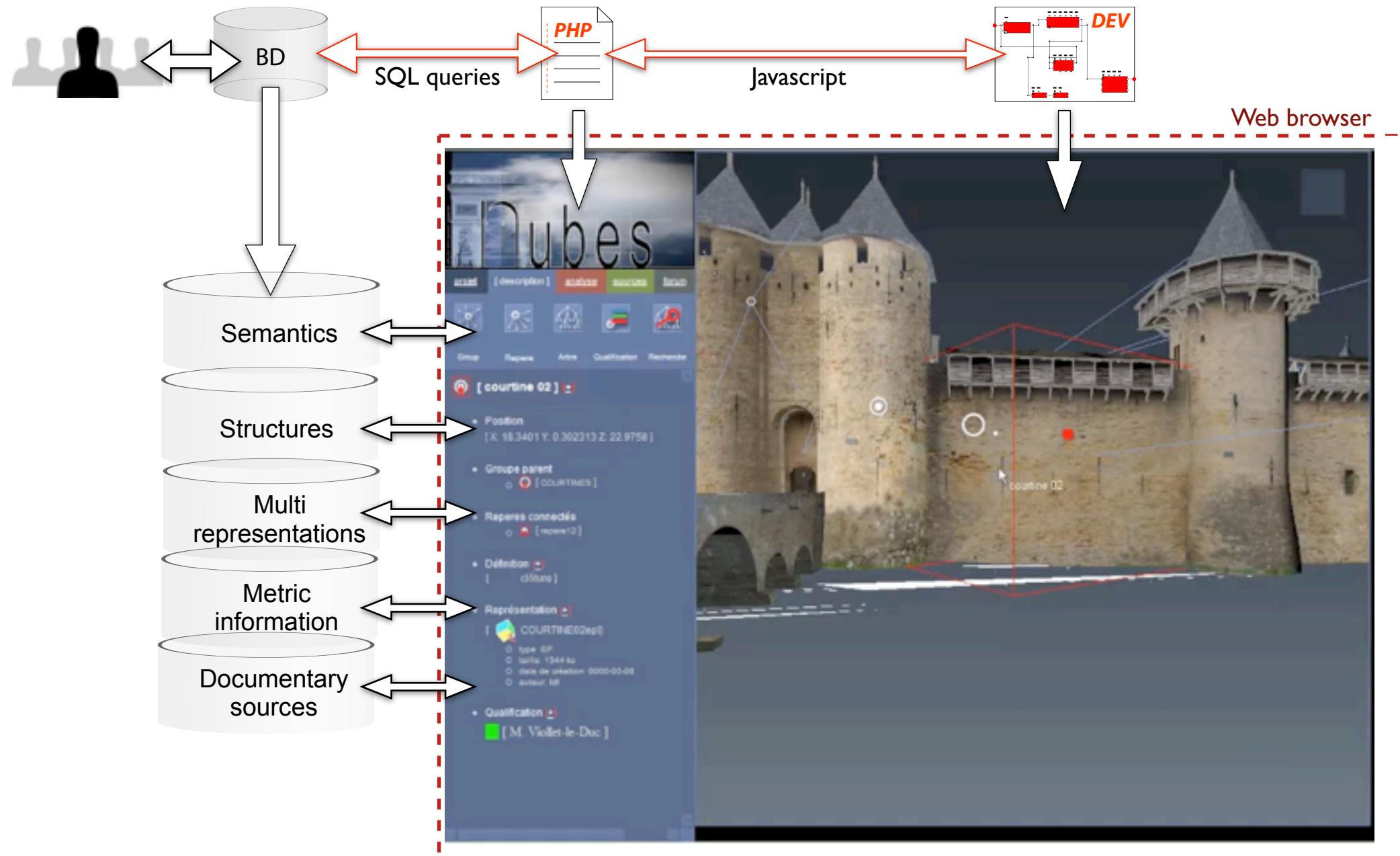


- Musée lapidaire de Saint-Guilhem-le-Désert
- The Cloisters, New York
- Société archéologique de Montpellier

