3D Documentation

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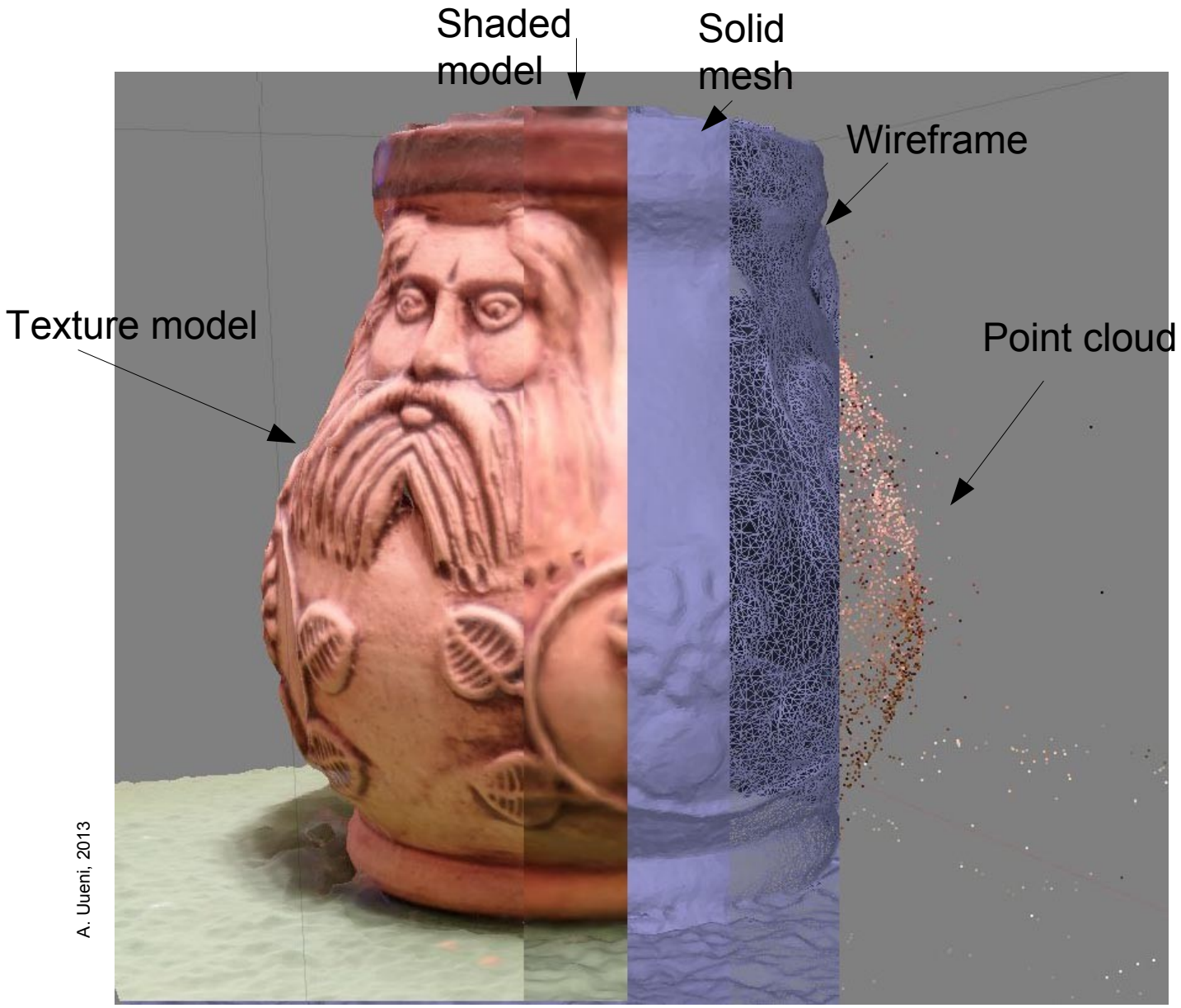
2013

- The surveying of our heritage estate is a crucial part of our role in caring for it

- ‘Metric survey’ - describes the application of precise, reliable and repeatable methods of measurement for cultural heritage documentation [English Heritage]

Cultural Heritage (CH) Survey

- A method to meet the needs of research, analysis and conservation must consider the value of measurement in the record
- Object survey, data processing (different sources, resolution +etc.)
- 3D model management and preservation for futher solutions
- Visualisation and presentation
- Indexing and searching
- Output dissemination – different purposes different solutions (educational, tourism, scientific, defence, entertainment)


Shaded model
Solid mesh
Wireframe
Texture model
Point cloud

A. Uueni, 2013

3D documentation

- Interdisciplinary
- Accessible
- Practical
- Efficient

links between 2D and 3D files
integration with several resources
files for CNC or 3D printing

Survey methods

- Appropriate technique it is essential to understand its performance, the precision expected and the resources available

