

# Rendre « intelligent » les nuages de points 3D

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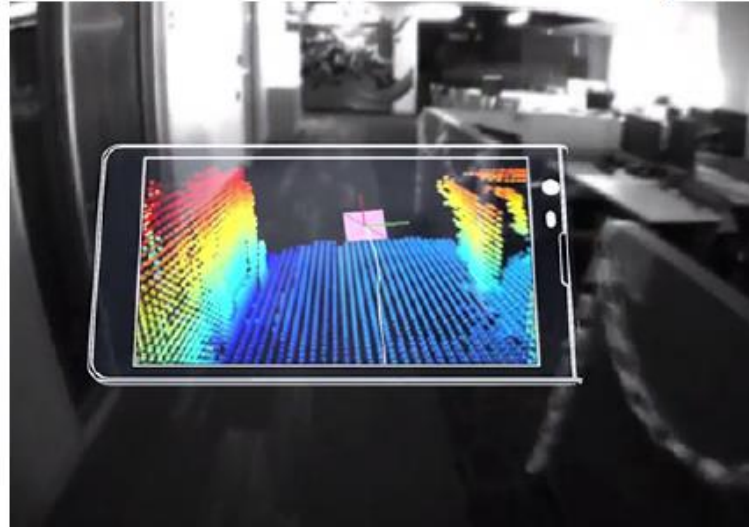
# Applications 3D émergentes