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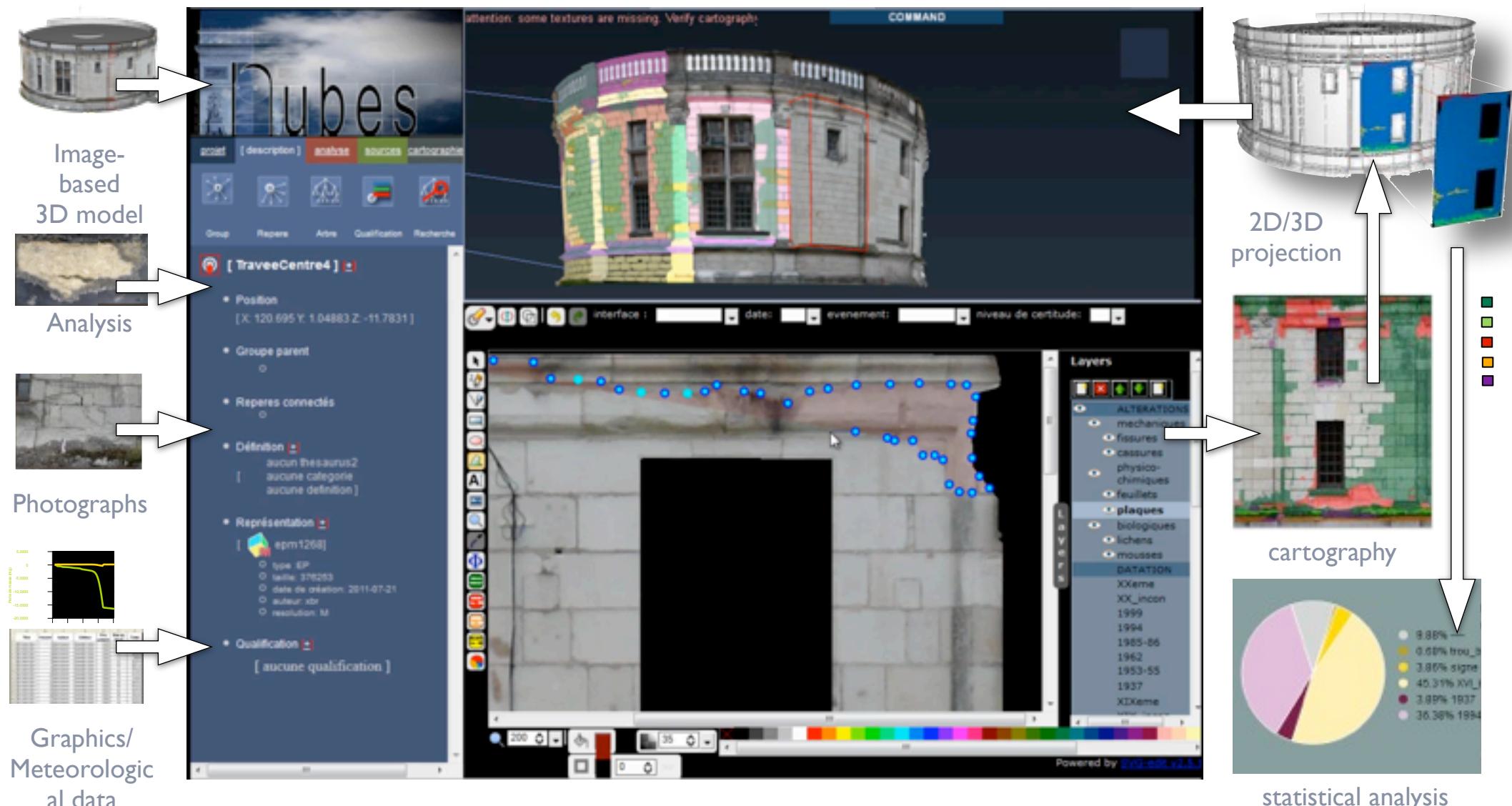
NUBES Web-based platform | Enriching 3D models



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NUBES Web-based platform | Enriching 3D models



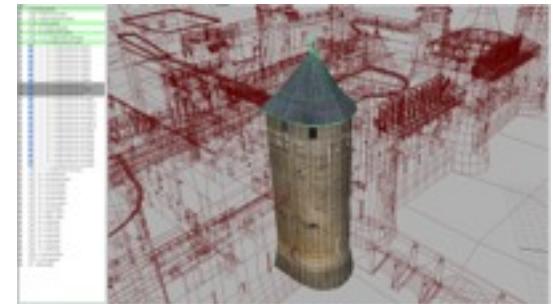
Case study | Documentation of stone alterations

