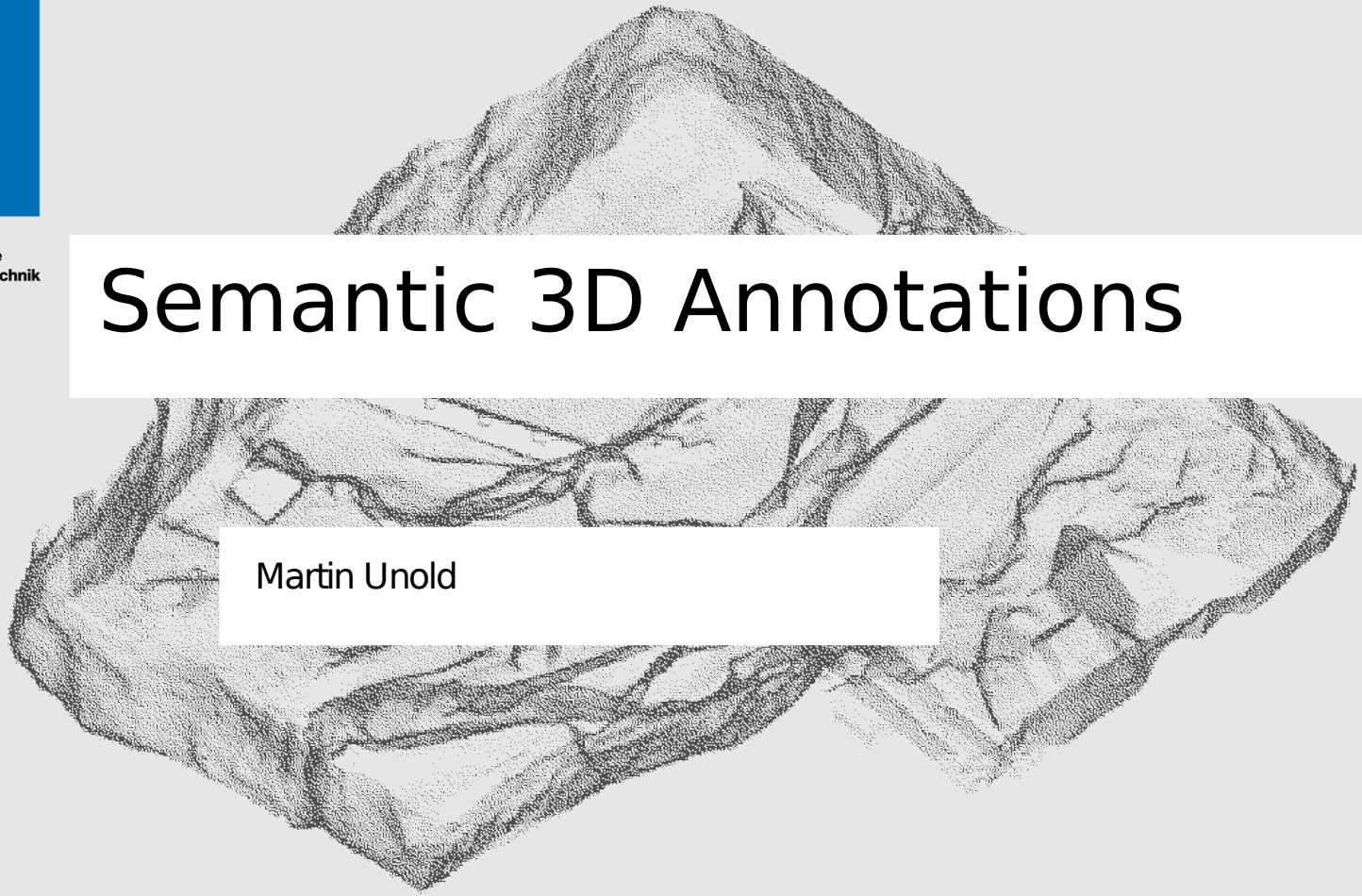
Institut für raumbezogene
Informations- und Messtechnik
Hochschule Mainz

Semantic 3D Annotations



Martin Unold

Outline

- Introduction
- 3D Data
    - Capturing
    - Storing
    - Analysing
- Semantic
    - 3D Annotations
    - GeoSPARQL