## Robot Perception



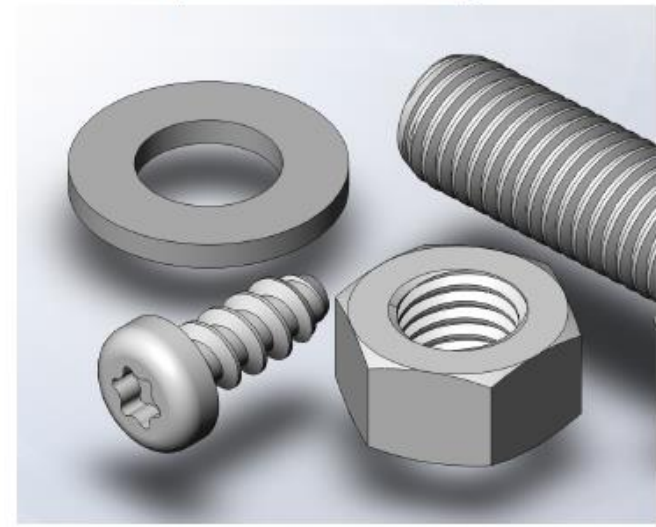
source: Scott J Grunewald

## Augmented Reality



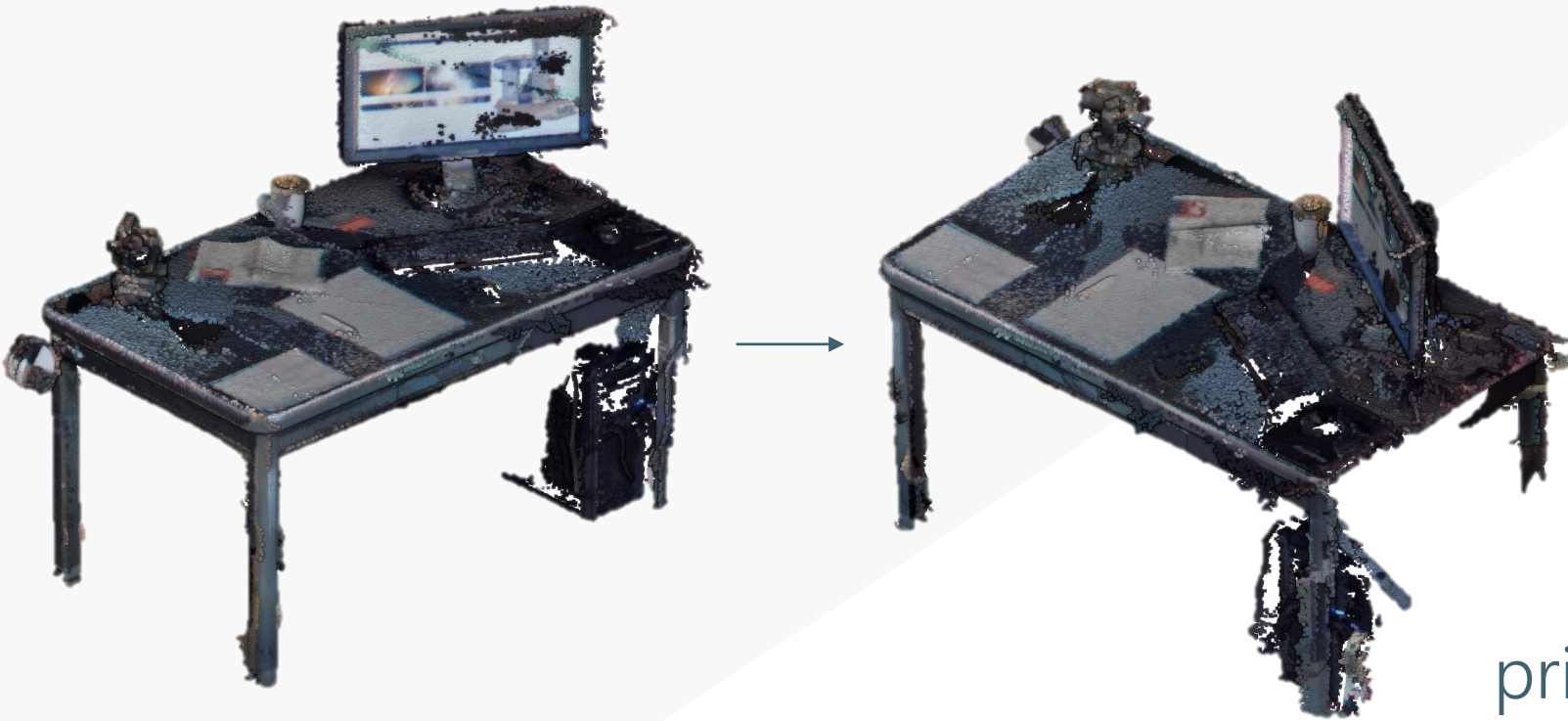
source: Google Tango

## Shape Design



source: solidsolutions

# Représentations 3D



Multi-view image

Depth map

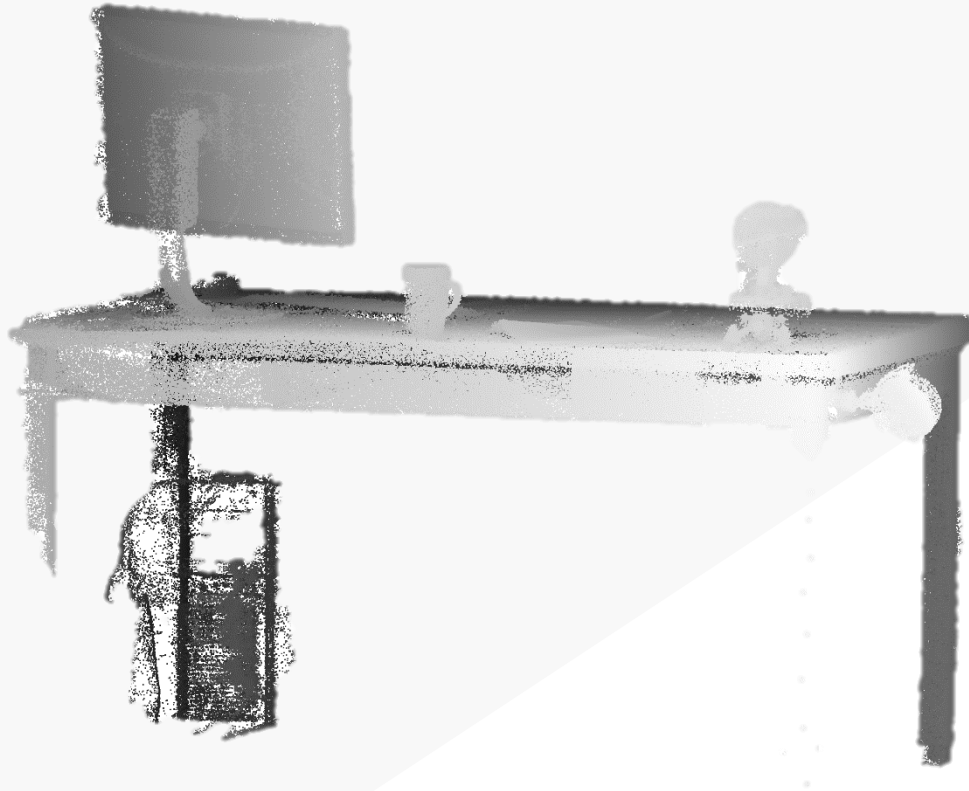
Volumetric

Polygonal mesh

Point Cloud

CAD / parametric /  
primitive-based models

# Représentation 3D



Multi-view image

**Depth map**

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# Représentation 3D



Multi-view image

Depth map

**Volumetric**

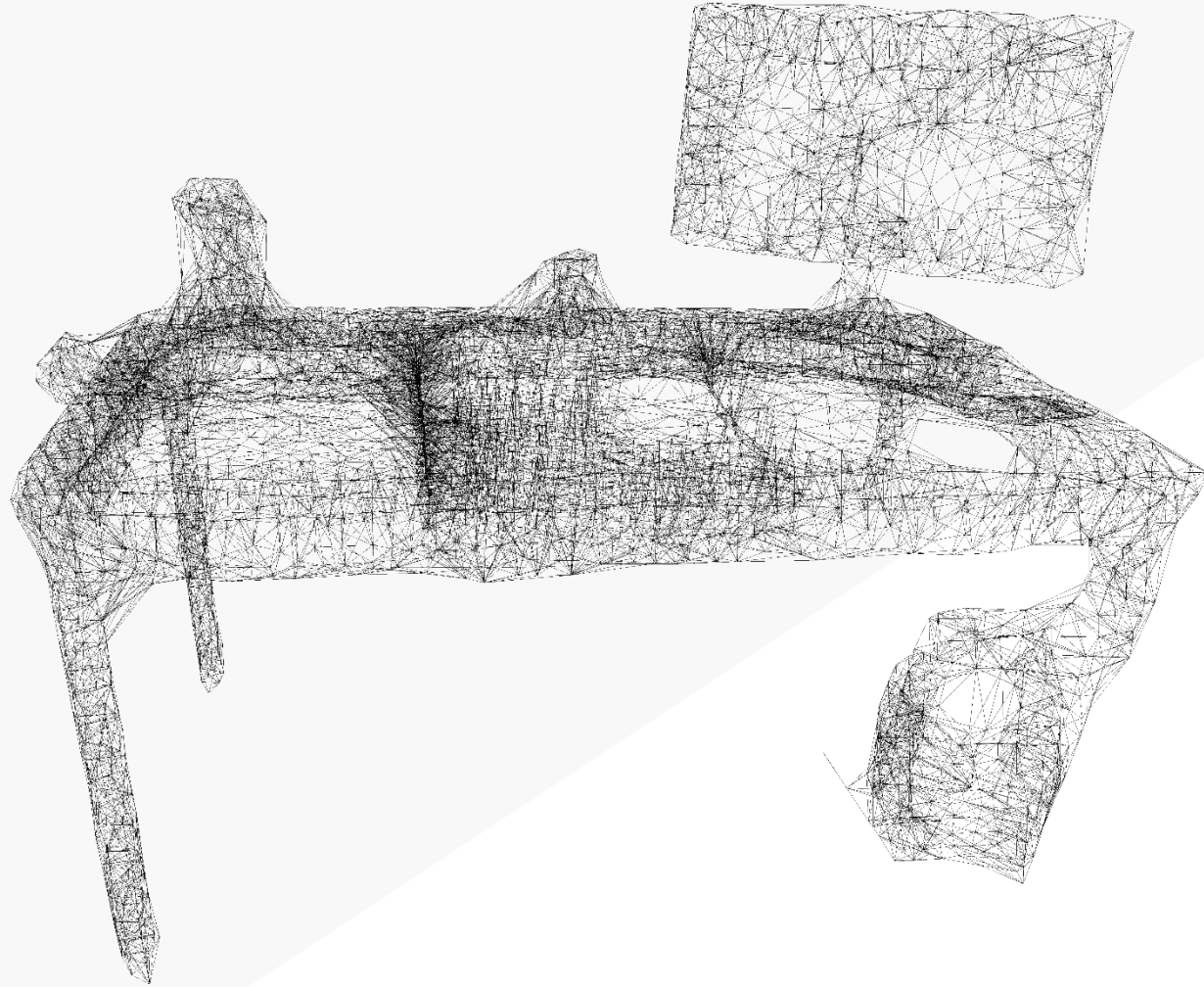
Polygonal mesh

Point Cloud

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# Représentation 3D



Multi-view image

Depth map

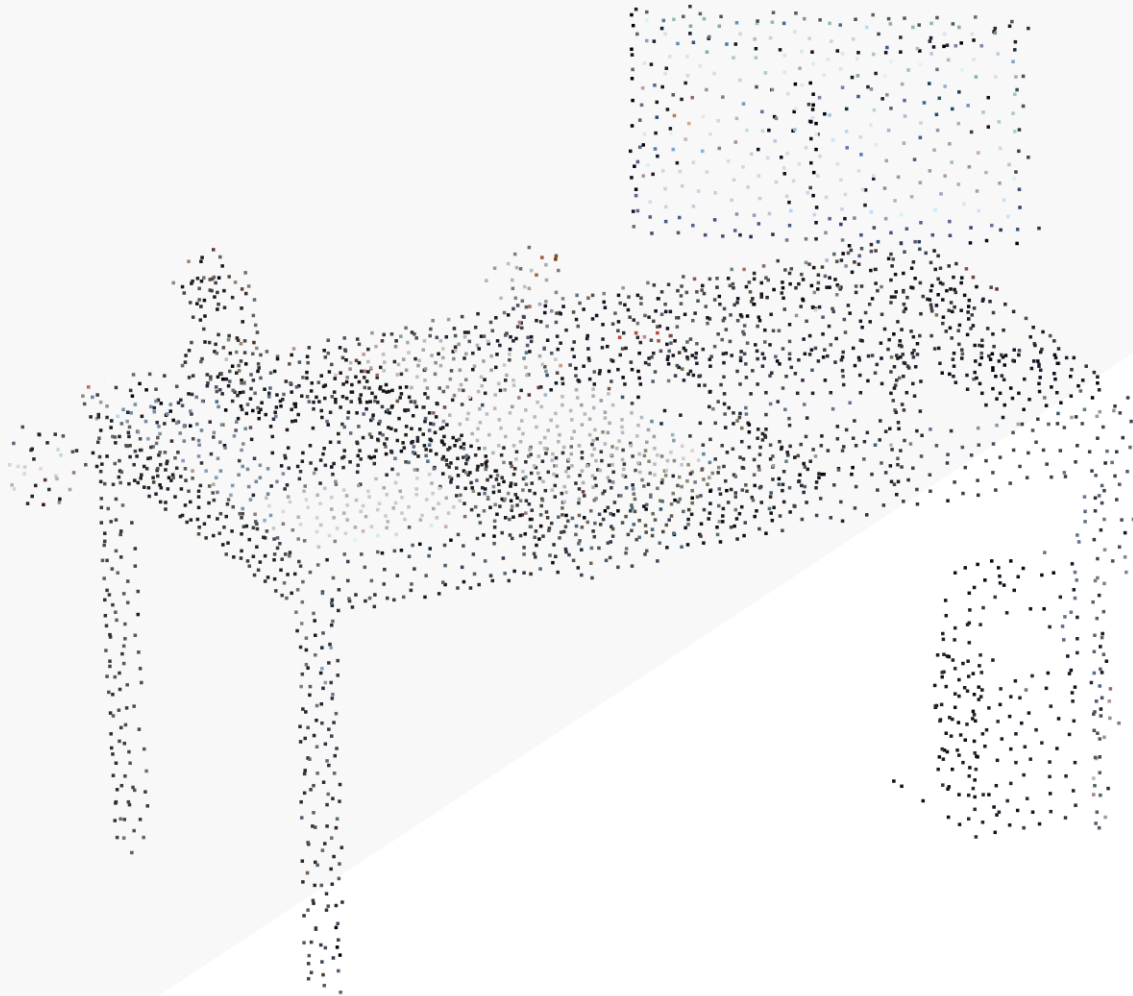
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# Représentation 3D