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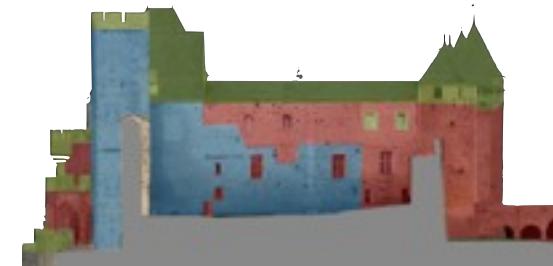
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2D/3D semantic annotation

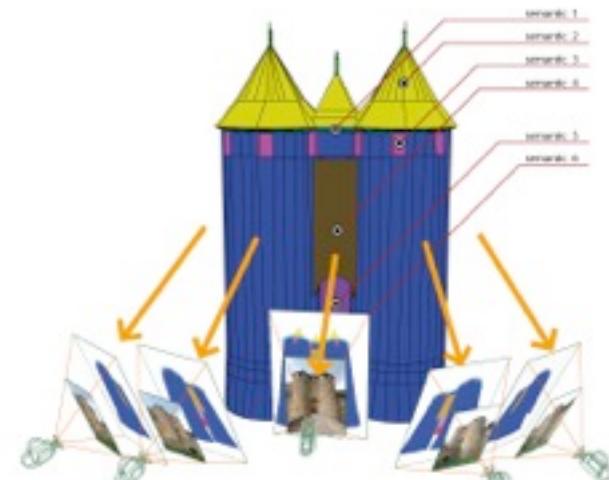
Locus Imaginis Project



semantic layer



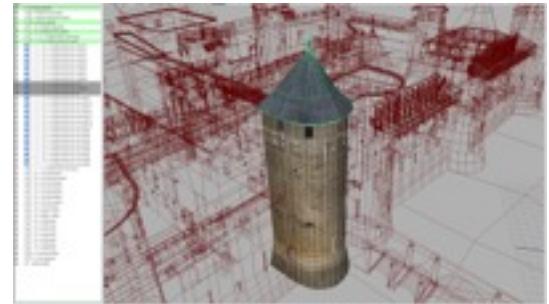
temporal layer



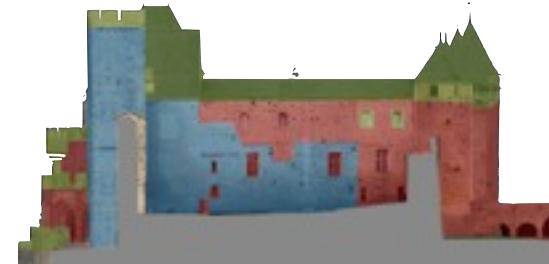