Introduction

What we did in our project …

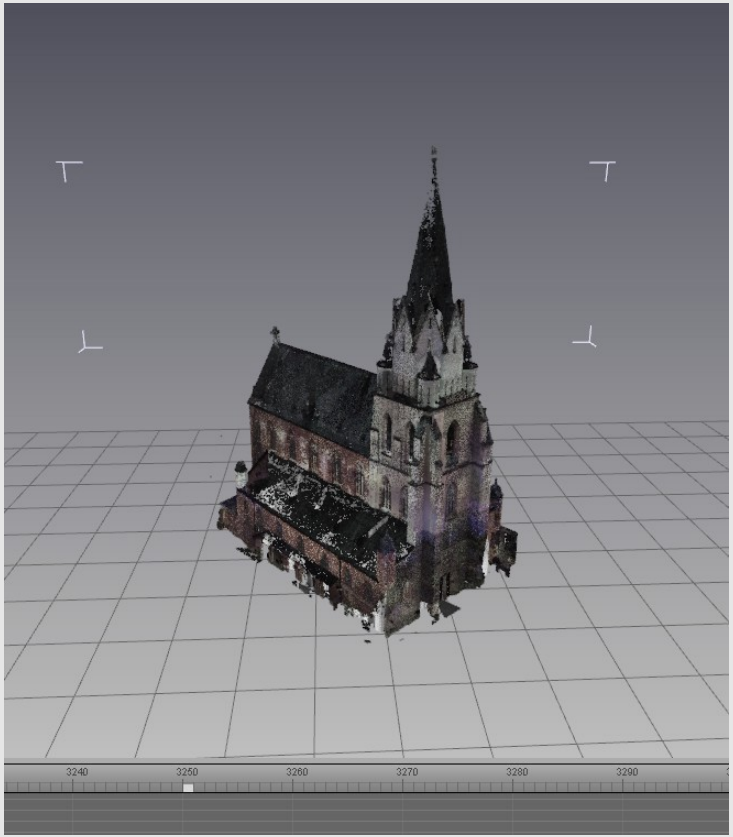
Inscriptions and their spatial context

- BMBF-Project (2012-2015)
  - Akademie der Wissenschaften und der Literatur Mainz
  - Hochschule Mainz
- Website
  www.spatialhumanities.de/ibr