Multi-view image

Depth map

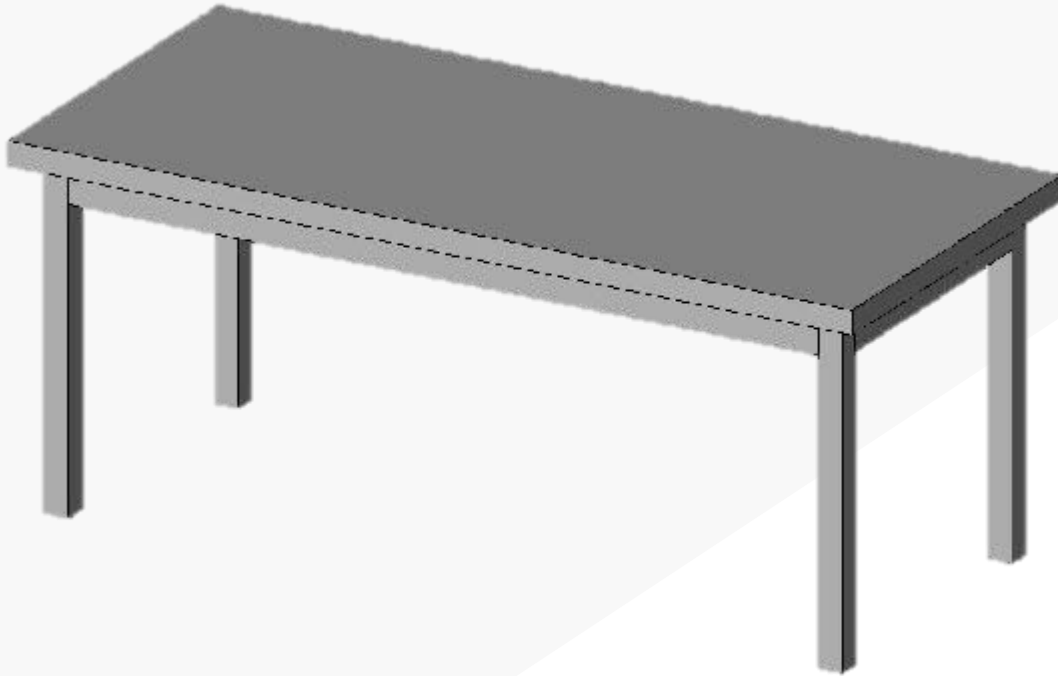
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# Représentation 3D



Multi-view image

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# Perception cognitive



*" when we open our eyes on a familiar scene, we form an immediate impression of recognizable objects, organized coherently in a spatial framework " (Treisman, 1980)*

*" Lorsque l'on ouvre nos yeux sur une scène familière, nous formons une impression immédiate des objets reconnaissables, organisée de manière cohérente dans un contexte spatial " (Treisman, 1980)*

# Perception cognitive



*" when we open our eyes on a familiar scene, we form an immediate impression of recognizable objects, organized coherently in a spatial framework " (Treisman, 1980)*

Perception

Décision cognitive

Action



Environment

# Cognitive perception



*" when we open our eyes on a familiar scene, we form an immediate impression of recognizable objects, organized coherently in a spatial framework " (Treisman, 1980)*

Perception

Décision cognitive

Action



# Perception 3D



*" when we open **our eyes** on a **familiar scene**, we form an immediate impression of recognizable objects, organized coherently in a **spatial framework** " (Treisman, 1980)*



***A sensor** captures a **scene**, and the computer will make sense out of gathered data through available **knowledge** and output a **semantic representation**.*

***un capteur** capture une **scene**, et l'ordinateur va la transformer en **representation sémantique** grâce aux connaissances disponibles et par raisonnement logique/automatique.*



# Perception 3D



- + Bcp d'applications
- + Recherche active
- + Poussée par l'industrie
- Multi-échelle
- Multi-capteur
- Multi-methodologie



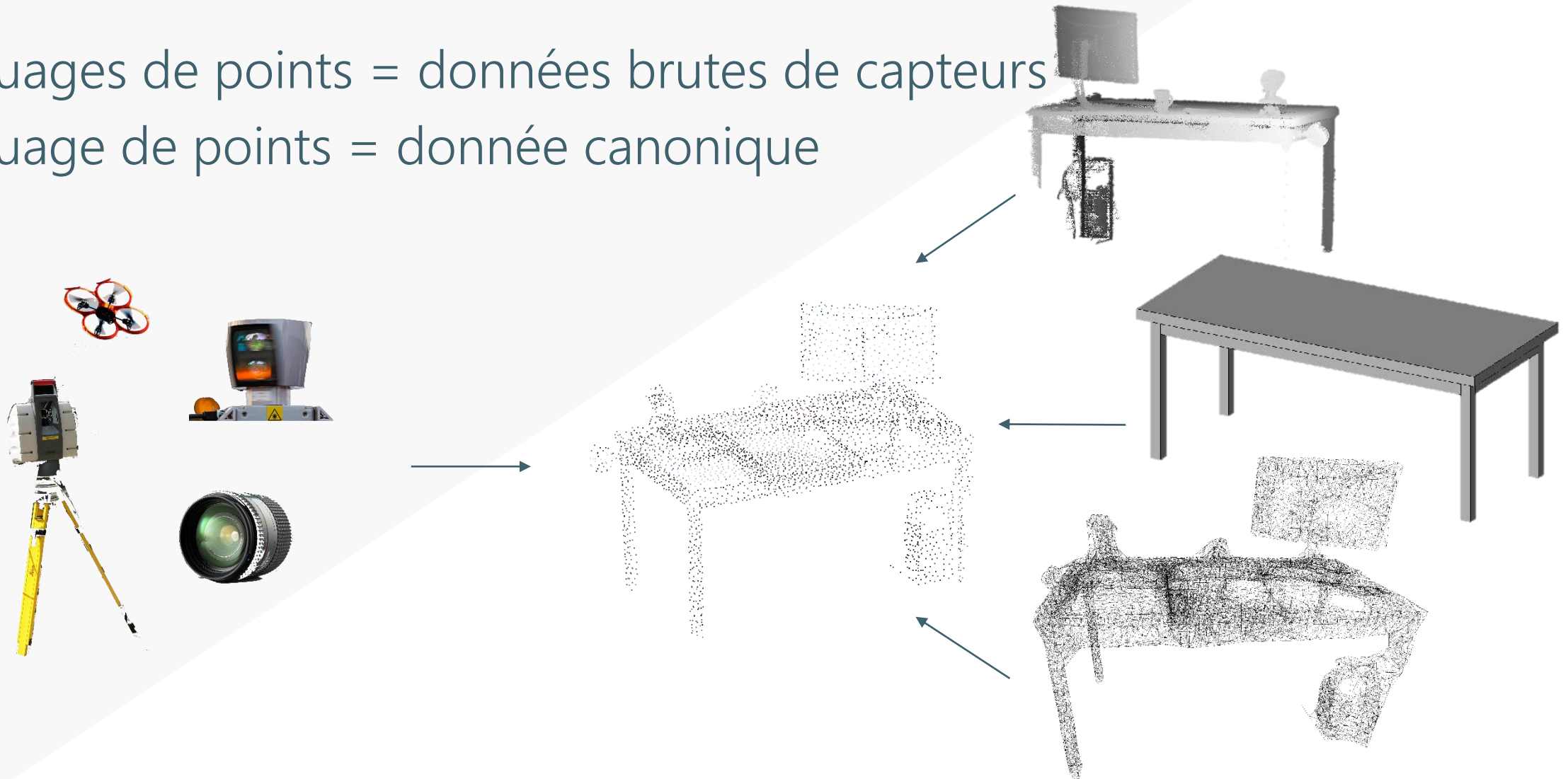
# Représentation 3D : les nuages de points

