The presentation of Cultural Heritage Objects in Epoch

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CI support of shape representation means that solutions are operational for:

1. **Acquisition**: Digitisation of artifacts
2. **Storage**: Sustainable archiving
3. **Presentation**: Interactive display

- Hundreds of shape representations, each with its pros and cons
  - Which of them to choose for CI?
  - How can all CI software make use of them?
Triangle meshes too simplistic:
- Huge loss of information w.r.t. the 12 images (6 MPixel each) used for reconstruction
- Only 1 texel per surface point

Triangle meshes too complex:
- Dataset has 526 MB, but screen has only 2 MPixel
- Consequence: Multi-resolution meshes
Shape Representations in Epoch CI

- **Synthetic reconstructions**
  - 3DStudioMax, Maya etc → obj, ply, nexus

- **Scanned 3D models**
  - Laser Scanner, Structured Light → obj, ply, nexus

- **Photogrammetric Reconstruction**s
  - Photo sequence, Arc3D Webservice → obj, ply, nexus

- **Procedural Cities**
  - CityEngine, shape grammar → obj, ply, osb

- **Parametric Shapes**
  - GML, generated + displayed on the fly (→ ply)

- **Scene Graph**
  - OpenSG, all above types in graph nodes → Collada, osb
Towards High-Quality Acquisition on a Mass Scale

- **Camera Dome:**
  - Systematic variation of light position
  - Systematic variation of eye position (optional)
  - Acquisition of many, many images

- **Advantages:**
  - Much richer materials \((n \text{ texels per surf. point})\)
  - Acquisition in conveyor-belt fashion possible
    - Open box, put artifact on belt, scan, put it back

- **Disadvantage:** No direct 3D measurements
  - Photogrammetry, shape from shading, space carving
The Camera Dome in Leuven

Geert Willems
Luc van Gool
The Camera Dome in Leuven

- 1 Camera (5 MP), 260 white LEDs
- 70 cm diameter
- Transportable
  - Weight <10 kg
  - 15 minutes setup
- No moving mechanical parts
- Acquisition time: 5 minutes / object
• 3D from integration of estimated srf.normal
  ▪ Idealization: Requires Lambertian material
• Result: Albedo map + Normal map, 40 MB
• Viewer application for CH scholars
  ▪ 2D, not 3D
  ▪ Many filters:
    • Relighting
    • Without color
    • Line drawing …
- “Cuneiform DL Initiative“
- Tests with Eastern Studies KU Leuven
- Tests with Cornell Univer., large collection
- TV coverage…
The Camera Dome in Bonn

Gero Müller
Martin Schneider
Reinhard Klein
The Camera Dome in Bonn

- 151 Canon A-80 cams
- One flash, 151 pict.
- 22801 img.
- Variation of light and view direct
- No moving mech. parts
- Calibration is done once beforehand
The Camera Dome in Bonn

- 151 Canon A-80 cams
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- Variation of light and view direct
- No moving mech. parts
- Calibration is done once beforehand
• BTF: 6-dimensional function
• Like texture, but plus light- and view-directions
• BTF is compressed
  ▪ Clustered PCA
• 3D via visual hull: Silhouette
  ▪ Computed on GPU
• Visual hull contains no cavities but BTF does!
• Rendering via relighting: Multiply w/ Environment map
• View BTF objects interactively via custom node in OpenSG
  ▪ Storage and Presentation
• Only single light direction: OpenGL light settings (often headlight)
  ▪ Simple GLSL shader!
The Epoch Viewer

Sven Havemann
Volker Settgast
Dieter Fellner
The Guiding Vision

- **Strategic goal:** Make using 3D technology not a gadget but a standard in all museums today
  - Beyond pilot projects: Completely different thing

- **Target scenario:** Museum curator decides "We make an exhibition on Etruscan culture"
- Real historic artifacts: Tiny brooches, pieces of jewelry, golden coins, decorated cups, sherds
- Curator hires digitization company: Creation of digital artifacts from real ones
The Guiding Vision

• From a recent archeological campaign:
  ▪ Purchase several digitized strata of excavation site
    • Places where some of the real artifacts were found
  ▪ Purchase laser scans of physical remains
    • Ground walls of houses, pillars, statues

• Create 3D backdrops for digital presentation via photogrammetric reconstruction
  ▪ Photo sequences of landscapes and old cities
  ▪ Photo sequences of prominent buildings & details
• Concept of a complementary exhibition: Digital artifacts complement real artifacts
  - Historian’s nightmare: Arcade games in Museums
  - Important: Un-intrusive use of technology
  - Artifact, not technology, must be in visitor’s focus

• Digital artifacts shall support+enhance the appreciation+understanding of the real artifacts
  - „Select a real artifact and take it in your hand, magnify it, view it from all sides“
  - „Grandparent compliant“
3D Powerpoint: Easy authoring of CH presentations
• **1. Drag & Drop Authoring**
  - Fill pre-defined layouts with content
  - Drag+drop from e.g. Windows Explorer to 3D

• **2. Easy 3D Navigation**
  - Too close, trapped in corner, gimbal lock…
  - Enforce valid views: Never get lost in 3D!