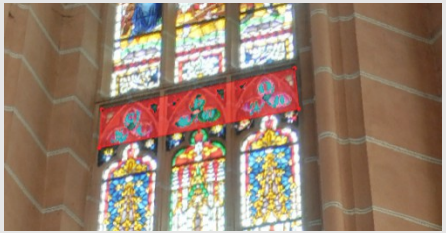
Liebfrauenkirche Oberwesel

Liebfrauenkirche Oberwesel – Laserscan

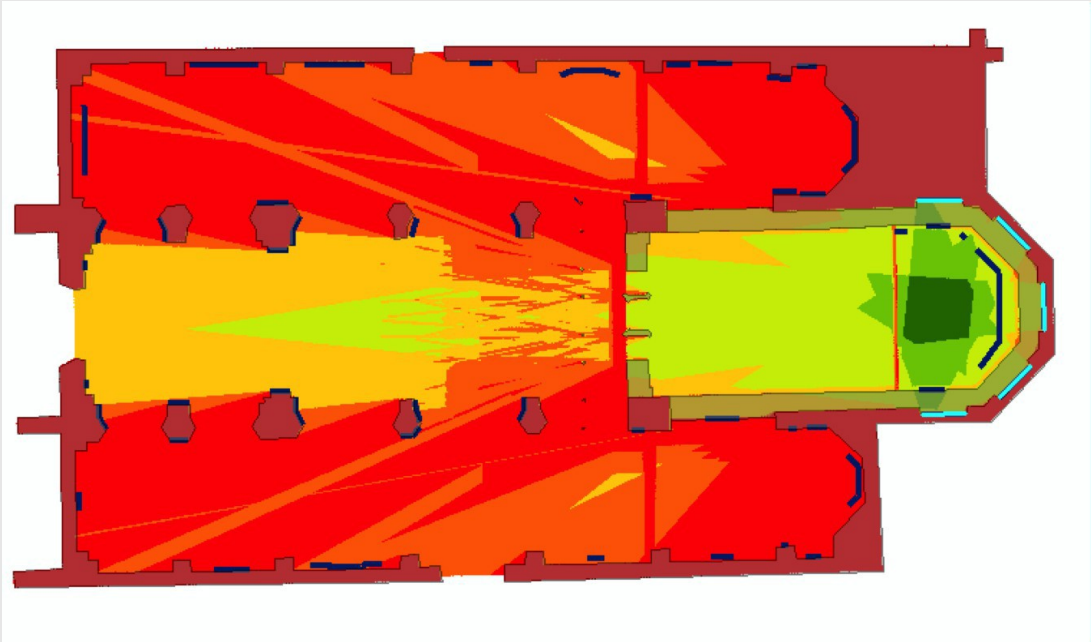
Liebfrauenkirche Oberwesel – Pointcloud

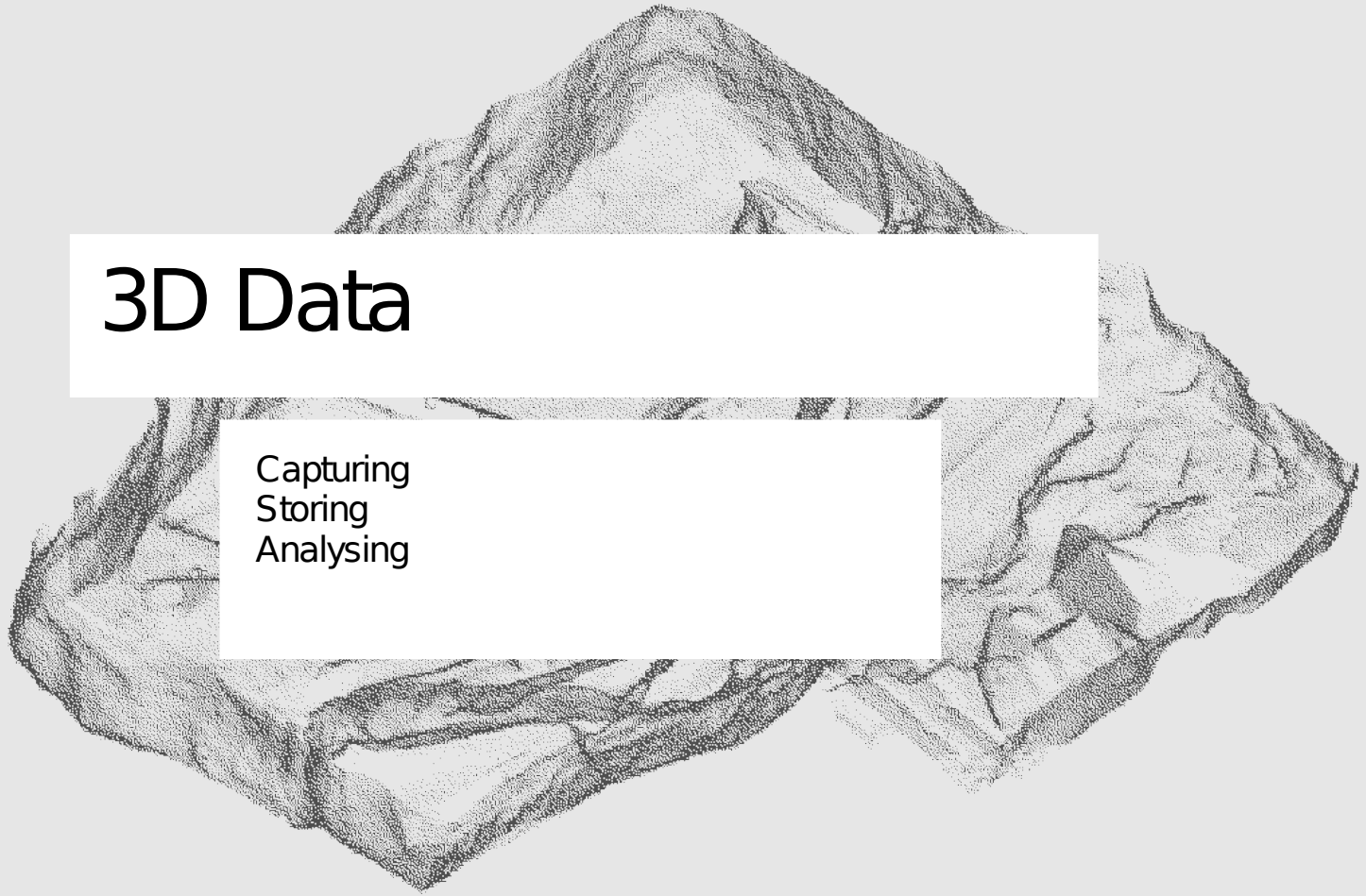


The foundational inscription



Visibility analysis





3D Data

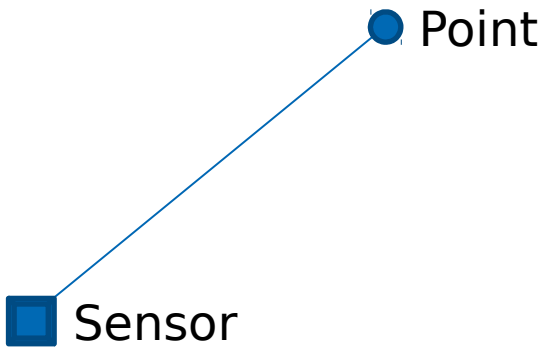
Capturing
Storing
Analysing

What do you want to measure?

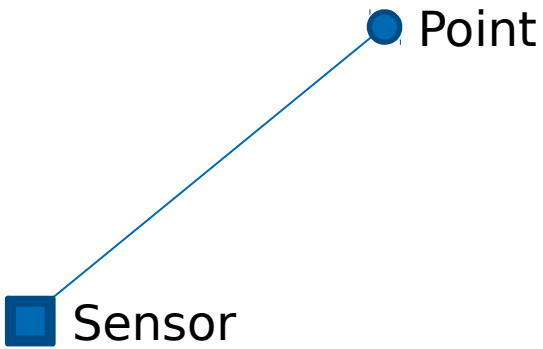
SPATIAL CONTEXT

Which measurement technique?

Structure From Motion



Optical Scan



What is measured?

Structure From Motion

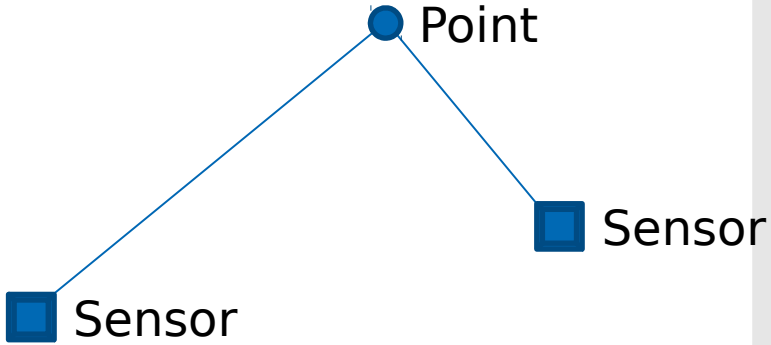
Color
Direction

Optical Scan

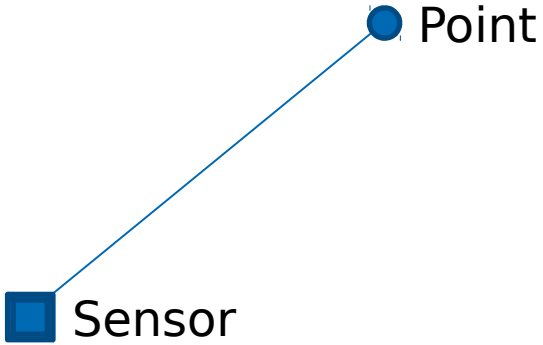
„Color“
Direction
Distance

Which measurement technique?