- ✓ Nuages de points = données brutes de capteurs

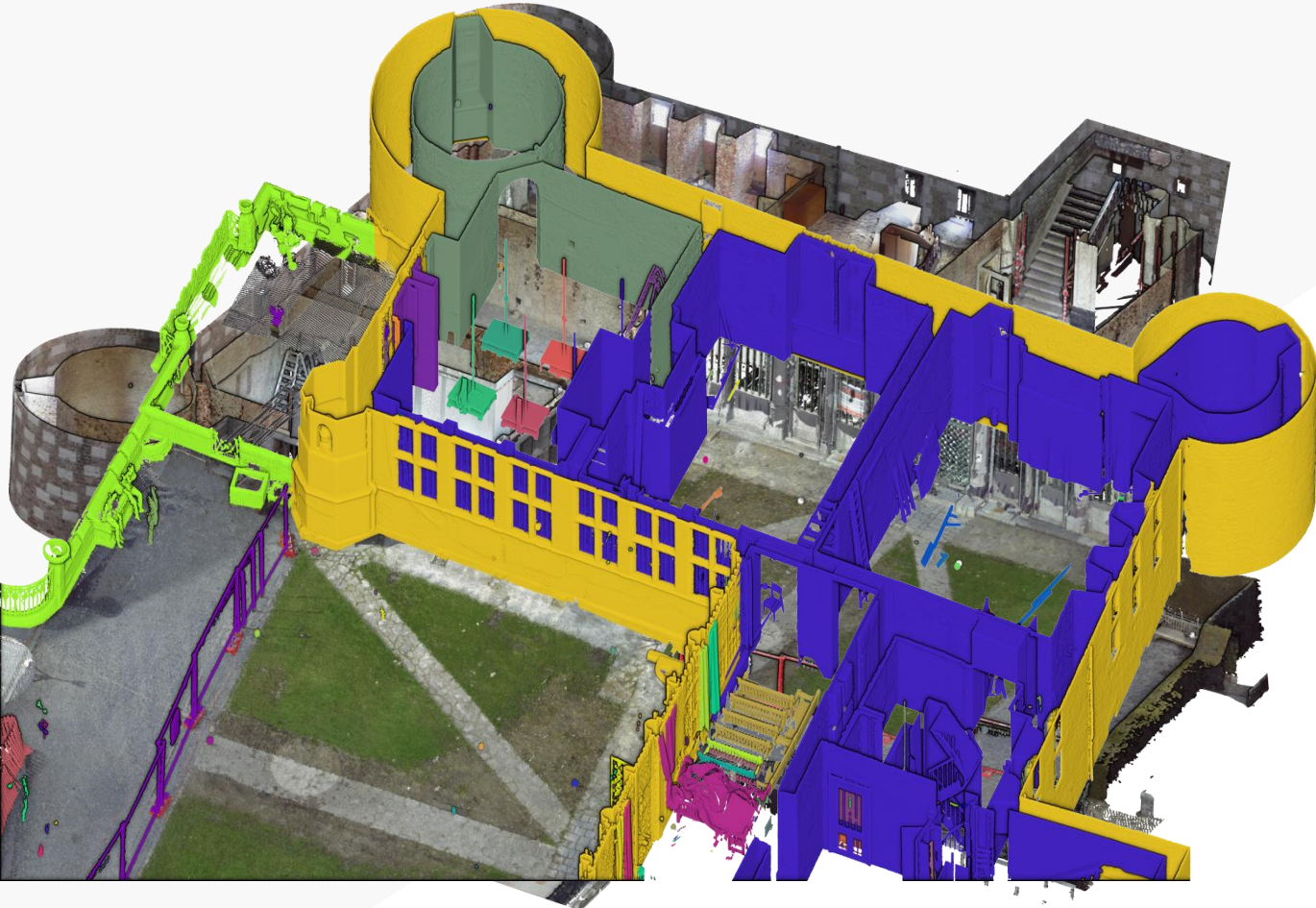


# 3D Representation : Point Clouds

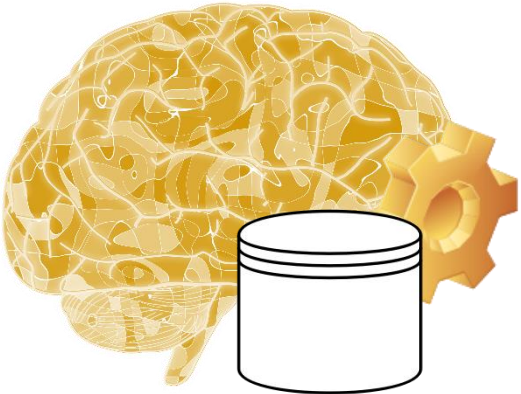
- ✓ Nuages de points = données brutes de capteurs
- ✓ Nuage de points = donnée canonique