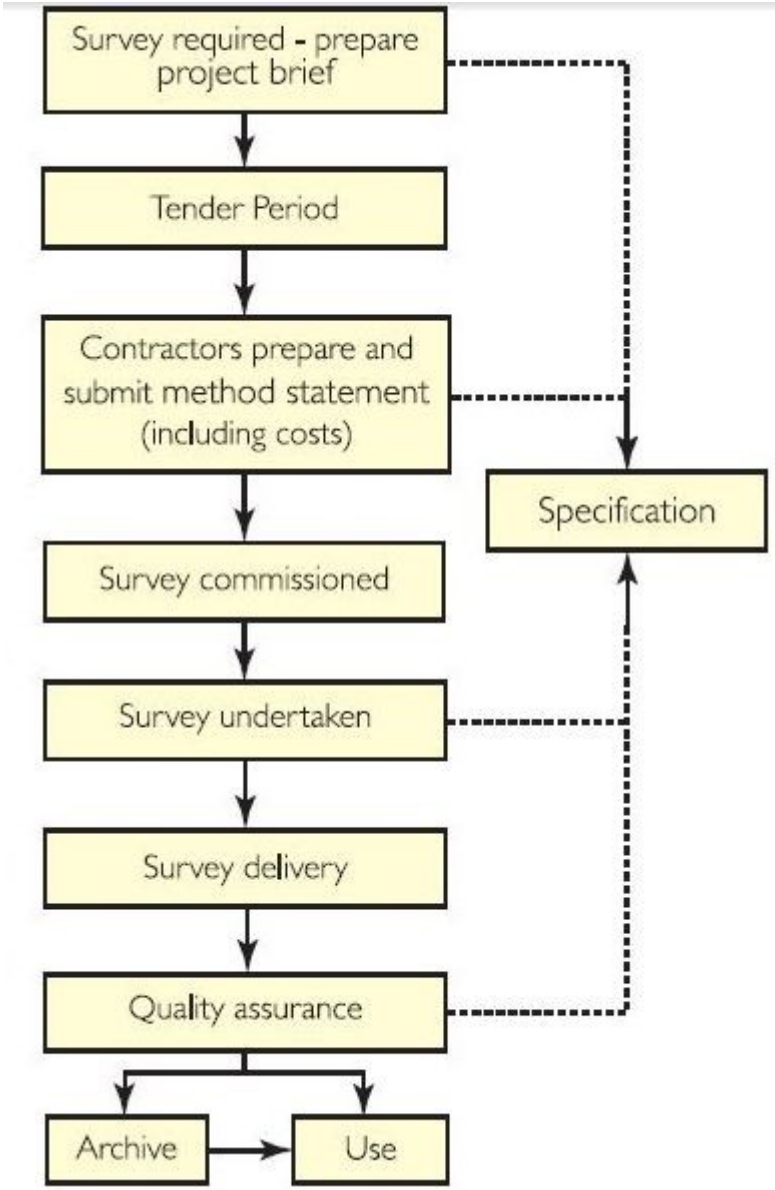
- Purpose of usage (Cataloguing and documentation, Public outreach and education, Historical studies, Experimental architectural and urban history)
- , but ...

No simple formula which survey technique might be most appropriate

$$
\begin{cases}
m_{X_{\text{flat}}} = \sqrt{\begin{array}{l} m_{X_G}^2 + (\sin\omega)^2 m_l{}^2 + (l\cos\omega)^2 m_\omega^2 \\ \quad + (\sin\kappa)^2 m_d^2 + (d\cos\kappa)^2 m_\kappa^2 \end{array}} \\
m_{Y_{\text{flat}}} = \sqrt{\begin{array}{l} m_{Y_G}^2 + (\cos\omega\sin\alpha)^2 m_l{}^2 + (l\sin\omega\sin\alpha)^2 m_\omega^2 \\ \quad + (l\cos\omega\cos\alpha)^2 m_\alpha^2 + (\cos\kappa)^2 m_d{}^2 \\ \quad + (d\sin\kappa)^2 m_\kappa^2 \end{array}} \\
m_{Z_{\text{flat}}} = \sqrt{\begin{array}{l} m_{Z_G}^2 + (\cos\omega\cos\alpha)^2 m_l{}^2 + (l\sin\omega\cos\alpha)^2 m_\omega^2 \\ \quad + (l\cos\omega\sin\alpha)^2 m_\alpha^2, \end{array}}
\end{cases}
\tag{1}
$$

Accurate 3D Survey Criterias

- Cost
- Material of digitisation subject
- Size of digitisation subject
- Portability of equipment
- Accuracy of the system
- Texture acquisition
- Productivity of the technique
- Skill requirements
- Compliance of produced data with standards


Survey required - prepare project brief
Tender Period
Contractors prepare and submit method statement (including costs)
Survey commissioned
Survey undertaken
Survey delivery
Quality assurance
Archive
Use
Specification

Technology To Capture

- 3D capture technologies
  - Scanning, photogrammetry
- Modelling with 3D software
  - AutoCad, Maya, 3D Studio Max
- Combined models
- Complexity in size and shape
- Morphological complexity
- Diversity of raw materials

Reality-based survey

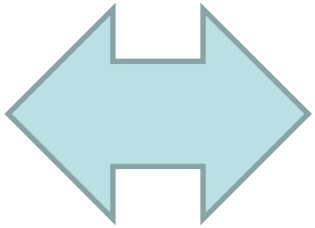
- Neccesary equipment
- Software
- (geo)localisation
  - Global Navigation Satellite Systems (GNSS)
  - Inertial Navigation Systems/Inertial Measurement Units (INS/IMU)
  - GIS (geographic information systems) and Web-GIS tools

    Digital terrain/surface model (DTM or DSM)

Non-real approach

- Procedural modeling
- Software (3D Studio Max, Maya)

- Digitisation in 3D
- Processing of 3D data
- Storage of 3D data
- Archiving & Management of 3D data
- Replication & Reproduction of 3D data
- Visualisation & Dissemination of 3D data



- Algorithms
- Hardware
- Software

3D laser scanning

- Advantages:
  - Object is REALLY measured
  - No targets on object
  - Quick
  - Precision and accuracy
  - Raw material futher processing
  - Combination of different methods:

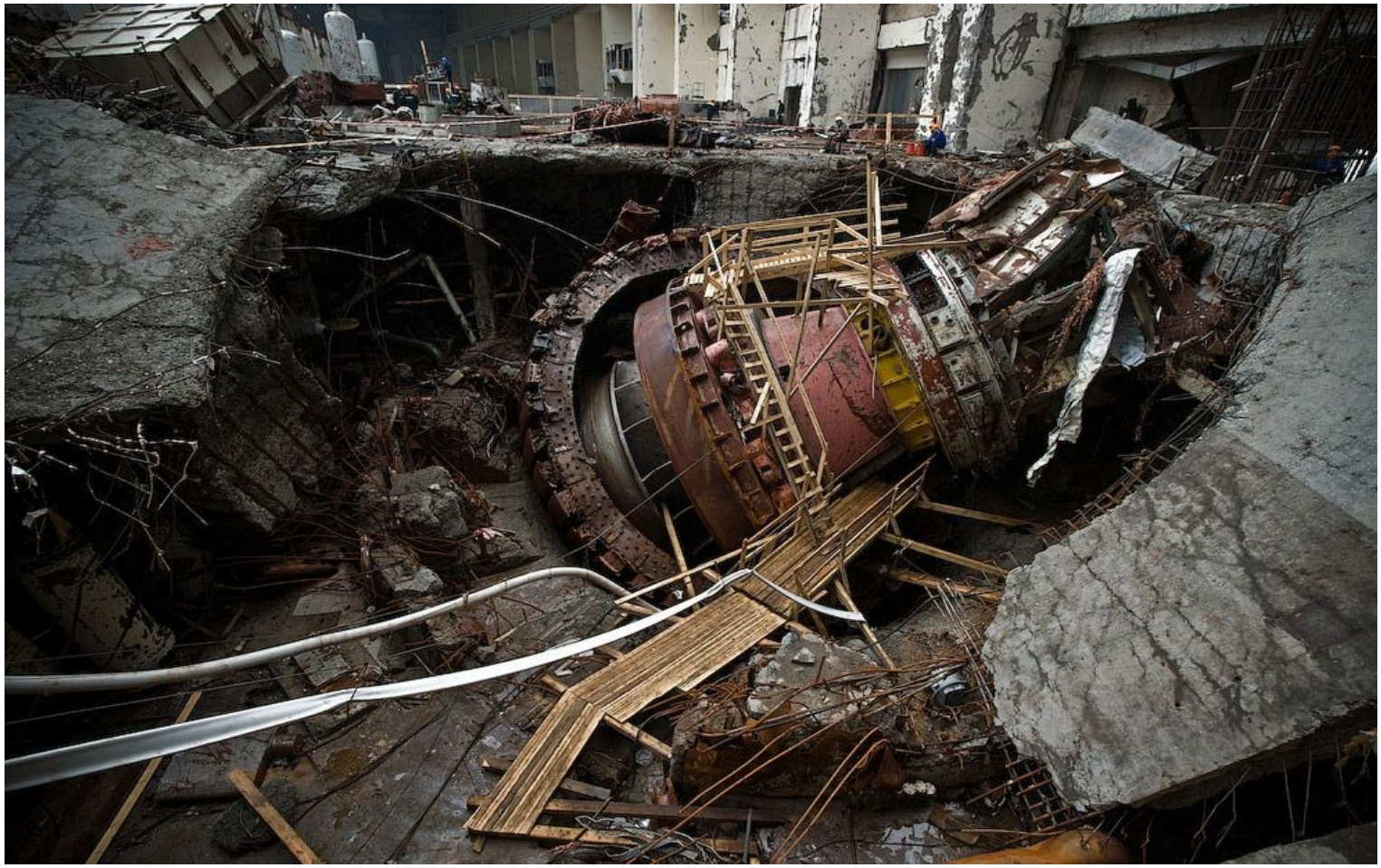
    Photogrammetry, Laser scanning,
    Topographical research, IR, UV, X-ray

3D laser scanning

- Disadvantages:
  - The price of the equipment (rent)
  - Created data size
  - Software price and solutions
  - Modelling from pointcloud is time consuming
  - Know-how accessibility

Better to research & to invest, than...