2D/3D projection

2D/3D semantic annotation

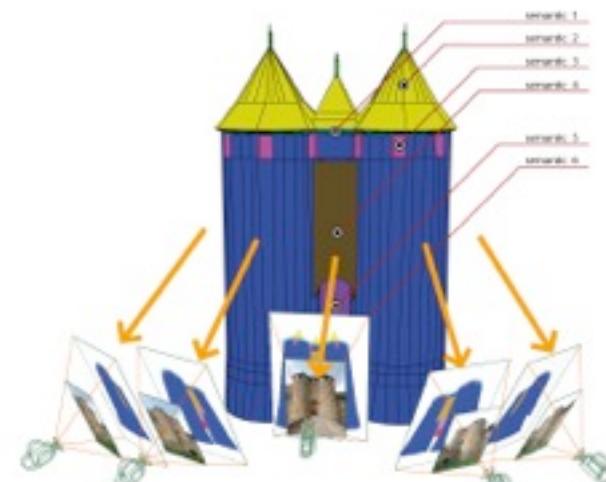
Locus Imaginis Project



semantic layer



temporal layer



2D/3D projection

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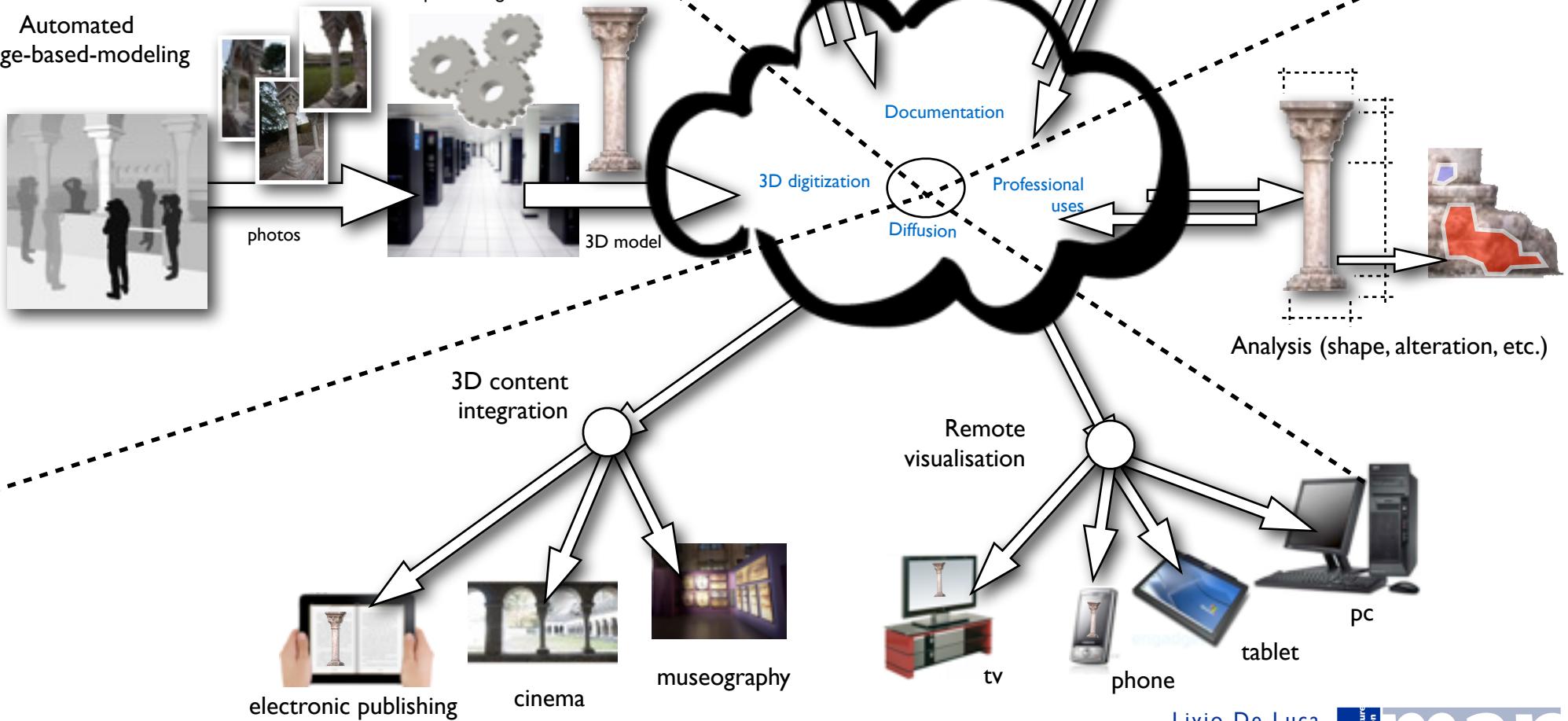
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NUBES is moving to a Cloud Computing infrastructure