Structure From Motion



Optical Scan



What are the results?

Structure From Motion

NO scale
NO global reference

Optical Scan

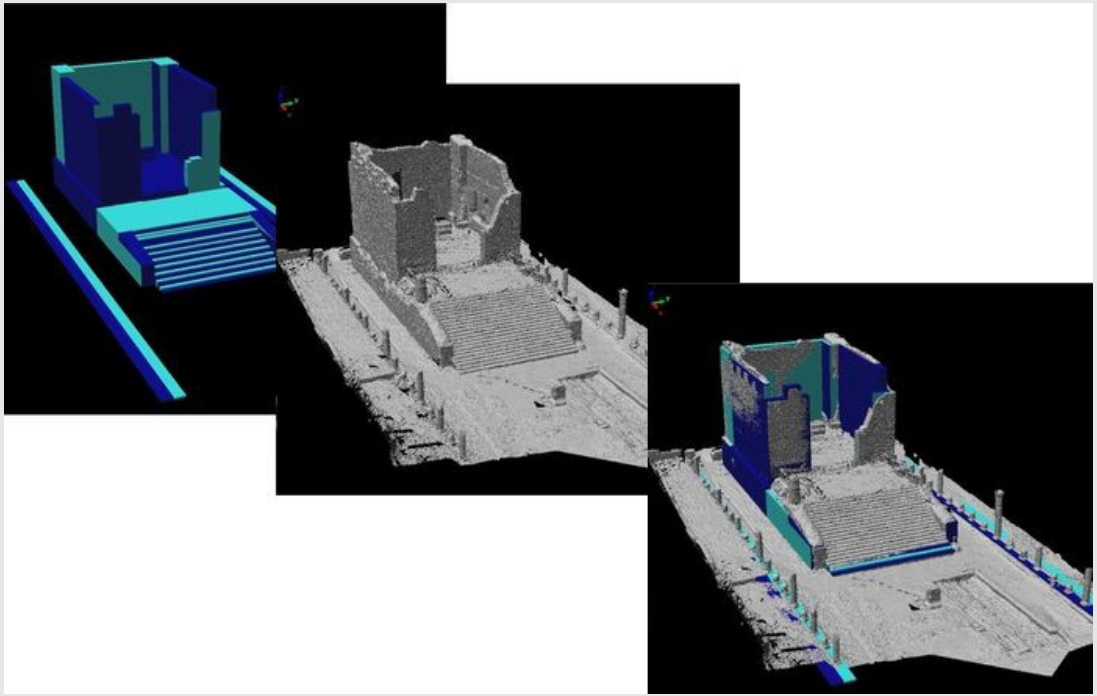
Measures distances
Higher precision

What are the results ?

- Point cloud (XYZ)

```
-2.747   -9.833   0.262
-1.777   -8.554   0.272
-2.603   -9.914   0.272
-3.198   -2.585   0.267
-2.743   -2.481   0.263
-3.197   -2.398   0.271
```

3D Model vs Point cloud



What can be derived from point cloud ?