# Semantique & Intégration de connaissances



Aujourd'hui  
← BUT →



CONNAISSANCE

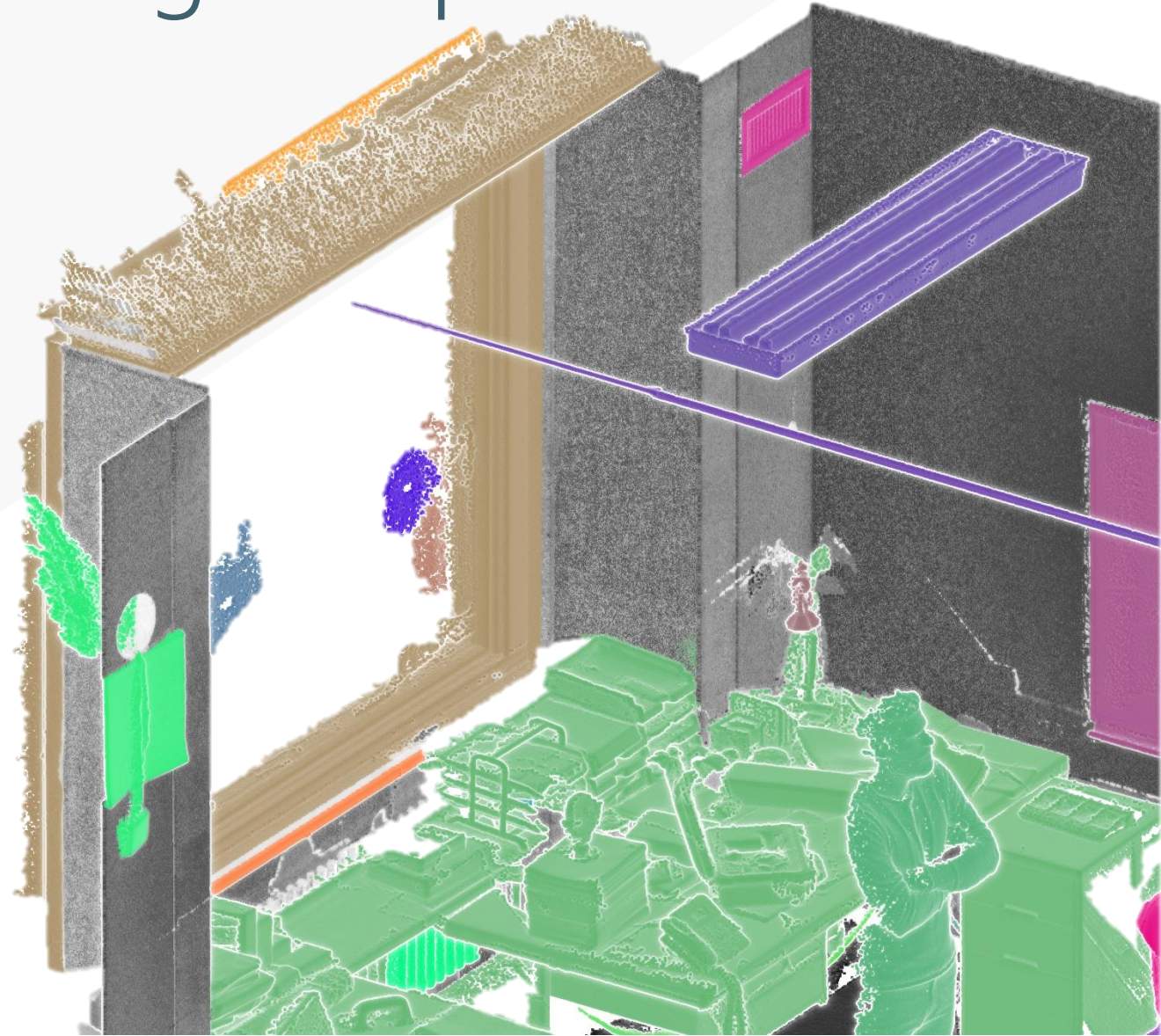
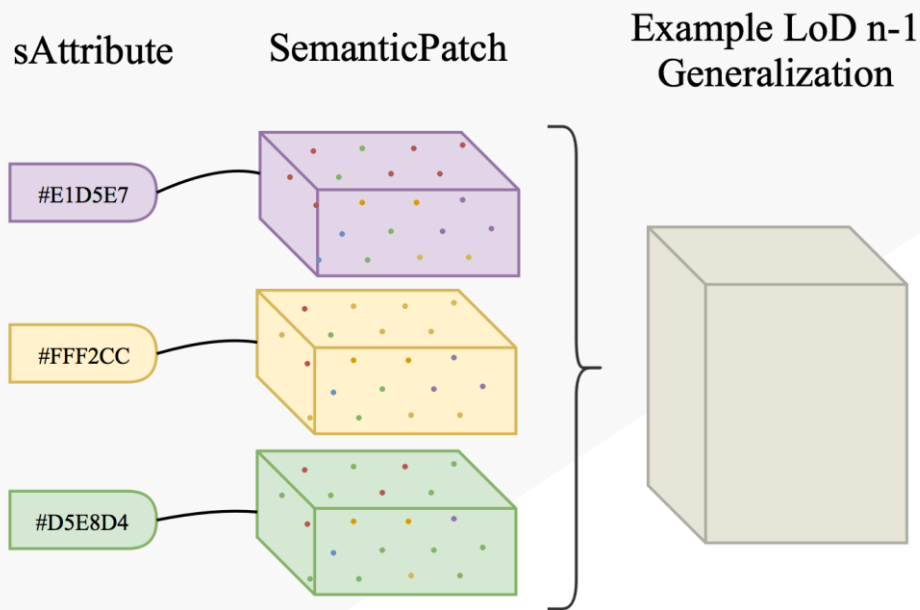


EXTRACTION D'INFORMATION  
plan, Mesures, Simulation, ...

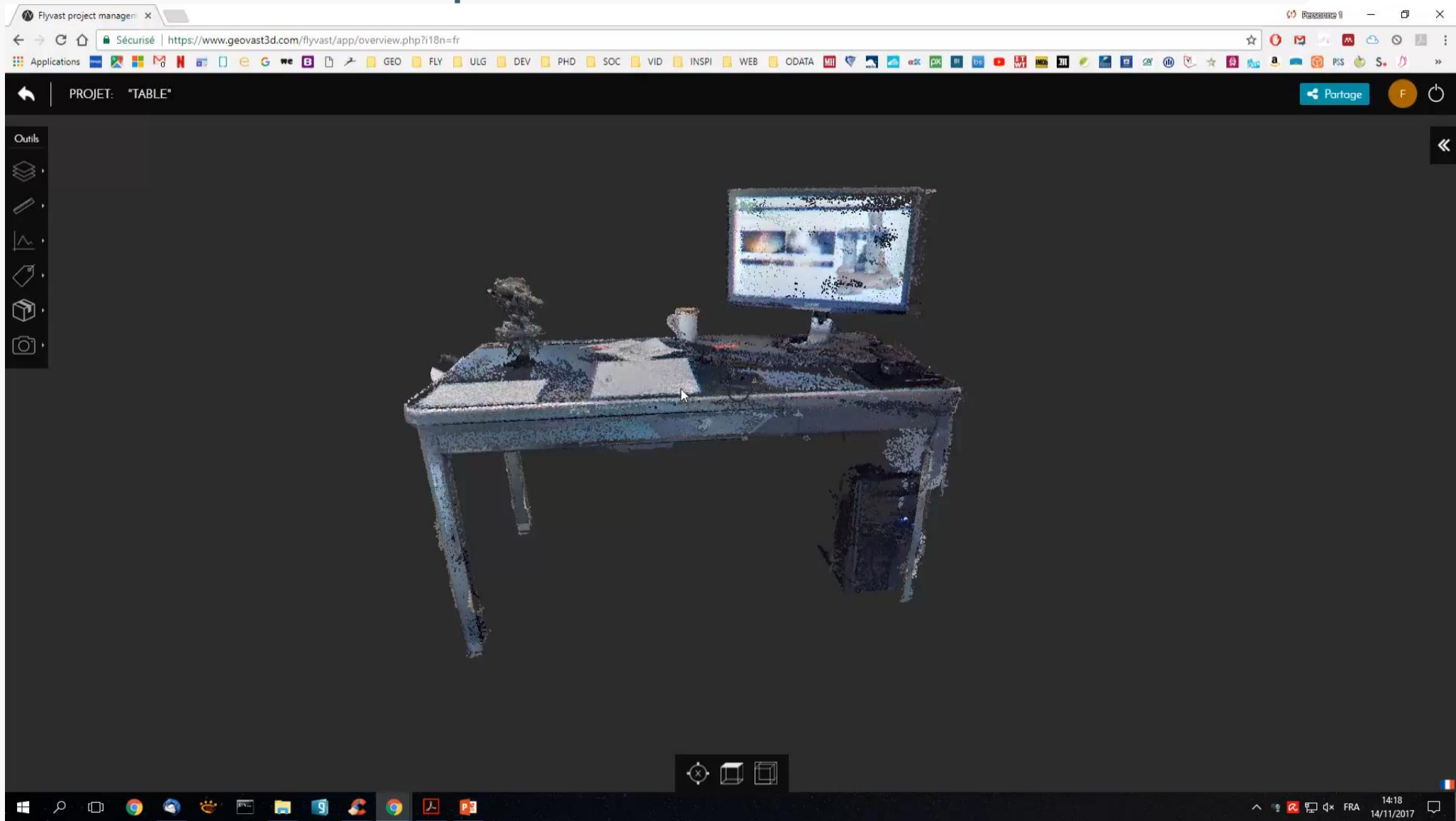


# Spécificité du nuage de points

*Unstructuré et trop volumineux pour une liaison DBMS un point par ligne*



# Compréhension de scène





# Décision cognitive



*" when we open our eyes on a familiar scene, we form an immediate impression of recognizable objects, organized coherently in a spatial framework " (Treisman, 1980)*