- Wiki : http://en.wikipedia.org/wiki/Sayano%E2%80%93Shushenskaya_Dam



Gotland University
Passion & Science

UPPSALA UNIVERSITET

Sustainable Management of Historic Rural Churches

SMC PROJECT | smcproject.org.ee

Sustainable Management of Historic Rural Churches in the Baltic Sea Region

CENTRAL BALTIC
INTERREG IV A
PROGRAMME
2007–2013

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND
INVESTING IN YOUR FUTURE

Wp4

- Photogrammetry
- UAV photogrammetry
- White light scanning
- Laser scanning

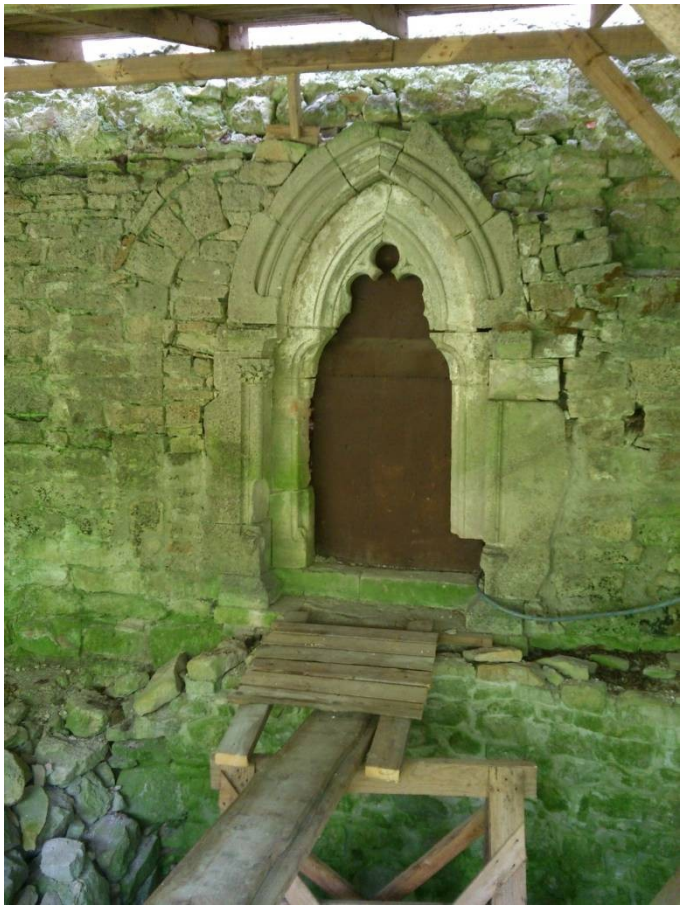
Pöide church

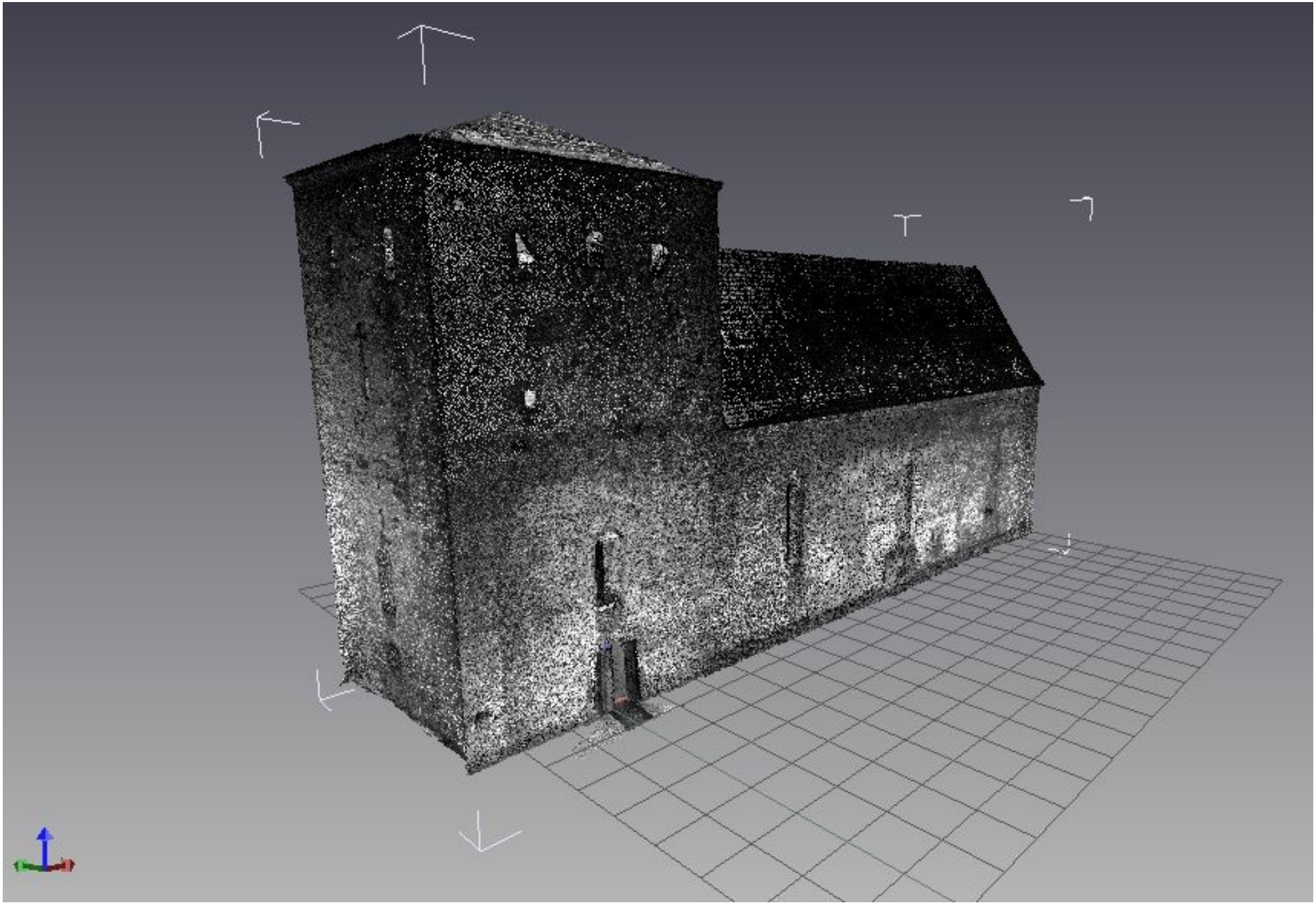
Partners:

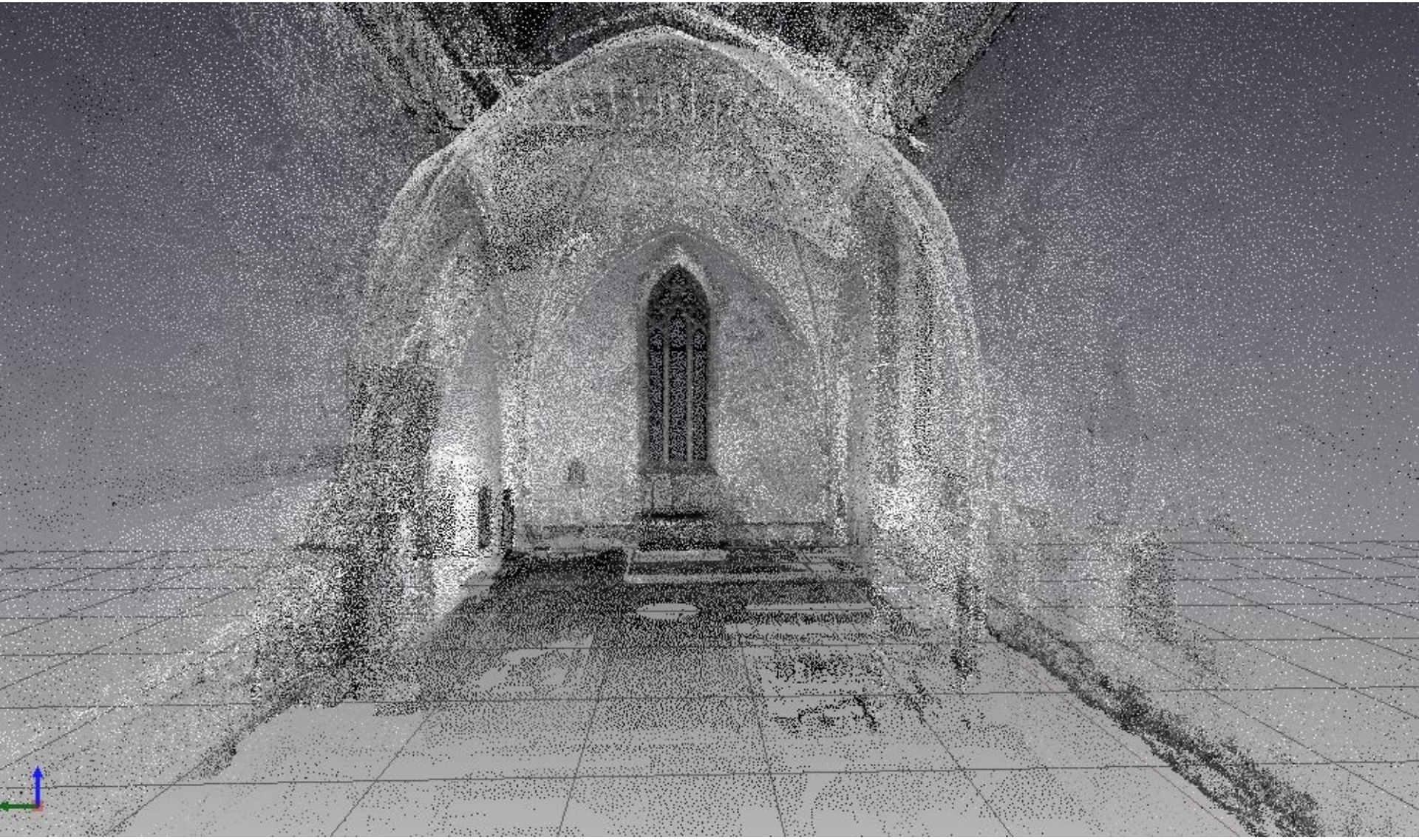
Conservation Centre Kanut
Geogrupp OÜ
3D Total Ldt.

- Scanning: 19. June 2012
  (13.30-22.30)
- Scans: 114 x 2
- Pointcloud cleaning: 1,5 week
- Formats: dxf, obj, x3d, xyz
- Points: 60M
- Size: 3Gb