• **3. CH Integration**
  - CH-specific standards: „Collada CH <extra>“
  - Ultimate goal: 3D-browsing CIDOC/CRM network of semantic information
• 4. **CH Sustainability**
  - Presentation is aggregated knowledge
  - Re-use of knowledge + *software* („shader“)
• 5. **Low-level Extensibility**
  - PTM-Viewer for cuneiform tablets, volumetric for Egyptian mummy, BTF for rich textures, …
  - New rendering modules, new file loaders
• 6. **Ad-hoc 3D geometry** (stone walls etc)
  - Like Powerpoint diagram editor, but in 3D
  - Create & animate simple 3D support objects
Feature Wish List

7. **Non-monolithic**
   - Software component, not full application
   - Integration with existing software easy:
     Add 3D canvas to database frontend
   - Consequence: No 2D GUI, just API

8. **Different User Levels**
   - Level 0: Presentation end-user in museum
   - Level 1: Drag&Drop authoring of presentations
   - Level 2: Scripting of presentation templates
   - Level 3: C++ extension developers
• Drop targets (made of standard geometry)
• Drop targets (made of standard geometry)
• Dropping of ad-hoc geometry
• Transformations: R,G,B
• Tripod
Creating Ad-Hoc Geometry
Beyond 3D-Powerpoint: The Epoch Viewer
Beyond 3D-PPT: The Epoch Viewer

- Pursuit of feature wish list
- Two major new developments:
  1. Attach semantics to 3D shapes using XML
  2. Component technology
- Now much more general than just 3D-PPT
  - Create sustainable knowledge in XML form
  - Bi-directional link to semantic technologies
  - And even better for non-expert users
Attach semantics to 3D shapes using XML

- Use XML+Web standards (XLink/XPath..)
  - Consequence: XML in the scene graph [VAST06]

- Why use XML with scene graphs at all?
  - XML is used for CIDOC/CRM (RDF-tripl.)
  - XML is used in semantic databases (MAD/SAD)
  - XML is used for semantic text markup (TEI)
  - XML can point into large CMS /DL (Fedora)

- Case Study: Re-processing of Arrigo DVD (Pisa)
  - 12 scanne massive multi-resolution meshes
  - Using VirtualInspector software from Pisa (Cignoni)
  - Beautiful edutainment presentation (web-designer...)
Case Study: Arrigo presentation

Beautifully made – but „dead end“ in terms of knowledge preservation
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Announcing Angel no. 2

Inscription:

(translation from Latin: A. F. Massetti)

The inscription, written in elegiac couplets, completes the funeral oration begun in the scroll of the angel on the left side of the gable on the Cathedral façade. It also uses the rhetorical device which substitutes adjectives with nouns in order to intensify, or render absolute, its meaning. As in contrast with this earlier emphasis on royal virtues, the final remark introduces the theme of vanity and the annihilation of death as an inescapable end for all men and every empire throughout history. Therefore, although here the Oldfeline city of Filia celebrates Henry VII in the sacred center of its Cathedral, these verses also represent the recognition of the conclusion of his legacy, and a warning of an imminent fall from grace for the city.

Announcing Angel no. 4 and 5, both statues

- Rear: The back of the statue is empty and has quadrilateral holes. It is doubtful if these holes were part of the original; possibly, they were for the insertion of wings.

Announcing Angel no. 5

- Mantle: The mantle is broken, originally, it probably had a short draped-fur-like, such as the one characterizing the gowns worn by his fellow angel and by other statues of the monument.

Announcing Angel no. 4

- Mantle: The two holes at the lower inn of the gown seem to be part of the original design. Perhaps they were for the insertion of some metal parts. These parts were probably standing in relation to the object the statue held in his hand.

- Hand: The statue must have carried a triangular object in his right hand - maybe a metal trident.

Arrigo VII enthroned

- Hands: The arms of the statue have been reduced to stumps. Originally, they must have been placed in such a way as to soften the diagonal folds of the dress at the chest. The hands must have held the imperial insignia. The first mutilation of the statue may have occurred when somebody tore them off; they were probably made of precious metal. The sceptre and the globe, together with the crown, symbolized power. They are therefore characteristic features of the iconographic representation of kings and emperors.