Perception

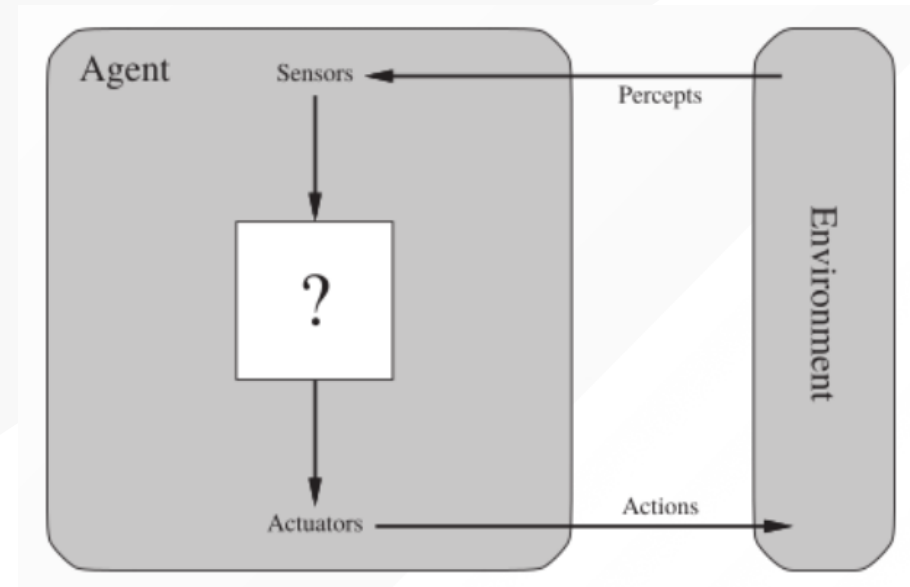
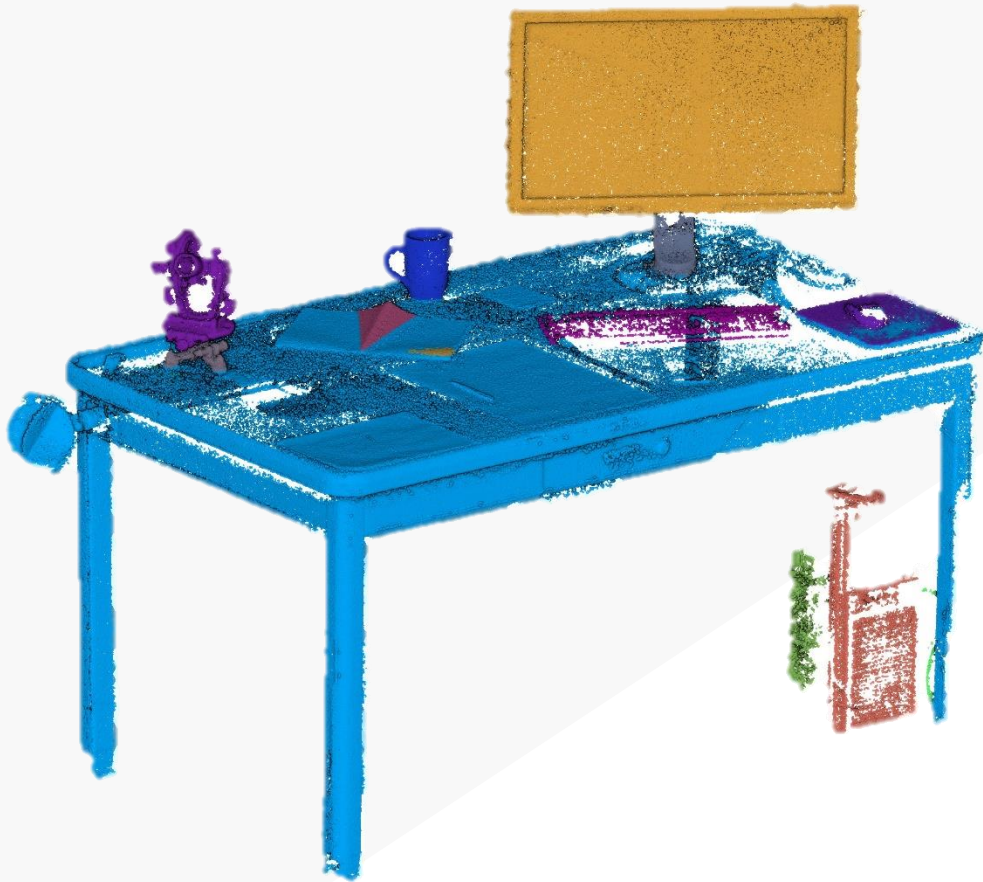
Cognitive Decision

Action



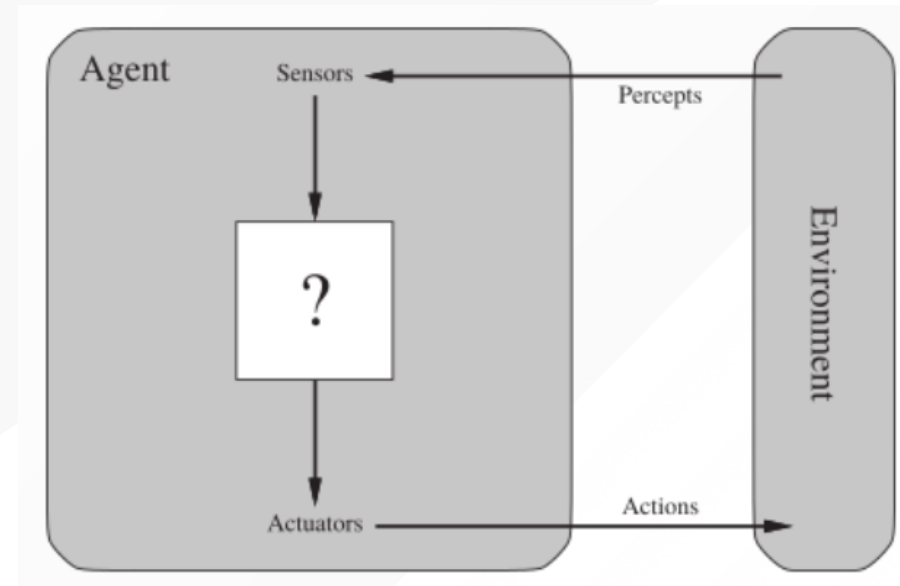
Environment

# Intelligence artificielle



L'agent agit au travers « d'Actuators. »

