

Ερευνητικό Κέντρο Αθηνά
Athena Research Center

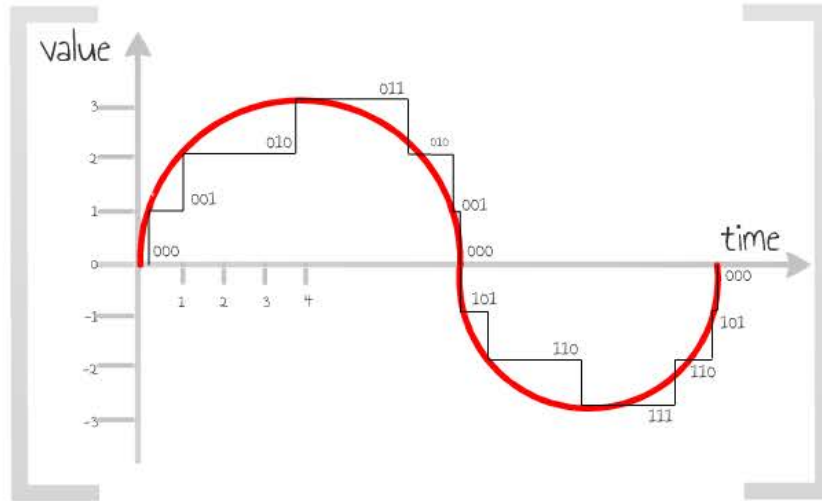
Ερευνητικό Κέντρο Καινοτομίας στις Τεχνολογίες
της Πληροφορίας, των Επικοινωνιών, της Γνώσης

Research and Innovation Center in Information,
Communication and Knowledge Technologies

Innovative applications in cultural heritage and trends for future research and development

George Pavlidis
Dr. Electrical Engineer
Research Director

Digital?



Why?

from infinity down to earth and the human mind.

- we get a sequence of numbers...in most cases using just 2 digits by "sampling" the original in specific time points

sequences of distinct numbers

- are easy to handle
- are easy to correct in case of errors
- are easy to encode & encrypt
- are easy to compress & save storage/transmission size & time

lead to devices and technology

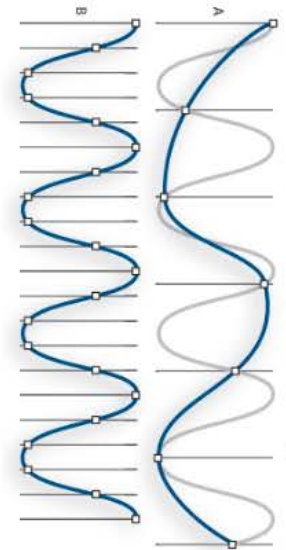
- with small size
- low power consumption
- easy processing and filtering
- guarantee better quality
- make the internet possible
- ...

What's with that '3D'?