- 3D Model (WKT)

```
POINT(-2.747 -9.833 0.262)

LINESTRING
   (-2.603 -9.914 0.272,
    -3.198 -2.585 0.267)
```

3D Model vs Point cloud

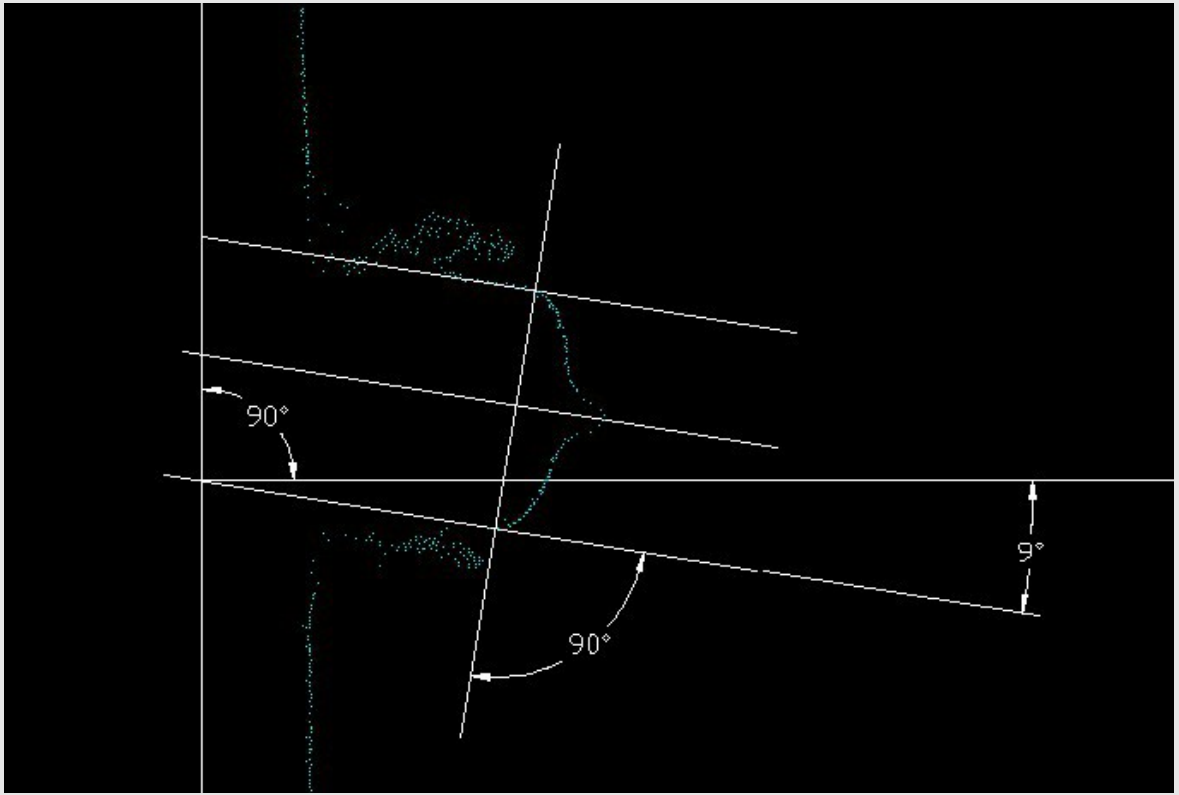
3D Model

- Man-made
  - subjective
  - time consuming
  - past/future possible
- Surfaces
  - only corners stored
  - sketchy structure

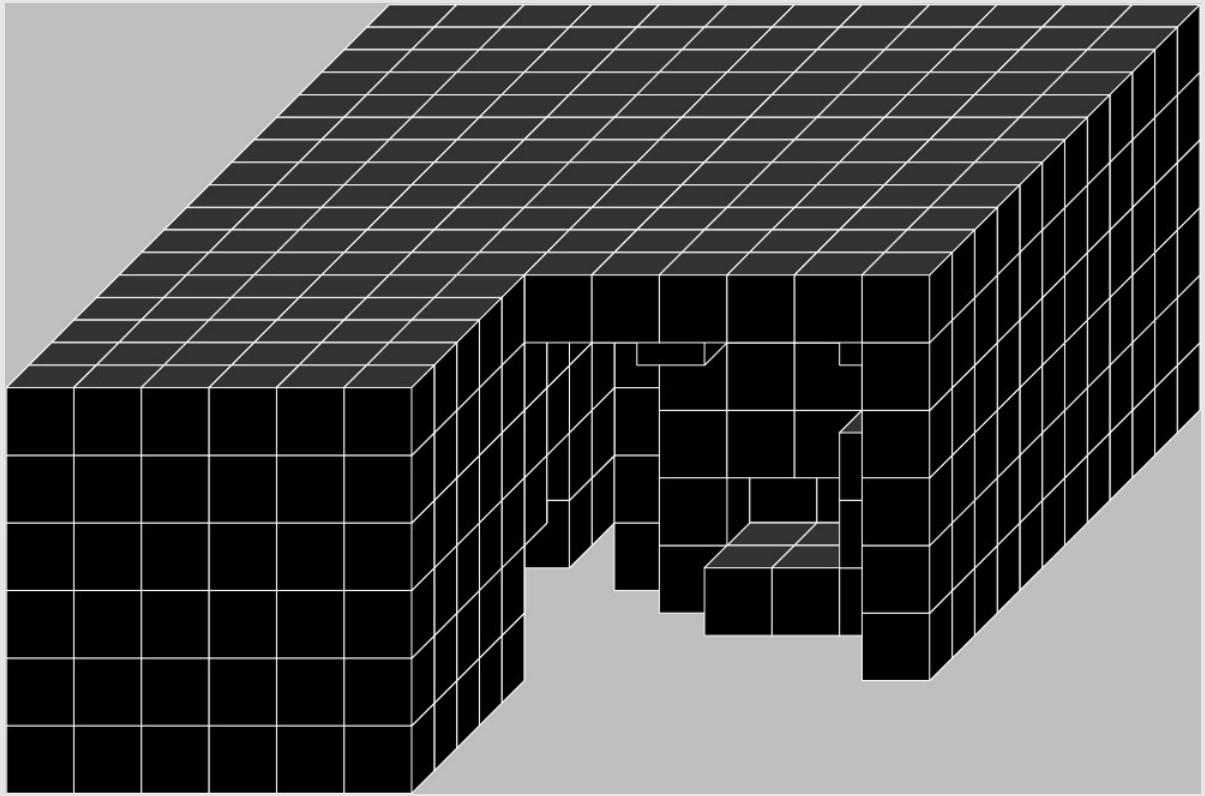
Point cloud

- Surveyed
  - free of interpretation
  - rather cheap
  - current state
- Points
  - a lot of disk space
  - very detailed