- Simplified pointcloud: 3,1M
- Size ca: 150Mb





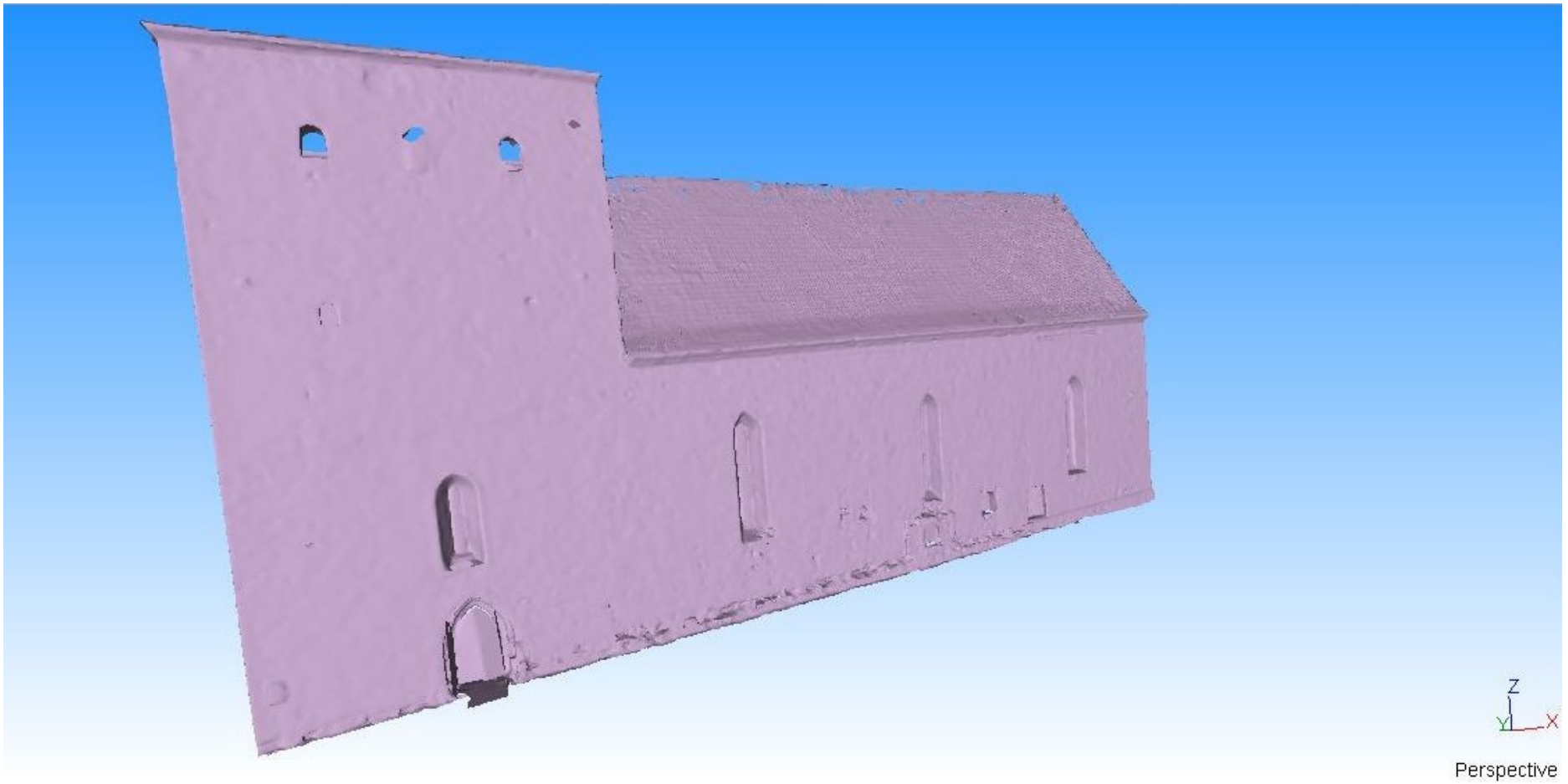


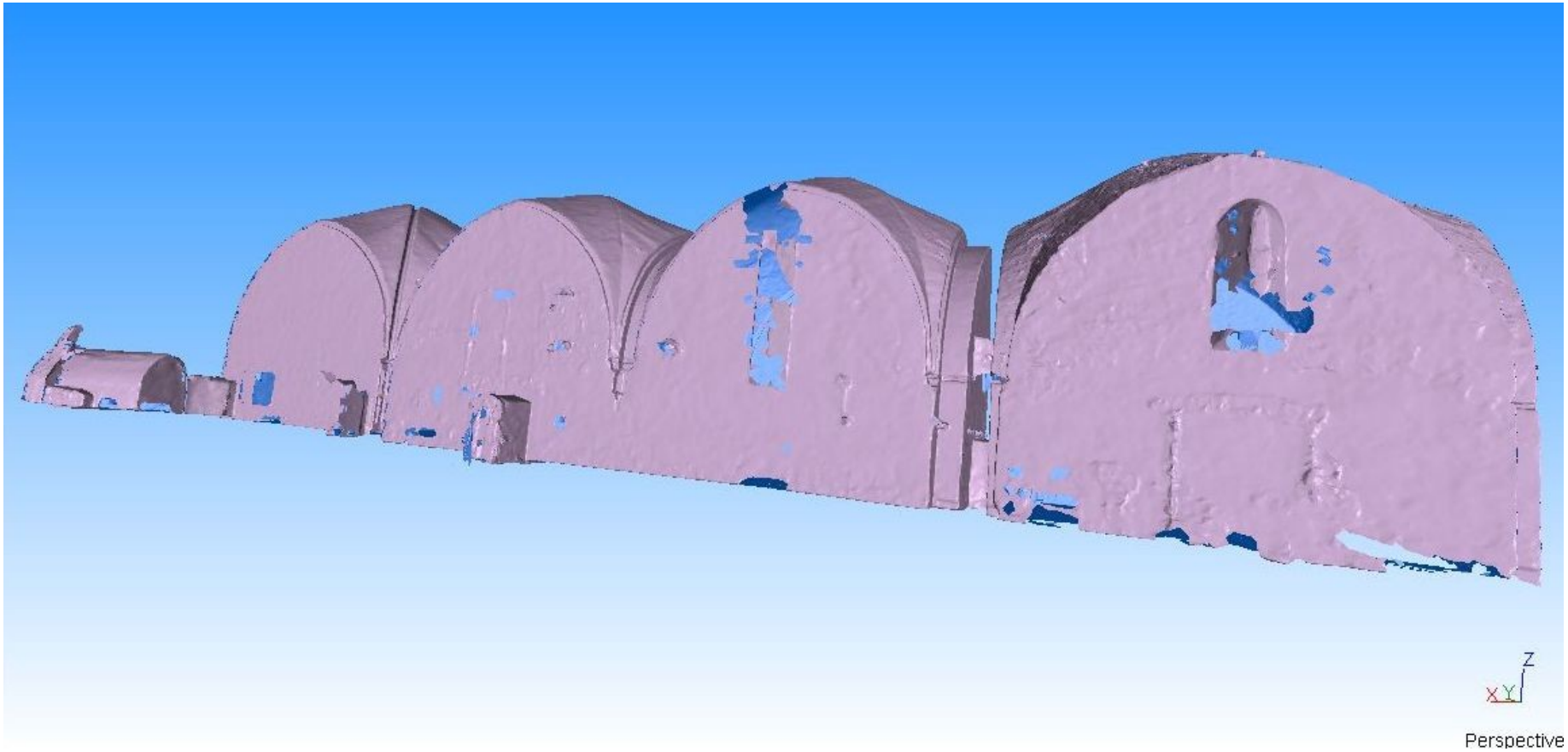
Creating 3D model from simplified pointcloud