We are 4D beings and perceive a 3D spatial universe

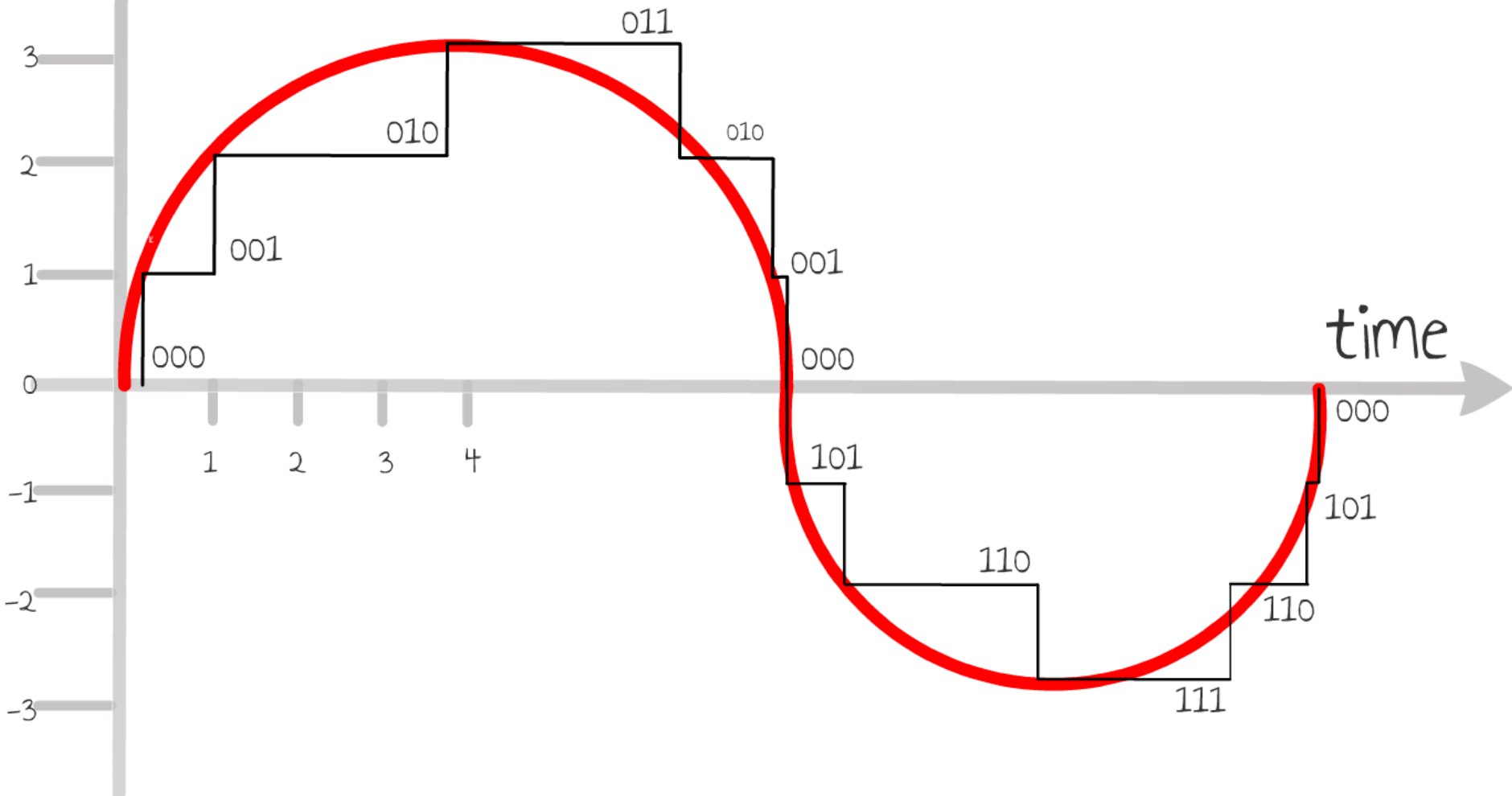
3D images

- convey geometry information
- can disassociate structure from color
- can produce different versions of reality
- can return back to the real world



But...sampling over "discrete" time? How frequent?

value



1,34987776...



0,54364342...

Why?

from infinity down to earth and the human mind.

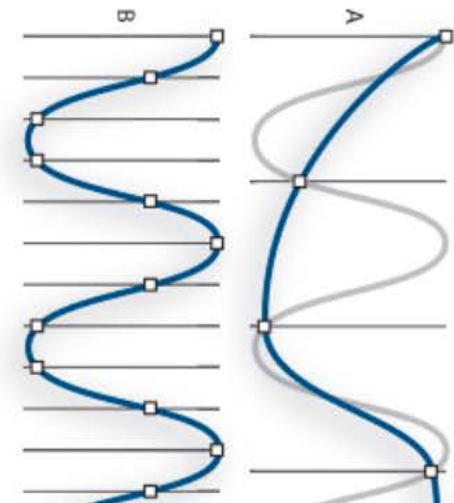
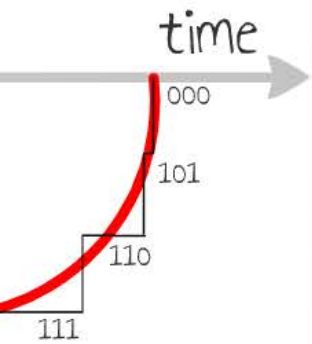
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D'?

and the human mind.