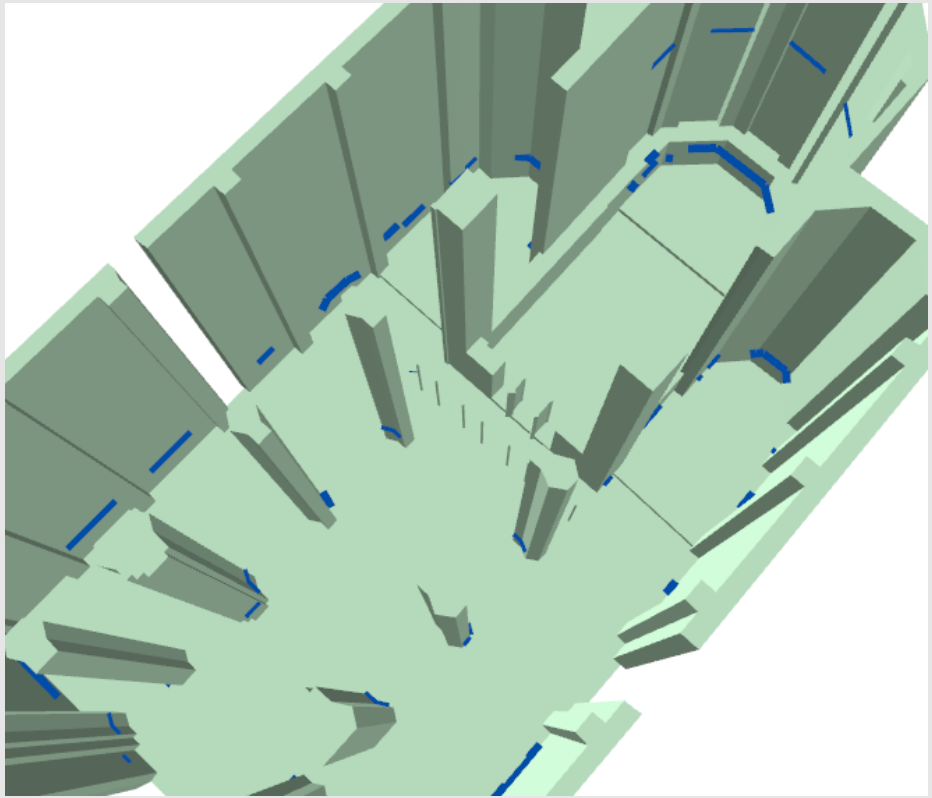
Analysis in point cloud: sight angle



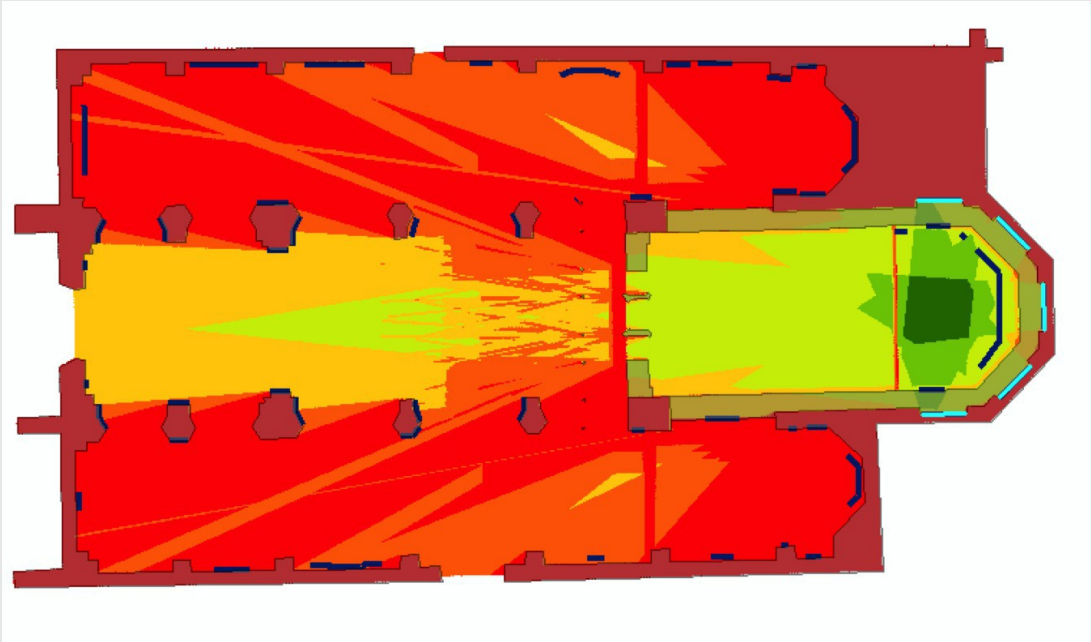
Analysis in point cloud: visibility



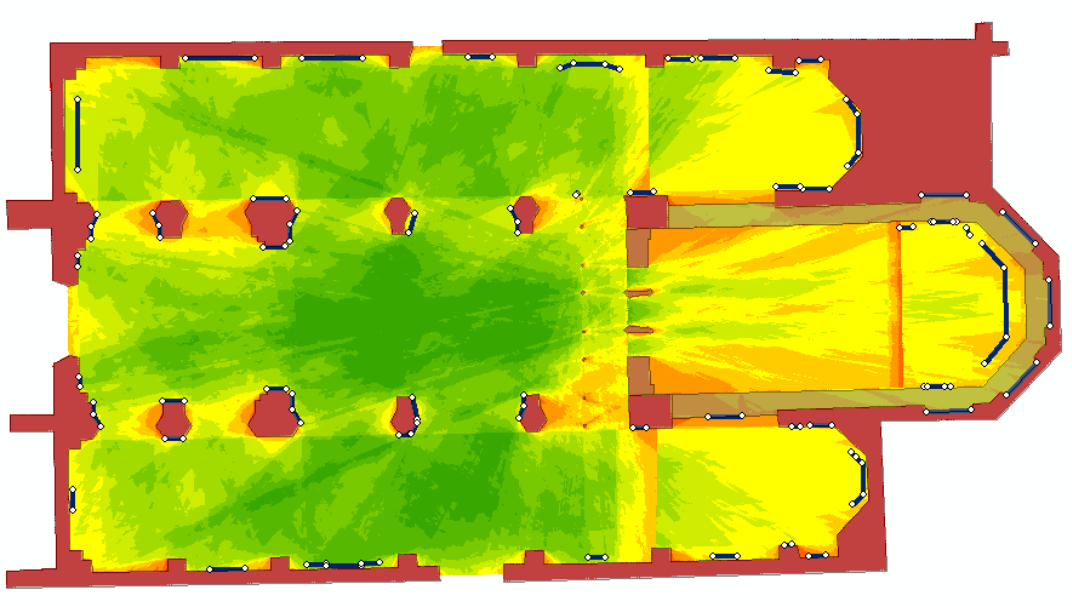