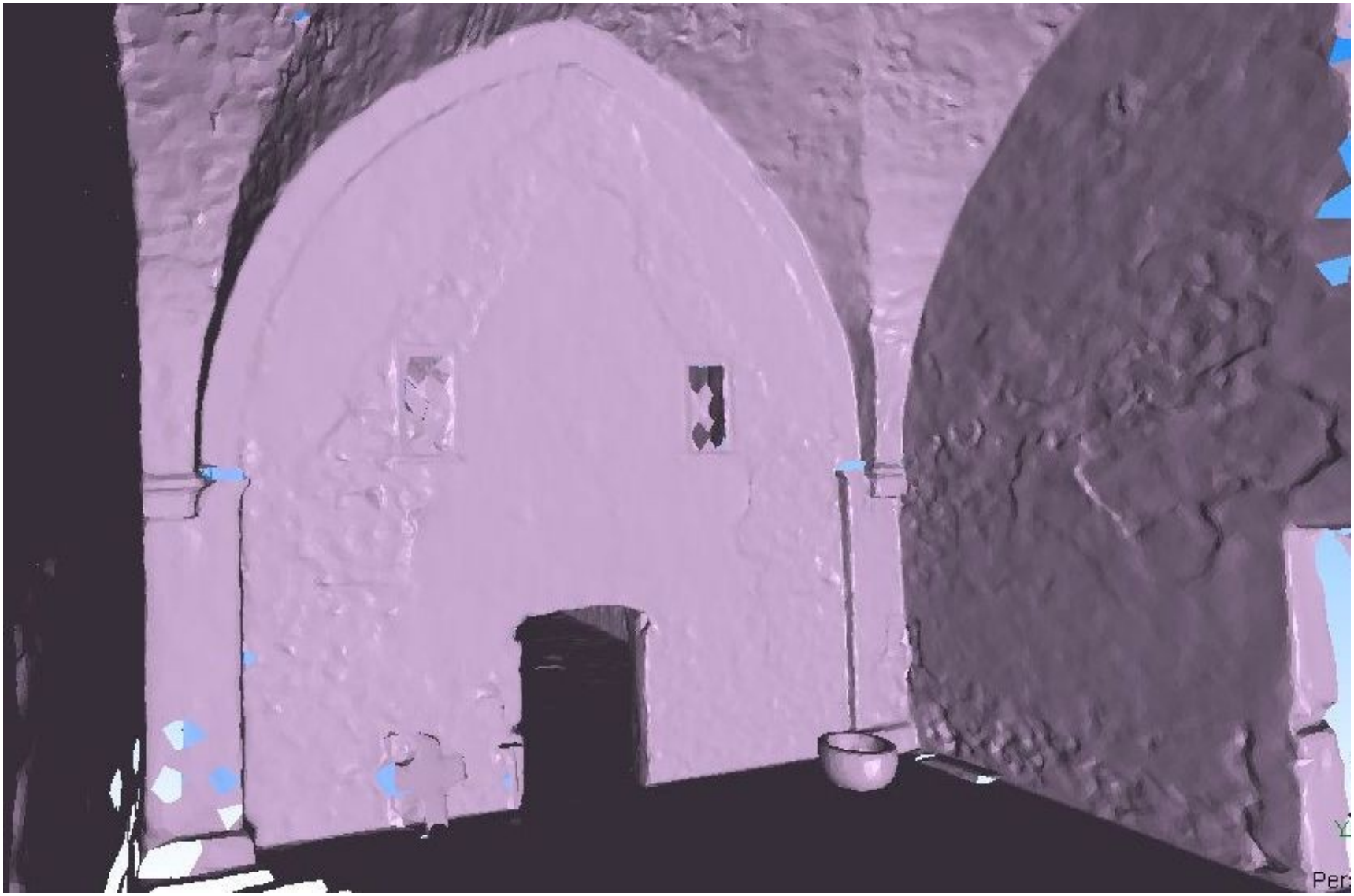
- MeshLab

  (http://www.meshlab.org/)