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ers

ase of errors

rypt

save storage/transmission size & time

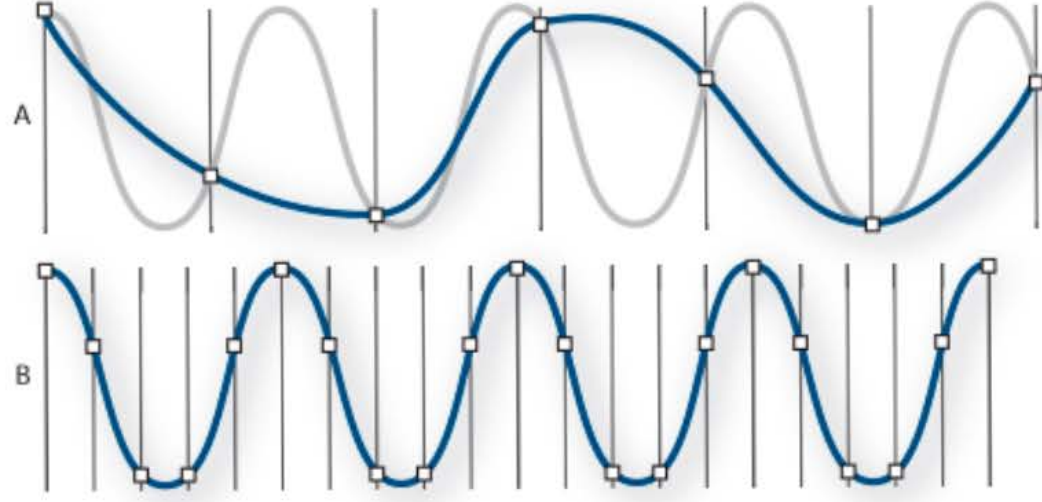
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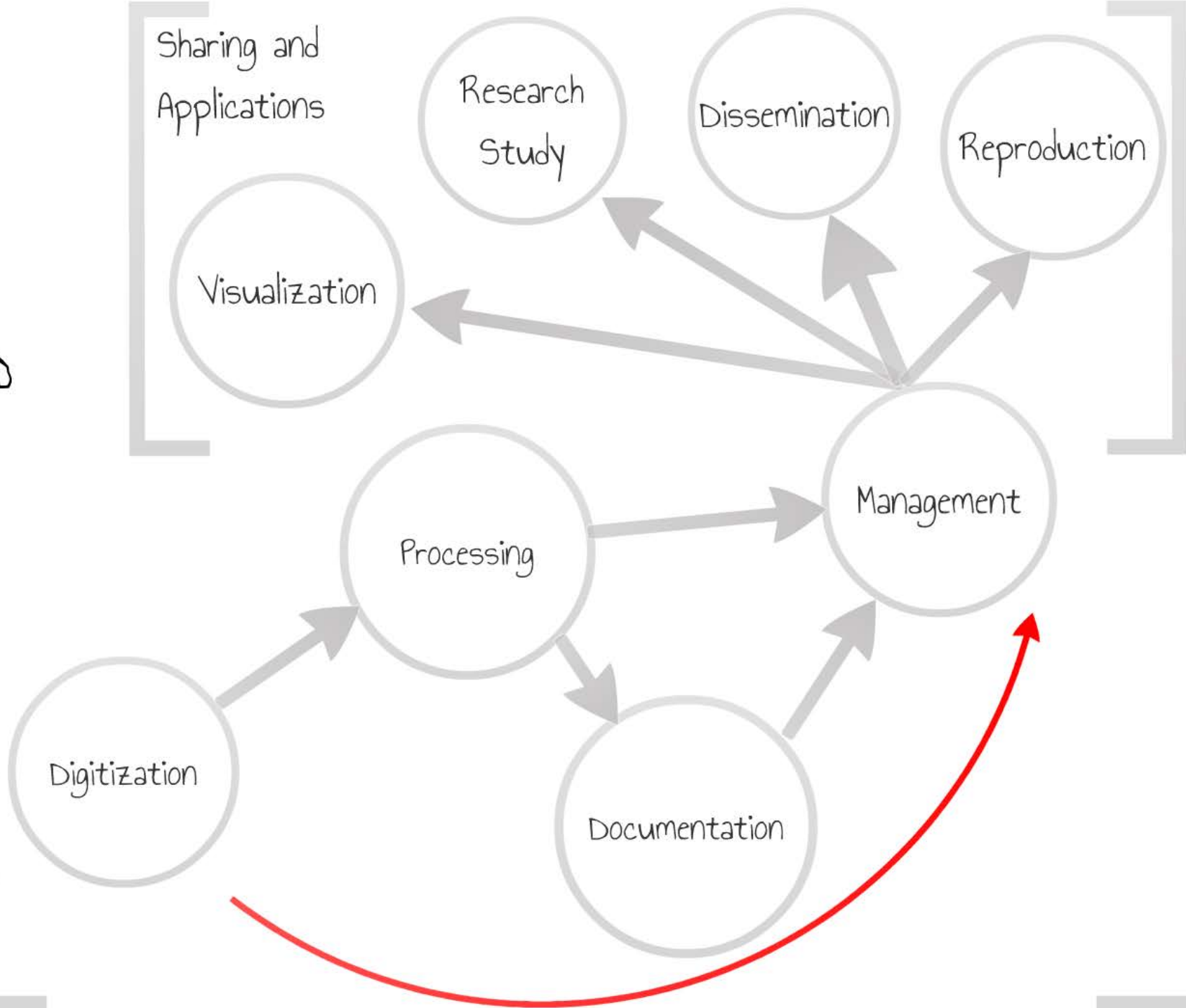