Analysis in 3D model



Analysis in 3D model: visibilty



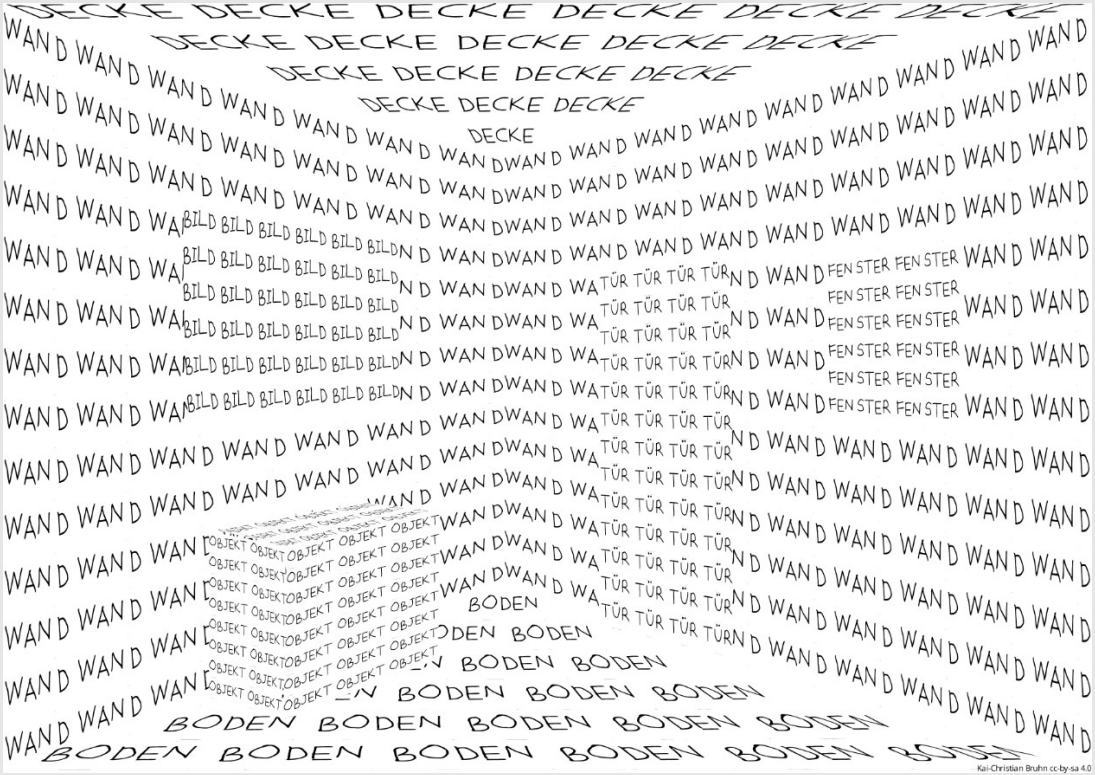
Analysis in 3D model: space syntax



Semantic

3D Annotations
GeoSPARQL

What is a semantic 3D annotation?