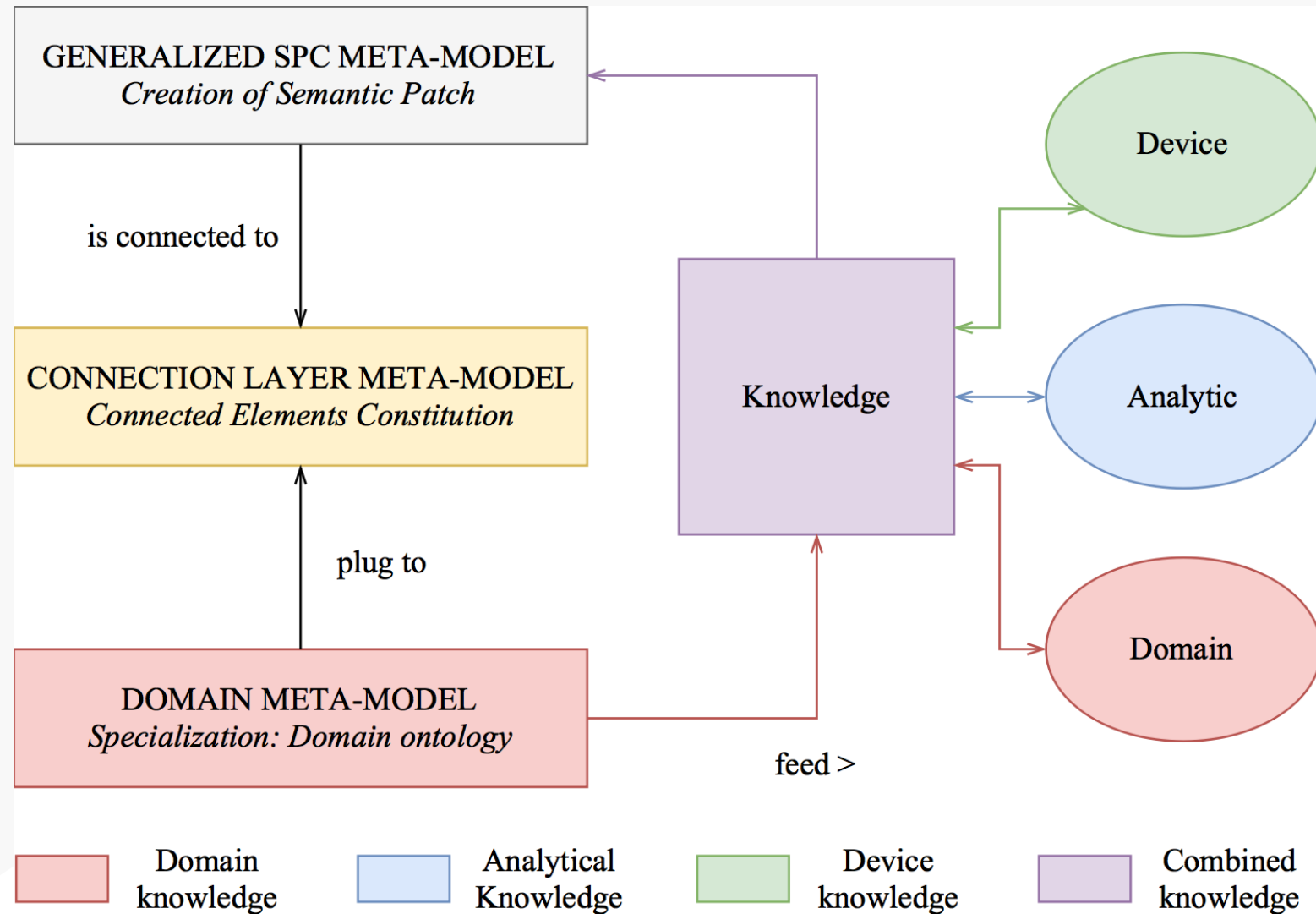
# Artificial Intelligence



Actuator definition (ex: Je dois avoir ma chaise à cette position optimale pour café + écran + clavier/souris)

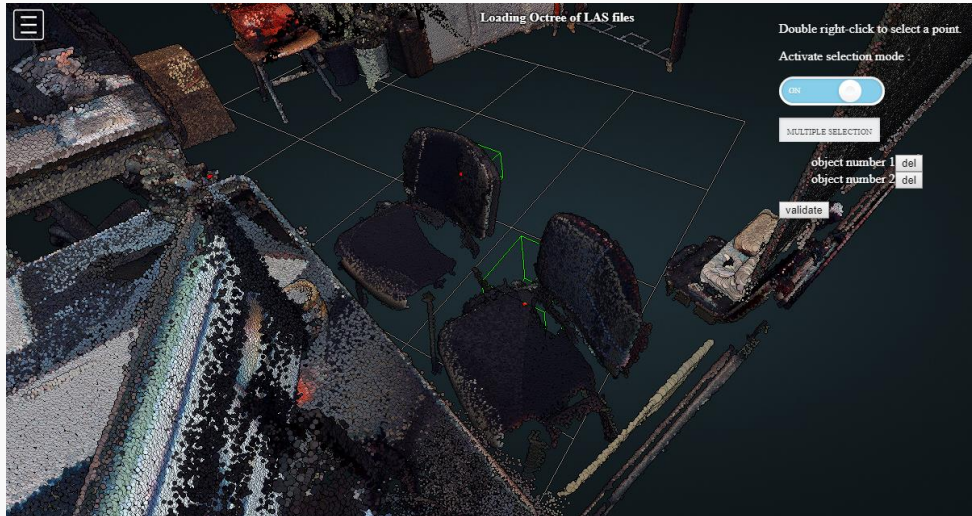
Comment structurer les nuages de points 3D pour intégrer les connaissances tout en conservant flexibilité et interopérabilité ?

# Modèle conceptuel du « Smart Point Cloud »





# Prototype



**Pointcloud name : CC\_v1 | database : SPC\_test**  
**Number of points : 154908**  
**Object(s) selected : CEL0011;**

Select again

points\_attributes: RGB

points\_size: 0.005

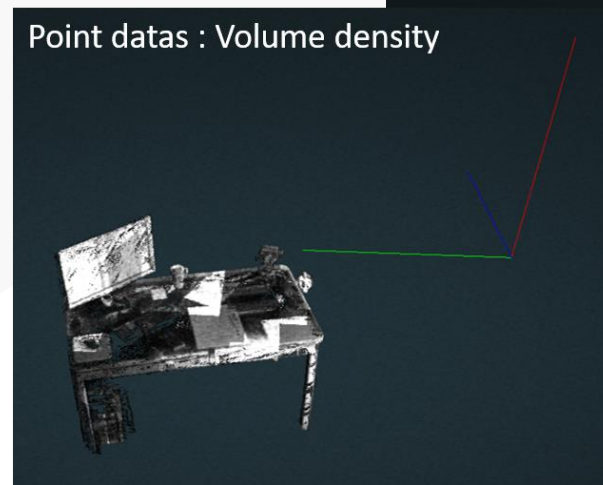
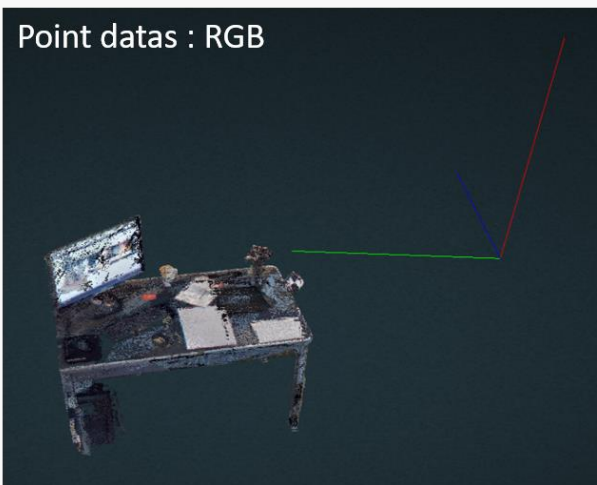
display:

Close Controls

**Enter object characteristics**

Type :

Usage :



Abs. level	Goal	SQL Statement
0	I want to select the 'semanticpatches' which intersects a defined polygon	SELECT pa FROM semanticpatch WHERE ST_INTERSECT(pa::geometry) = TRUE
0	I want to select all 'semanticpatches' that have been classified	SELECT pa FROM semanticpatch WHERE spclassifstatus = 1
1	I want to select the connected element CEL0011	SELECT pa FROM semanticpatch WHERE connectedelement_id = 11

Loading Octree of LAS files

Double right-click to select a point.