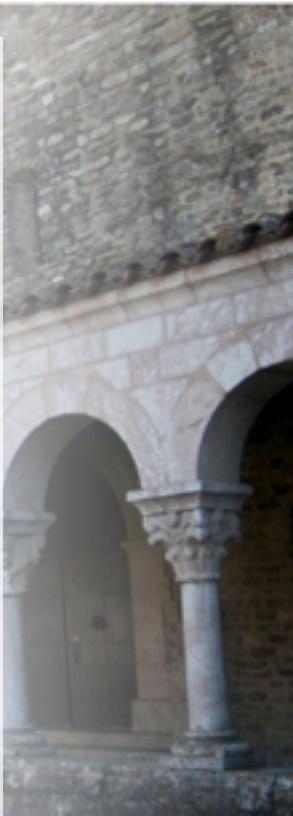
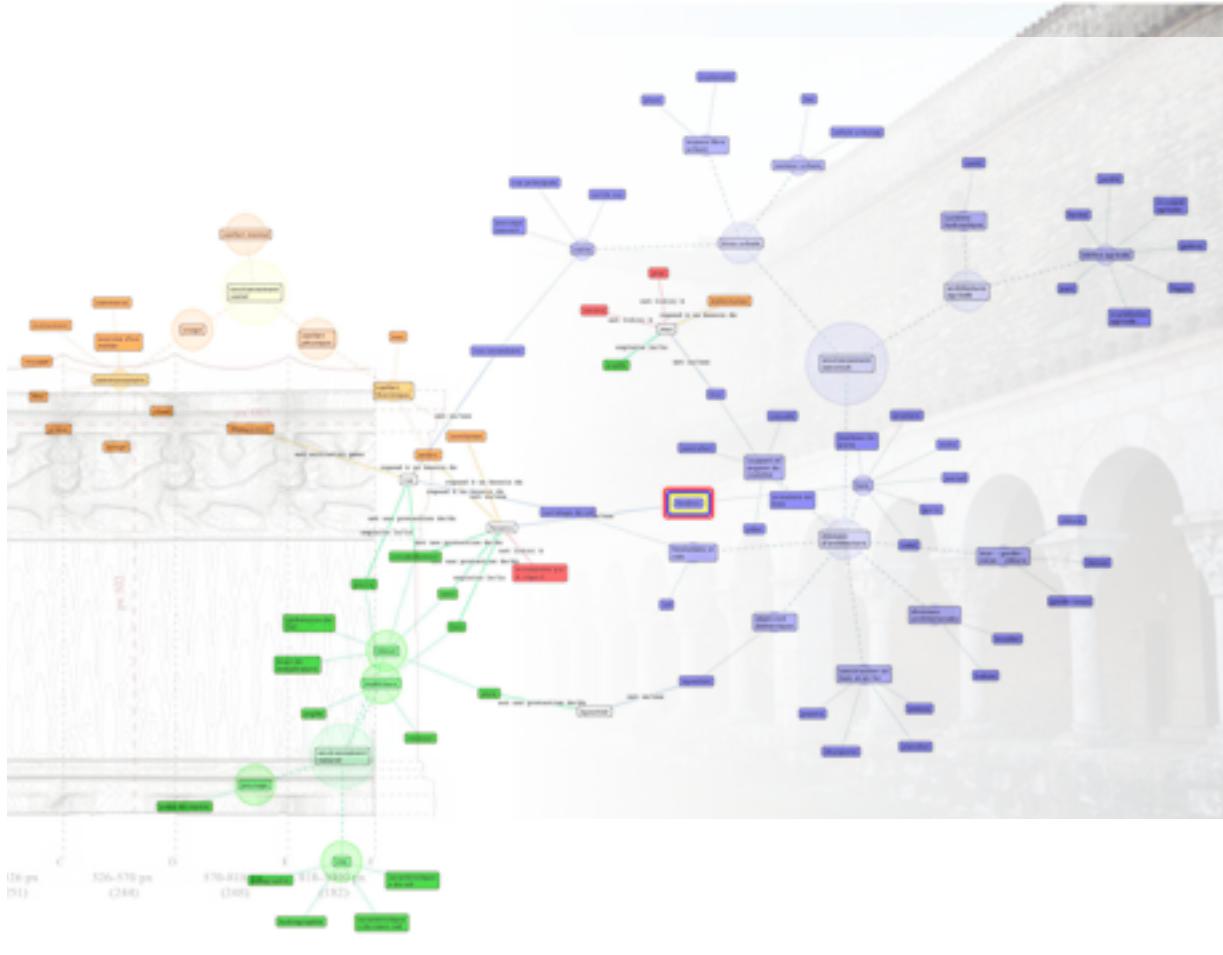
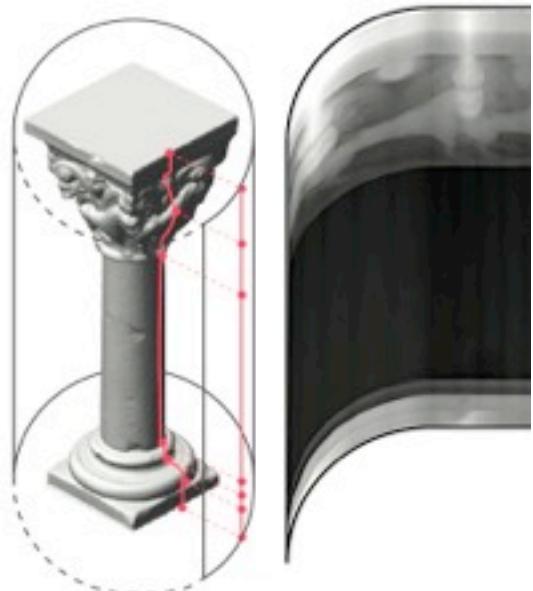
Culture 3D Clouds Project

Ministry of Industry
Ministry of Culture

Automated
Image-based-modeling



Thank you



livio.deluca@map.archi.fr

www.map.archi.fr

www.map.archi.fr/nubes

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