- Head: The head of the emperor has broken off from the body and does not fit well on the neck of the statue. There is a certain disproportion in the relation of the head and the rest of the statue. Moreover, there is a stylistic difference between the minute refinement of the face carved on the left hand side of the body and the rest of the body and the figures of the "counselors" on the other. There is also a hypothesis according to which the head is made of a different material than the body. All this has led to a number of questions. Does the head belong to this statue? Were they made by different artists? It seems rather impossible that the head belongs to another statue. The fact that the head does not fit evenly onto the trunk is insufficient proof to the contrary, since the marble on the upper part of the chest and on the shoulders has been chiseled off. Further, the assumption that head and body are made of different materials should be checked by means of a stratigraphical test: it is a common feature that the gray veining in marble is discontinuous and more or less diffused in different parts of a single block of stone. The affinity of the head in question to the head of the reclining Henry VII in the Cathedral seems to confirm that the enthroned figure did indeed belong to the imperial tomb. However, this affinity is not recognized by all art critics. Thus, the whole issue concerning this head still awaits a definite clarification — a clarification that is particularly crucial, since it would tell us whether or not the whole group can be identified with the emperor and his following, and whether or not it really belonged to the tomb of Henry VII.

- Rear: The rear of the statue is hollow. This may be due to the medieval sculptor's common practice of economizing their costly material, it is also the reason why those parts of a statue that were not seen due to its position in relation to the public were left rough and unfinished. Moreover, leaving a hollow-in a statue made it lighter, this was necessary where the figures were positioned in a high place.
The arms of the statue have been reduced to stumps. Originally, they must have been placed in such a way as to soften the diagonal folds of the dress on the chest. The hands must have held a great deal of power, as indicated by the imperial insignia. The first mutilation of the statue may have occurred when somebody tore them off: they were probably made of precious metal. The sceptre and the globe, together with the crown, symbolized power. They are therefore characteristic features of the iconographic representation of kings and emperors.

The head of the emperor has broken off.
Arrigo Re-processed: CIDOC/CRM

Output: CIDOC/CRM markup in RDF triplets

```
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  <!-- Shortcut -->
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    </crm:P1.is_identified_by>
    <crm:P67.is_referred_to_by>
      <crm:E73.Information_Object rdf:ID="p1"/>
    </crm:P67.is_referred_to_by>
    <crm:P67.is_referred_to_by>
      <crm:E73.Information_Object rdf:ID="p2"/>
    </crm:P67.is_referred_to_by>
  </crm:E21.Person>
</crm:P62.Depicts>
<crm:P46.is_composed_of>
  <crm:E22.Man-Made_Object rdf:about="Hands">
    <crm:P47.is_identified_by>
      <crm:E42.Object_Identifier rdf:ID="http://havemann.cgv.tugraz.at/fedora/get/arrigo/Statue7#hands"/>
    </crm:P47.is_identified_by>
    <crm:P102.has_title>
      <crm:E35.Title rdf:about="Hands">Hands</crm:E35.Title>
    </crm:P102.has_title>
    <crm:P67.is_referred_to_by>
      <crm:E73.Information_Object rdf:ID="a2"/>
    </crm:P67.is_referred_to_by>
  </crm:E22.Man-Made_Object>
</crm:P46.is_composed_of>
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Courtesy: Oyvind Eide, Unit for Digital Documentation, University of Oslo
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Epoch Viewer is now ActiveX-Control
  - Completely GUI-less for embedding
  - Contains it all: OpenSG + GML + XML
  - Create applications using VisualBasic, C#, ...
• Example: Powerpoint-like authoring application
• Example: Kiosk-Viewer application
• Deployed in binary form (ActiveEpoch.ocx)
  - Source code for examples freely available
  - Availability: www.cgv.tugraz.at/EpochViewer
  - Long-term availability: Applications in psychology…
Example: Powerpoint-like Authoring Appl.

- Loads GML template
- Shape markup (URL)
- Output: Collada

**Trick:** The C# application sends GML commands to ActiveX control
Example: Kiosk-Viewer Application

- Loads Collada
- Shows 3D with markup
- Embed Internet Explorer

**Trick:**
The C# application sends GML commands to ActiveX control
Simple Solution but Major Breakthrough

- **Simple, easily understandable concept**
  - Takes basically 3 slides to explain it!
- **Collada .dae files are lightweight**
  - Scholars can exchange .dae files via e-mail
  - Generate .dae-files dynamically (3D-queries)
- **Generalizable in many ways**
  - Markup also using points, lines, volumes, meshes
  - Attach .gml-files to individual objects: Behaviour
    - Example: Explain ancient mechanism
- **Anchors into 3D-files**
  - Bi-directional linking: 3D ↔ Fedora, 3D ↔ MAD/SAD
• **Scene assembler to create 3D-hypotheses**
  - Objects may also come from remote sources, since `<instance_geometry>` also takes URLs
  - Receiving scholar should have access rights
• **Digital library of 3D-hypotheses**
  - .dae files represent knowledge! – sustainable
  - .dae files from exhibitions, from scholars, …
• **Bi-link 3D to arbitrary multimedia**
  - Embedded IE can show videos, Flash, GML, …
  - Easy to embed multimedia data into HTML
• **Browsing hierarchical information**
  - Map scene graph hierarchy to semantic hierarchy
  - Statue has head, head has nose, eyes, mouth, …