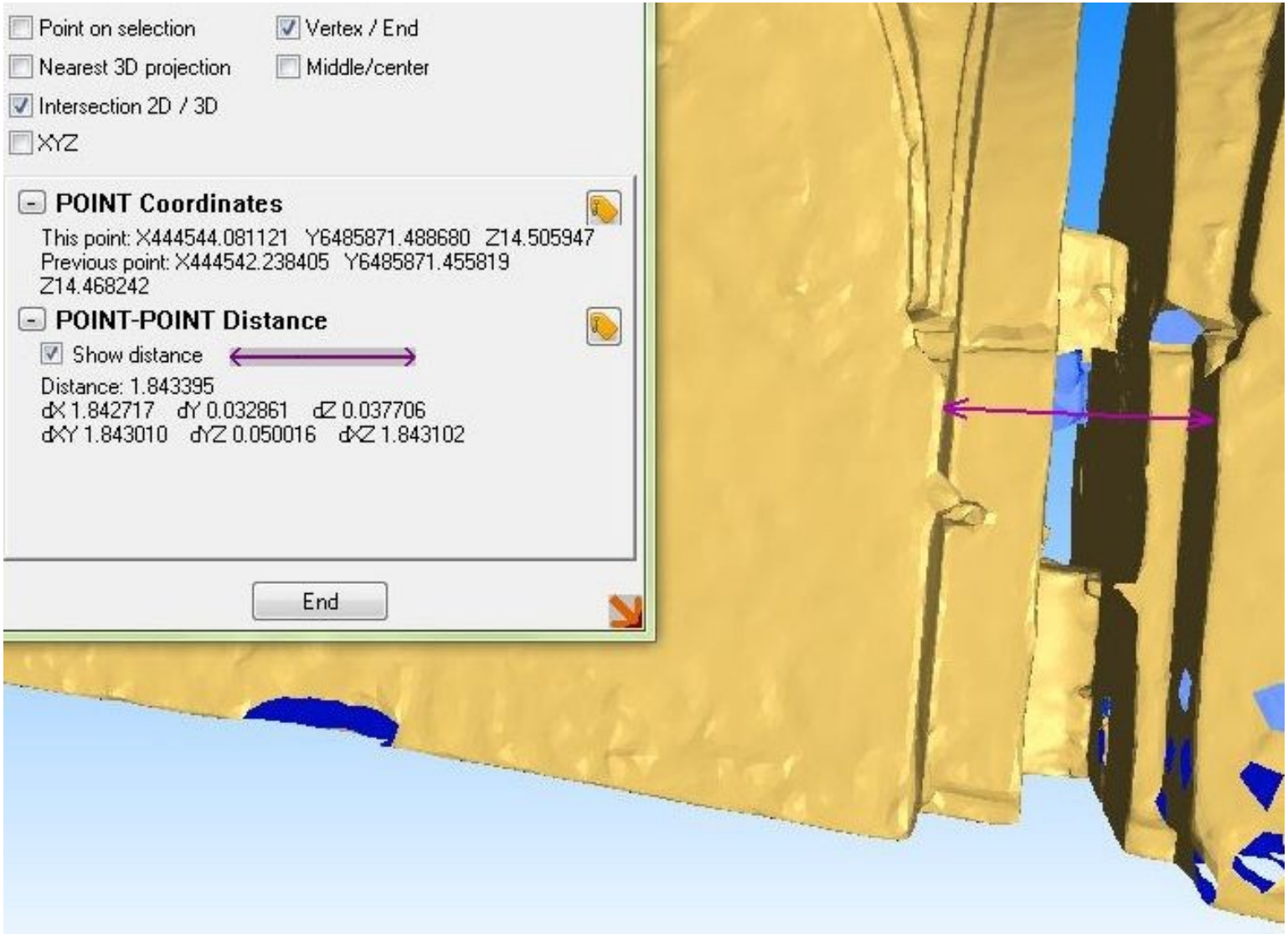
  - Wide range of formats
  - mesh and processing
  - multi-platform (windows 32& 64-bit, linux, os x, iOS, android)
  - 3D rendering
  - modelling


Z
Y
X
Perspective


Z
X Y
Perspective




Perspective


Point on selection
Vertex / End
Nearest 3D projection
Middle/center
Intersection 2D / 3D
XYZ
POINT Coordinates
This point: X444544.081121 Y6485871.488680 Z14.505947
Previous point: X444542.238405 Y6485871.455819
Z14.468242
POINT-POINT Distance
Show distance
Distance: 1.843395
dX 1.842717 dY 0.032861 dZ 0.037706
dXY 1.843010 dYZ 0.050016 dXZ 1.843102
End

Ongoing developments

- Confidence model (cleaned and raw data mixture)
- Using confidence model in Pöide church documentation
  - 4D Tetra, Adobe Acrobat, X3DOM
- Providing public access

- Testing different long-term preservation methods
  - Metadata, version control +etc.

Data reuse requirements

- Suitable format
- Adequately described
- Available/reusable
- Long-lived file formats
- Significant properties defined
- Metadata standards

Challenges

- Digital rights management
- Clear depiction of uncertainty in 3D reconstructions
- Version control for 3D models
- Effective metadata structures
- Long-term preservation
- Interoperability
- 3D searching

- Application of computational analysis tool
- Organizational structure of a peer-reviewed archive

Version Control for 3D Models

- Version control (revision control/source control) for managing multiple revisions of the same unit of information
- Version control is most commonly used in the software development process to manage repositories of source code under development
- Theoretically can be adapted to any type of electronic document, (CAD)
- 3D models of CH sites

- UNIX ‘diff’ command

Metadata for 3D CH Data

- List of external sources / files
- Plug-ins/shaders in use
- Layers/components
- Materials
- Audience type of interaction
- Methods and techniques
- Datasets used to create a 3D model

Metadata for 3D CH Data

Adminstrative

- What are the privacy issues?
- Who can access this object?
- Has the object been modified since its creation?
- How can the content of the object be trusted?

Descriptive

- What does the 3D digital object represent?
- Are there any flaws in the 3D digital object?
- What are the properties of the 3D digital object?
- What are the features of the human body represented in the 3D digital object?

Technical

- How was the (3-D) digital object acquired?
- How many scans (views) of each object are there?
- How were these scans integrated? With what software?
- What is the precision and accuracy of the data?
- What kind of calibration technique was used?
- What kind of modelling technique was used?

- More information:
- http://www.pocos.org/images/training_reading/s_v/JennyMitcham.pdf

J. Doyle, H.Viktor, E. Paquet: Long-term digital preservation: preserving authenticity and usability of 3-D data

3D file formats

- About 170 different 3D file formats in commmon usage
- Open formats (ply, stl, obj, xml based format, 3ds, etc)
  - Subformats (autodesk Collada)
- All are different (depends about format purpose)

  Updating and/or converting = information loss

  Preserving its interactive functionality
- File format registries (PRONOM – DROID)

- Projects:
  - SMC Project - http://smcproject.edu.ee
  - CARARE - http://www.carare.eu/
  - 3D Coform - http://www.3d-coform.eu/
  - V-MUST - http://www.v-must.net/
  - CyARK - http://archive.cyark.org/
  - Protage - http://www.ra.ee/protage
  - ICOMOS - http://www.icomos.org/en/

Kiitos!
Tänan!
Tack!
Thank you!

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