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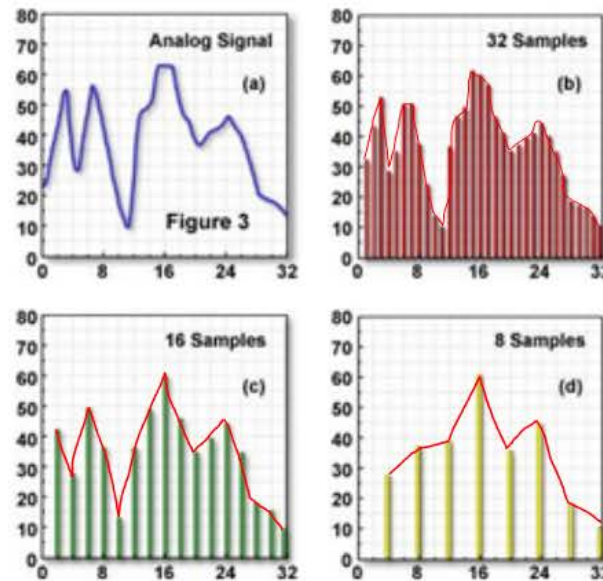
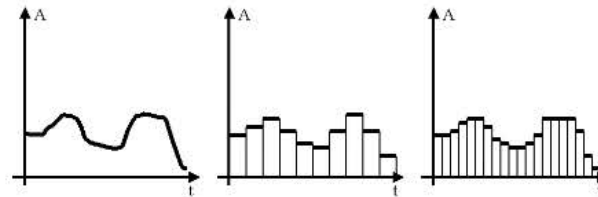
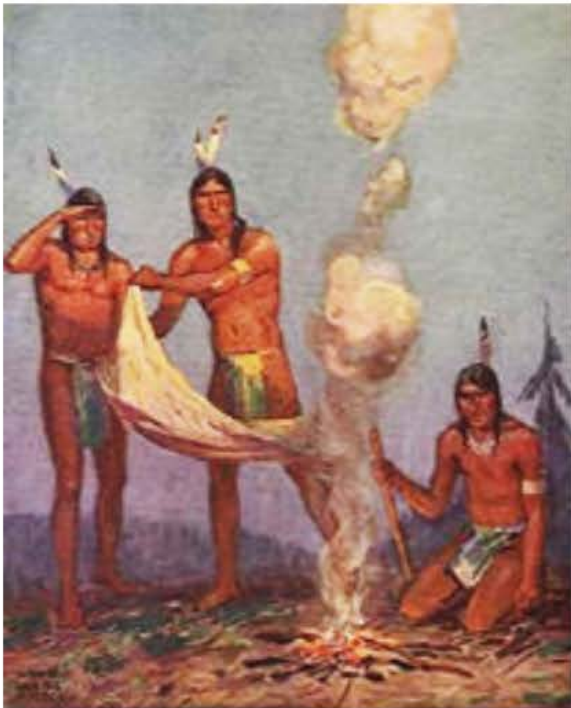
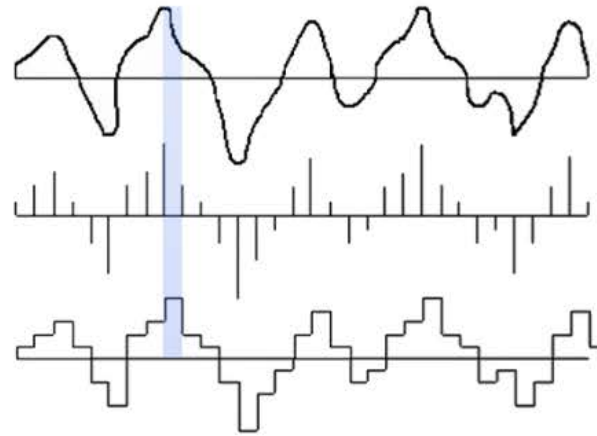
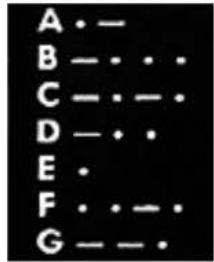