Activate selection mode:

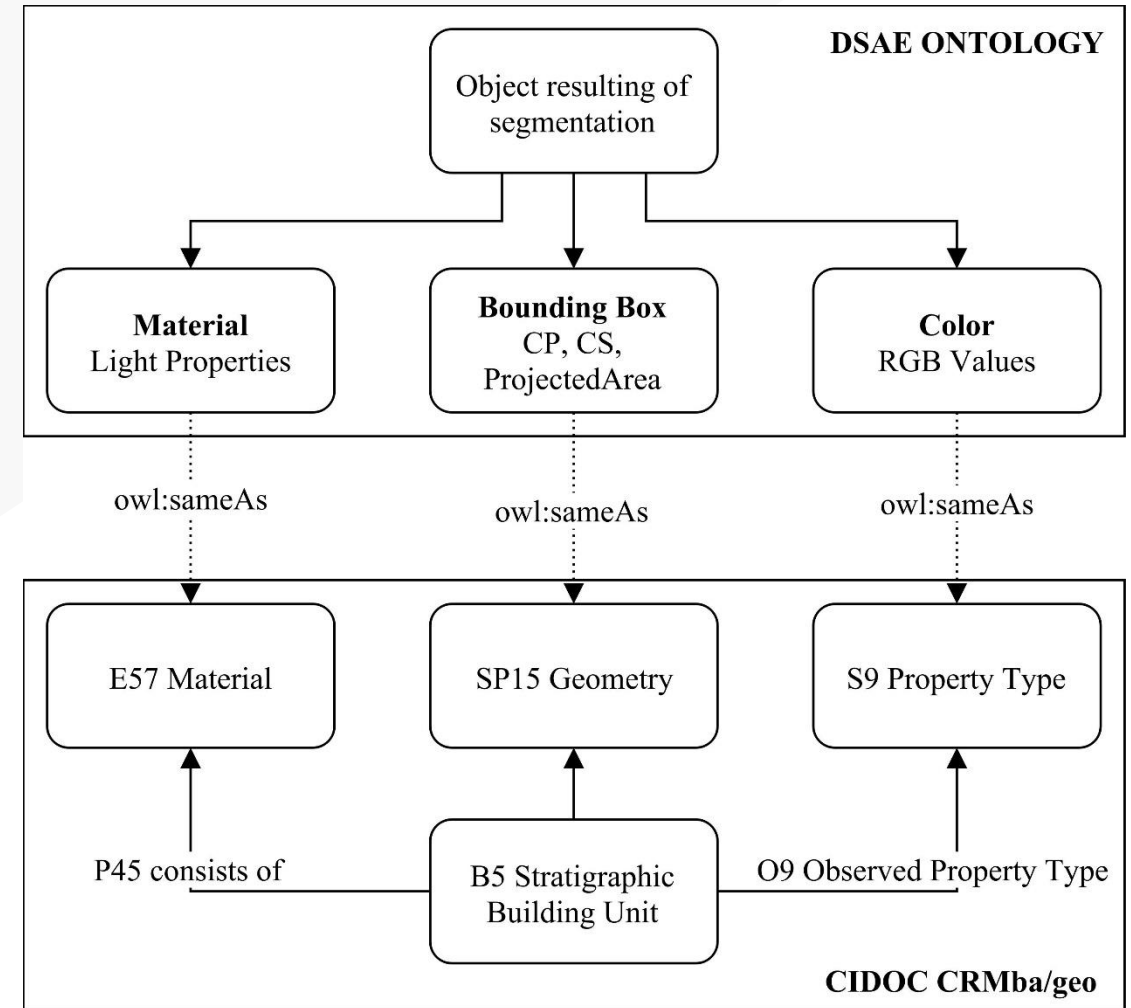
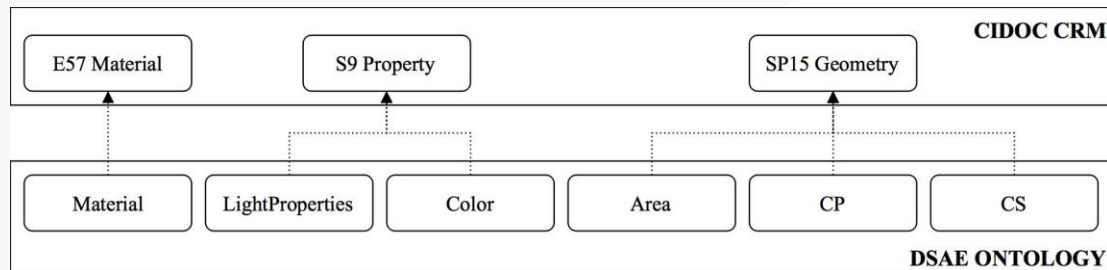
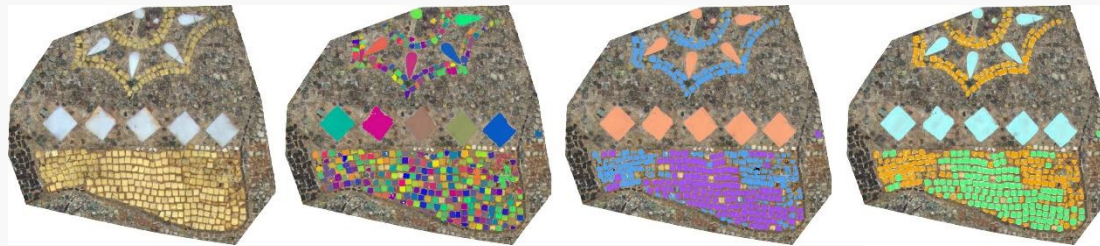
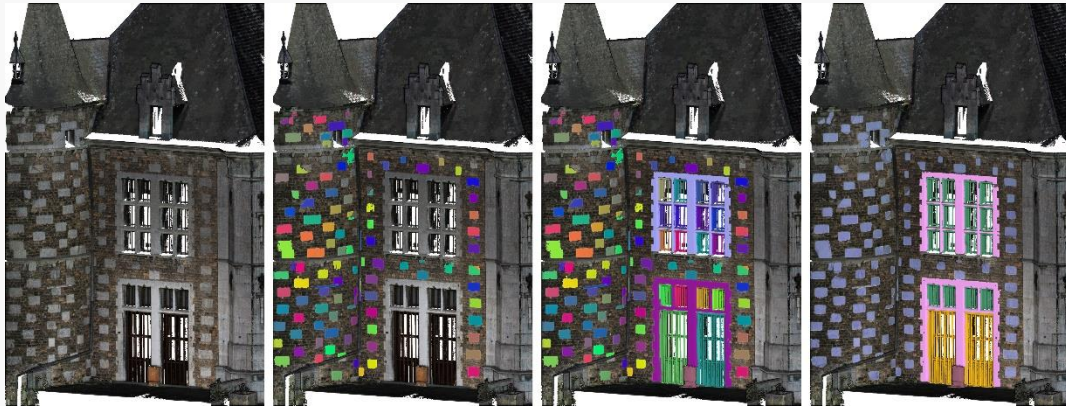
OFF

ALWAYS SELECT

ALWAYS HIT



# Intégration avancée





Merci  
fpoux@uliege.be

Pour aller plus loin:

- 2017, 3D Point Clouds in Archaeology, MDPI Geosciences Journal.
- 2017, Model for semantically rich point cloud data, ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci.
- 2016, Smart Point Cloud: Definition and Remaining Challenges, ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci.