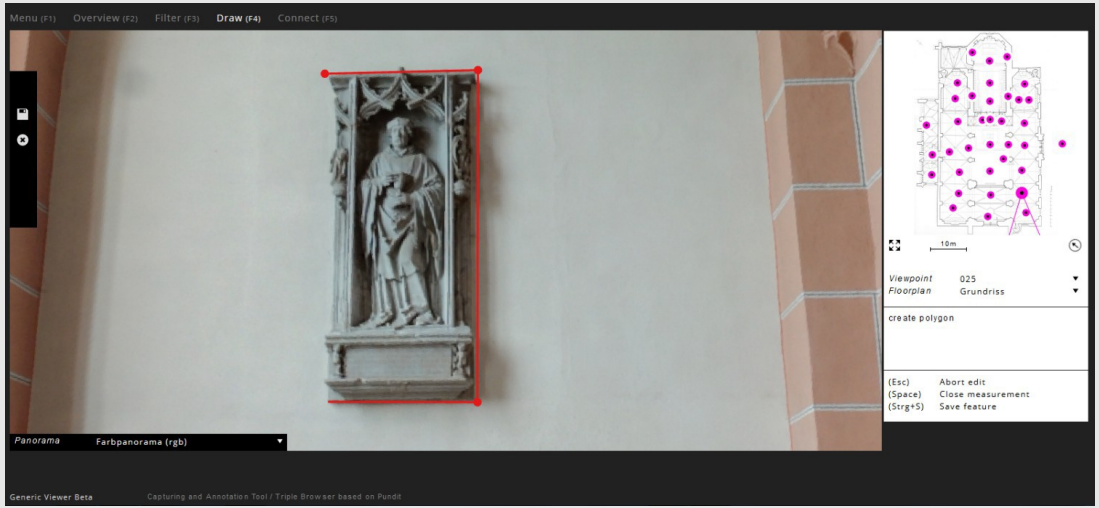
Identification of parts of the 3D data

- Automatic

  3D object detection
  - pattern recognition
  - machine learning
- Manual

  CAD software

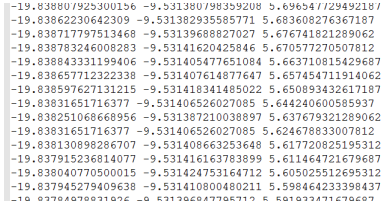
Identification of parts of the 3D data



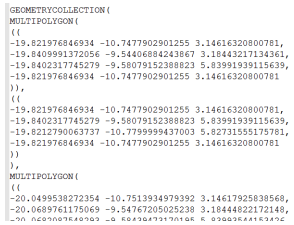
Link geometric information to other expert data

Geometric Information

Point cloud



3D Model



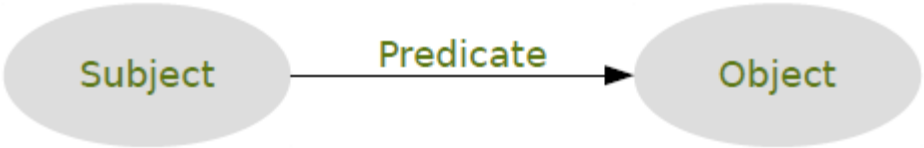
Expert Data

Type	Epitaph
Person	Petrus Lutern
...	

RDF Triple Stores

- Uniform Resource Identifier (URI)
  - http://example.org/uri

- Triple Statement (Turtle Syntax)
  - `Subject Predicate Object .`



Link geometric information to other expert data

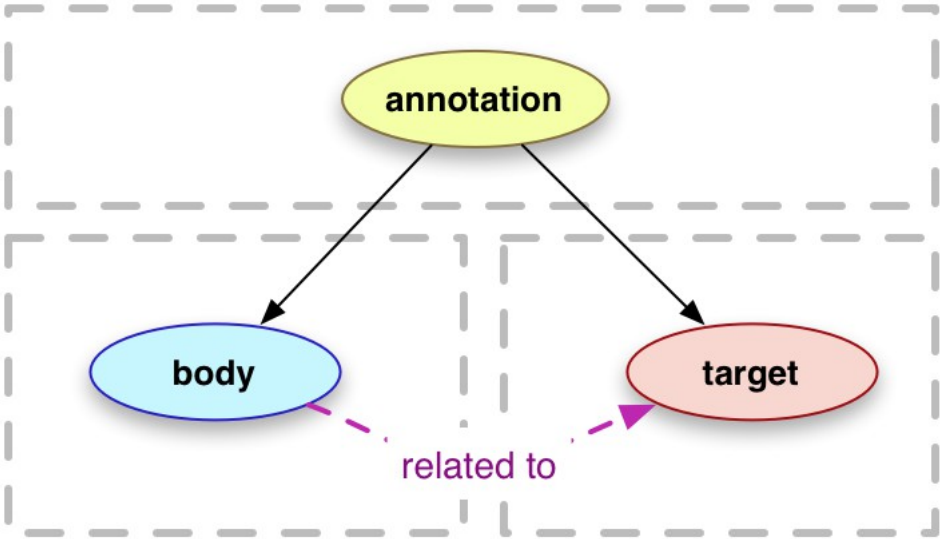
- Linked Data

```
myObject ogc:hasGeometry GEOMETRY .
GEOMETRY rdf:type wkt:GeometryCollection .
GEOMETRY ogc:asWKT "GeometryCollection(…)" .

myObject rdf:type myontology:Epitaph .
myObject myontology:depicts LUTERN .
LUTERN rdf:type foaf:Person .
…
```

Link geometric information to other expert data

- Open Annotation



Link geometric information to other expert data

- Open Annotation

```
ANNOTATION rdf:type oac:Annotation .
ANNOTATION dc:title "My Annotation" .
ANNOTATION dcterms:creator CREATOR .
CREATOR foaf:name "Martin Unold" .
…
ANNOTATION oac:hasTarget GEOMETRY .
…
ANNOTATION oac:hasBody myObject .
myObject rdf:type myontology:Epitaph .
…
```

GeoSPARQL

- Get all Epitaphs within myRoom

```
SELECT ?object WHERE {
      ?object rdf:type myontology:Epitaph .
      ?object ogc:hasGeometry ?geom .
      myRoom ogc:hasGeometry ?roomgeom .
      ?geom ogc:within ?roomgeom .
}
```

GeoSPARQL

- Get all Epitaphs within myRoom

```
SELECT ?object WHERE {
      ?object rdf:type myontology:Epitaph .
      ?object oac:annotates ?geom .
      myRoom oac:annotates ?roomgeom .
      ?geom ogc:within ?roomgeom .
}
```

Thank You for Attention

Martin Unold