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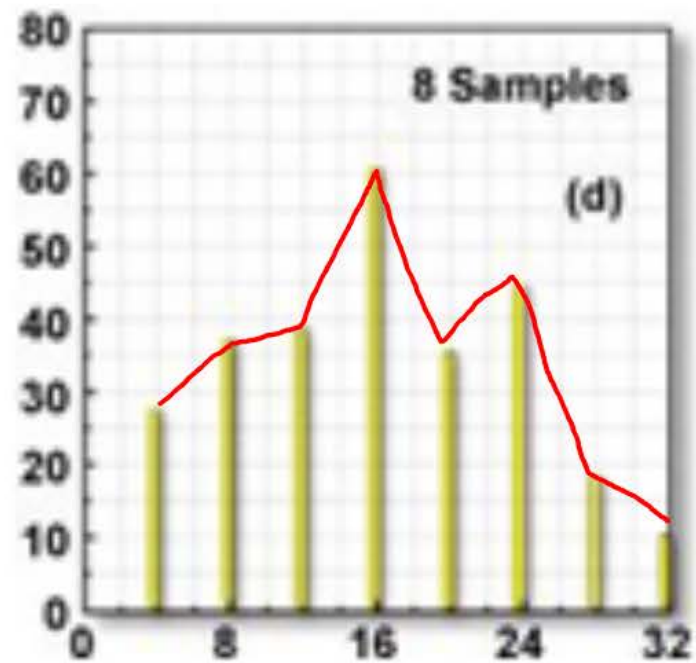
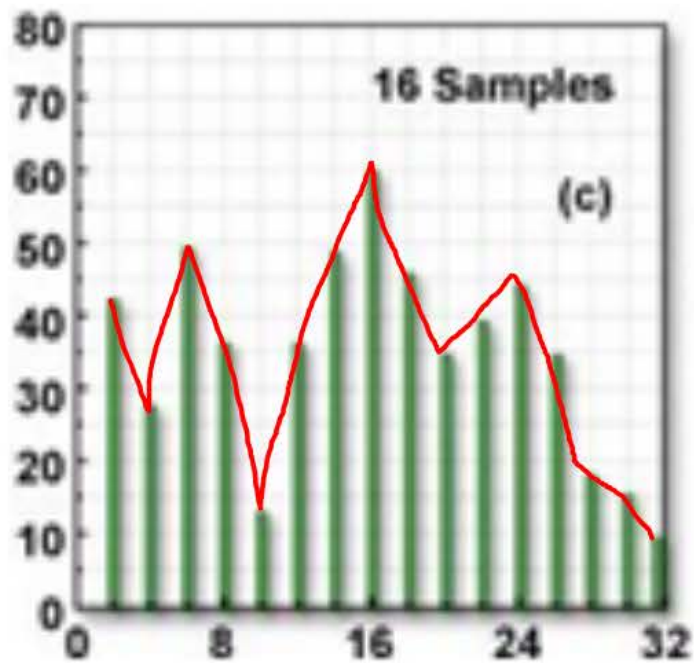
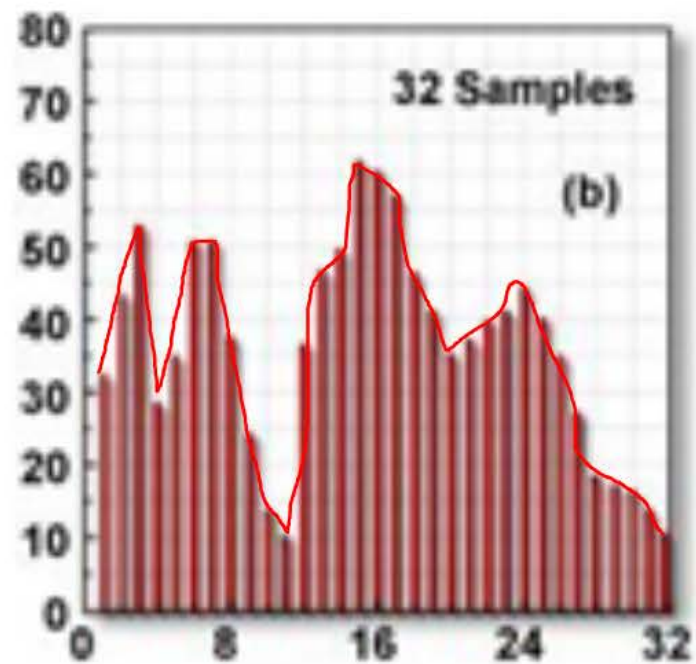
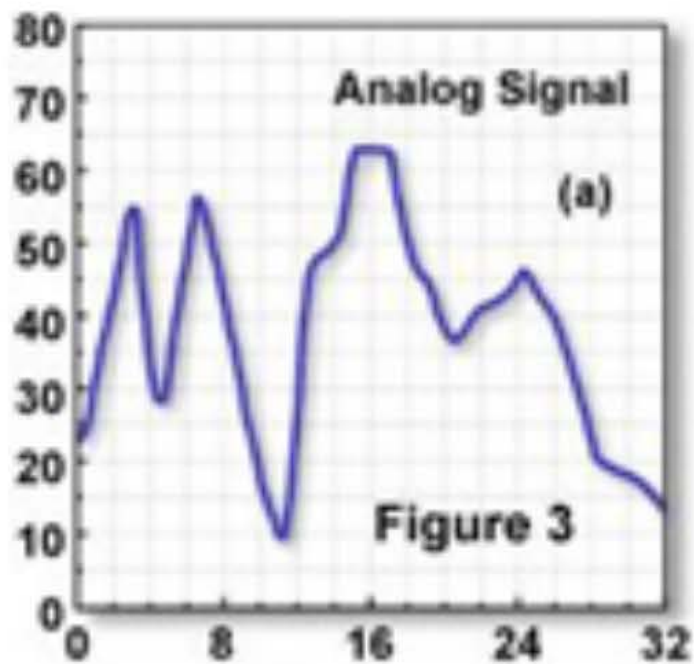
Data Life Cycle



Digitization

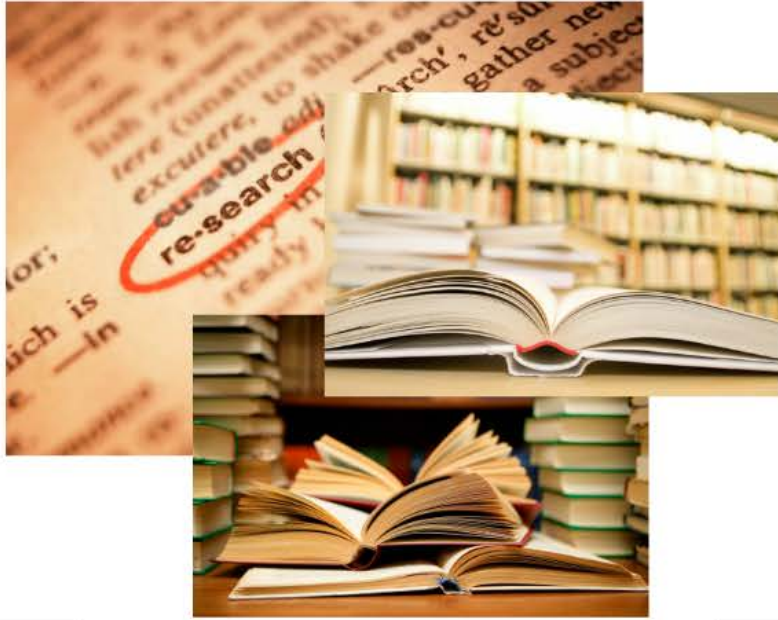


Decimal	Digital
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010

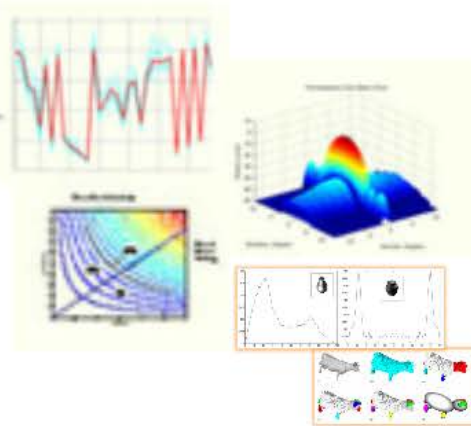


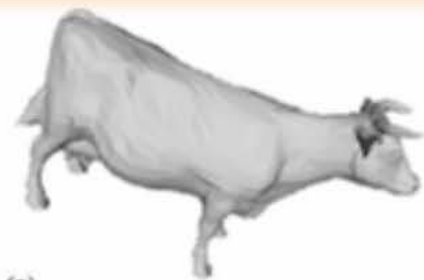
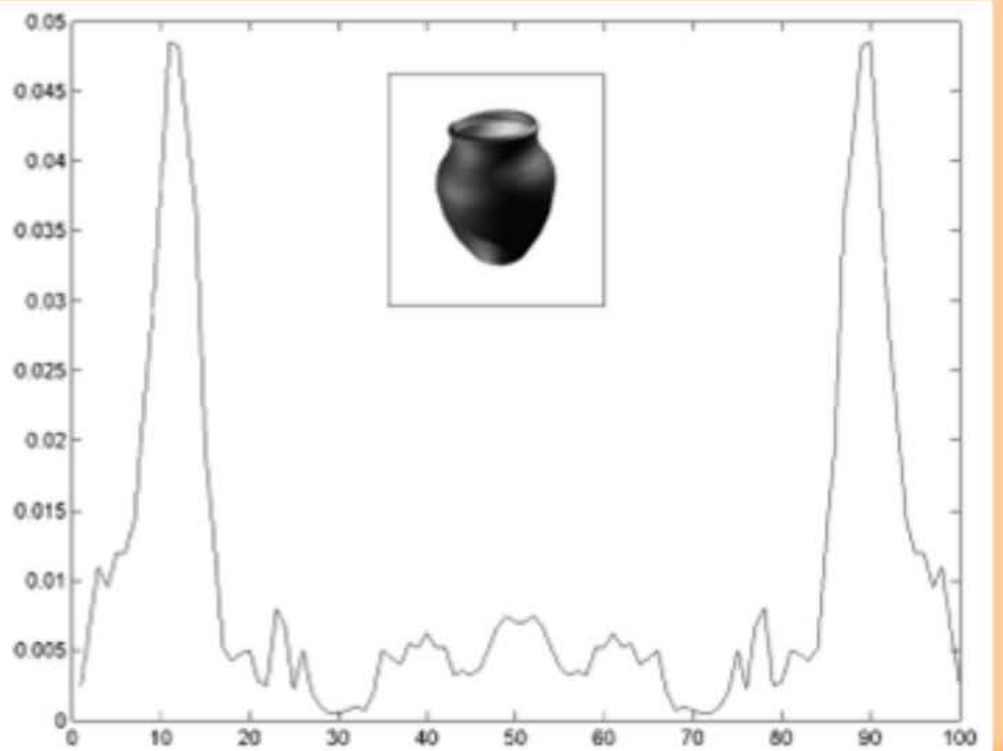
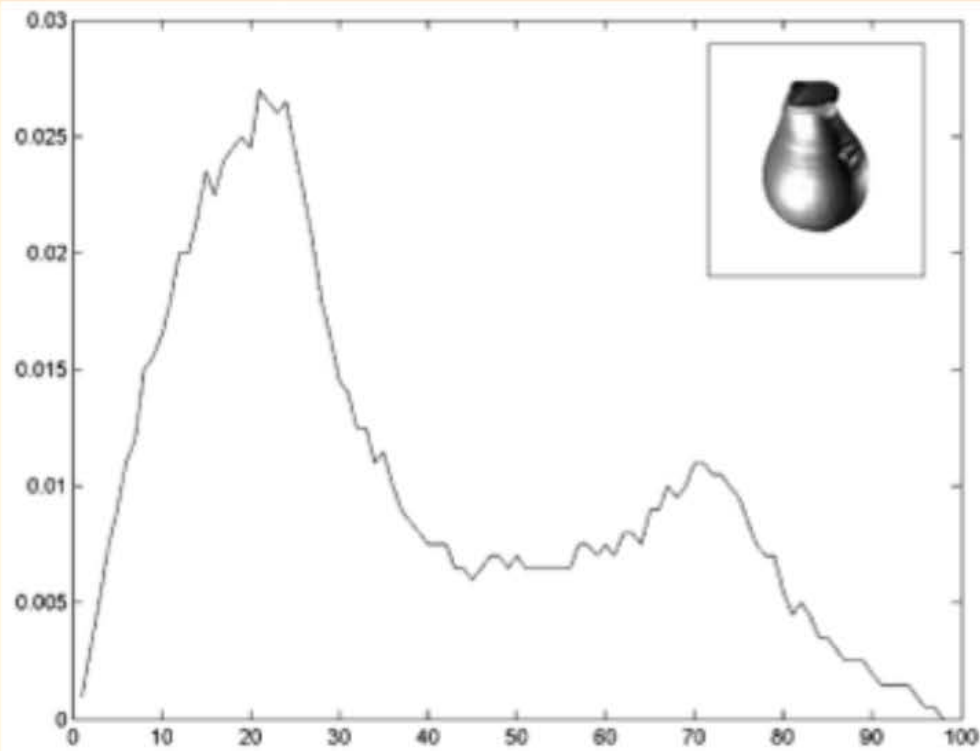
0
4
5
6
7
8
9
10

Documentation



Data analysis and
feature extraction

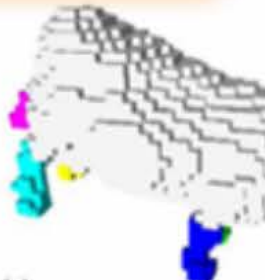




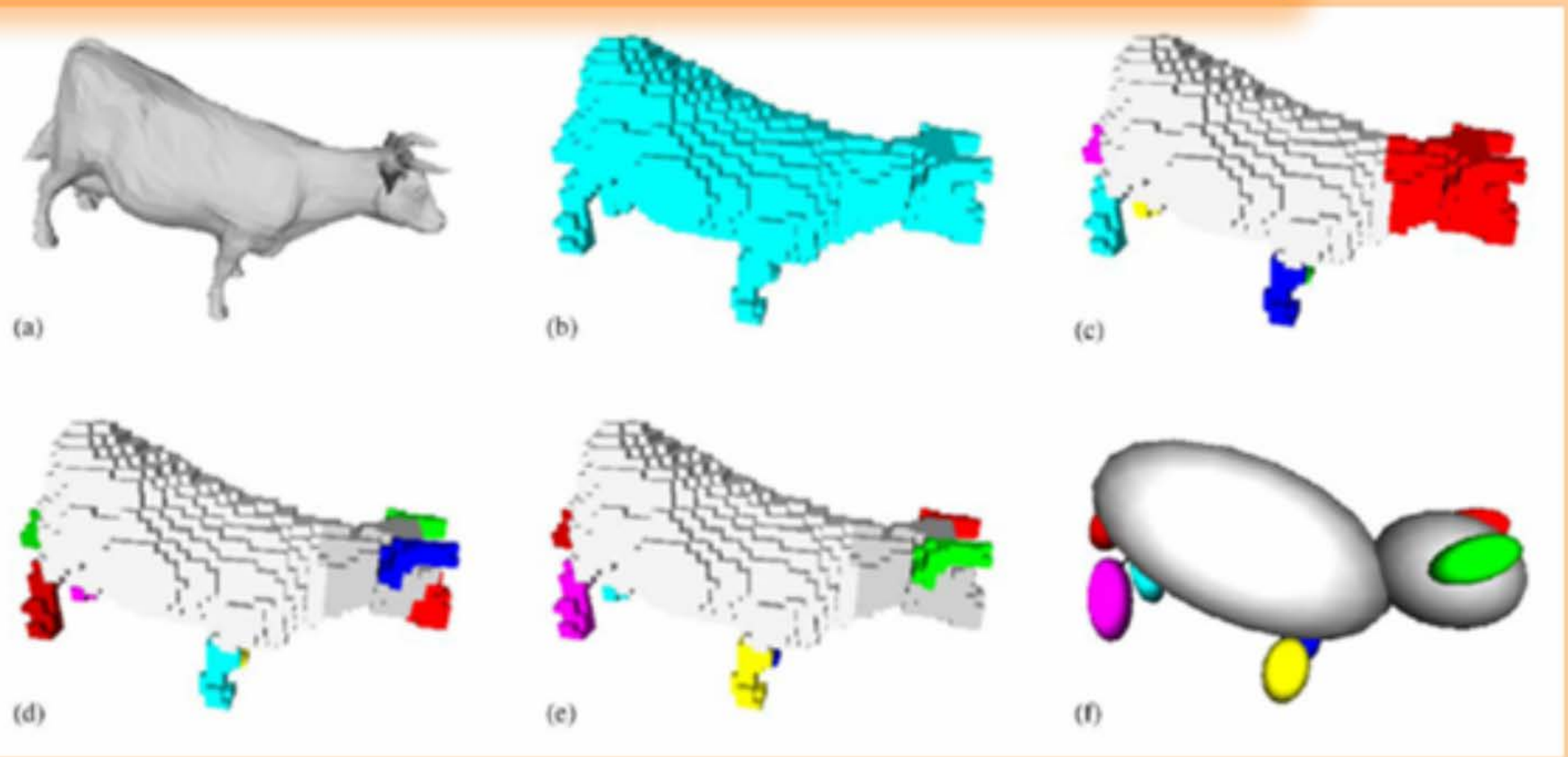
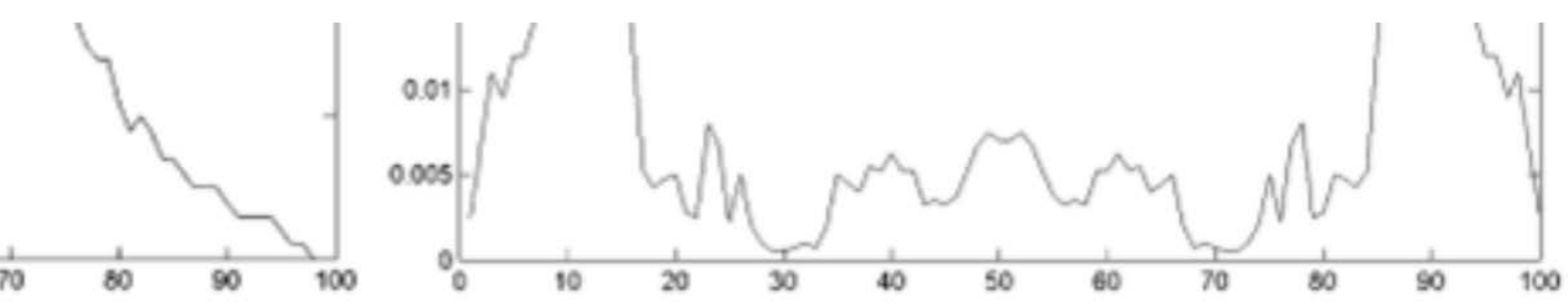
(a)



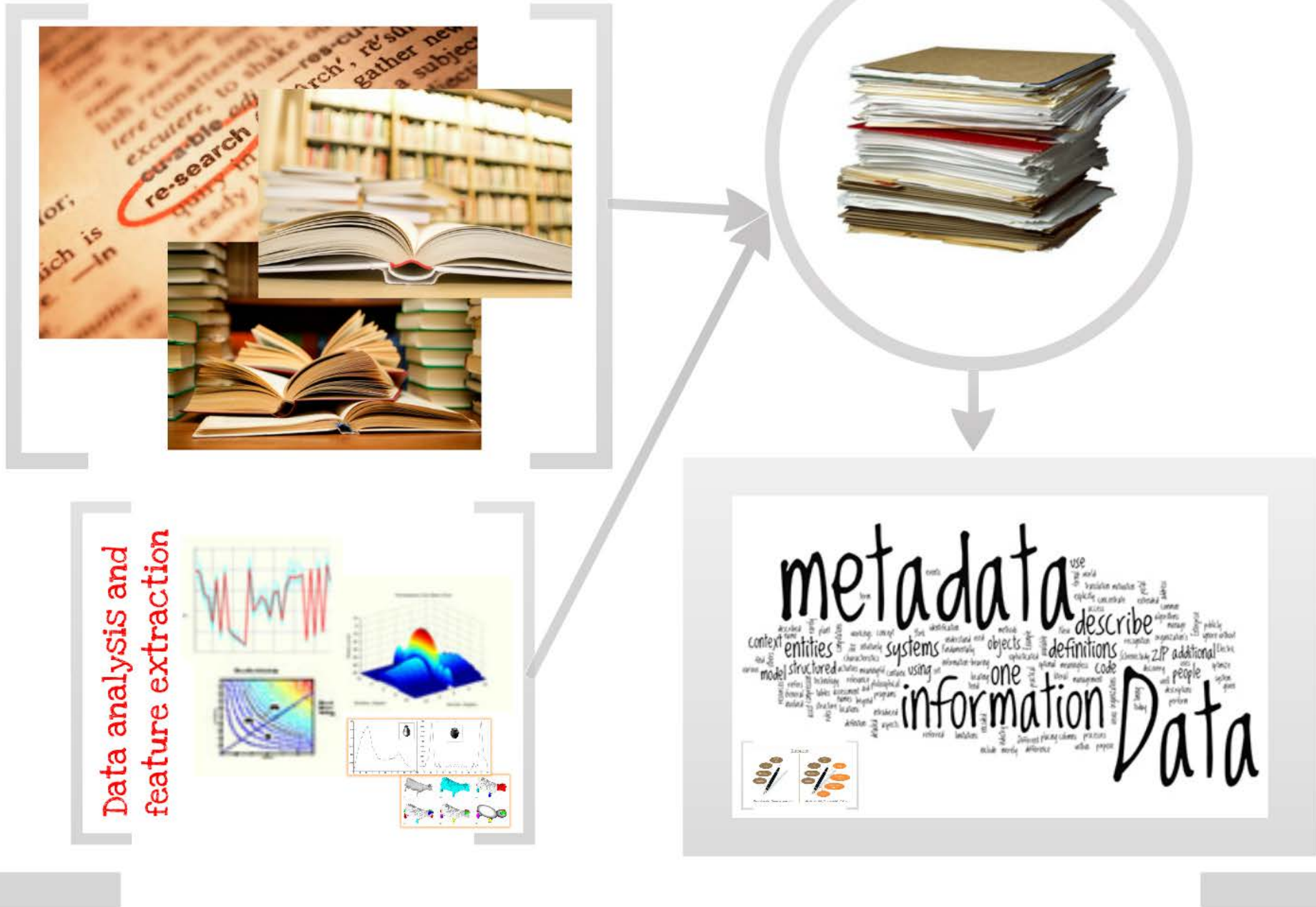
(b)



(c)



Documentation



Historicity



Mental model, *Grapho ordinarii*



Mental model, *Grapho historicitae*

Metadata

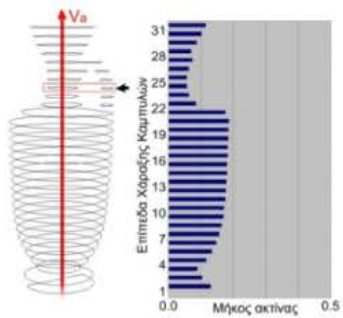
- Descriptive metadata / manually entered
- Versioning, data management metadata
- Mathematical descriptions of data features
- Copyrights

Mathematical descriptions

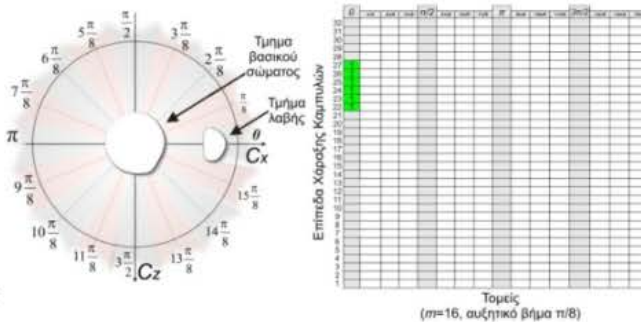
Content-based descriptions

- Automated content analysis
- Feature extraction
- Content-based identification

...to match the human segmentation/identification/classification processes



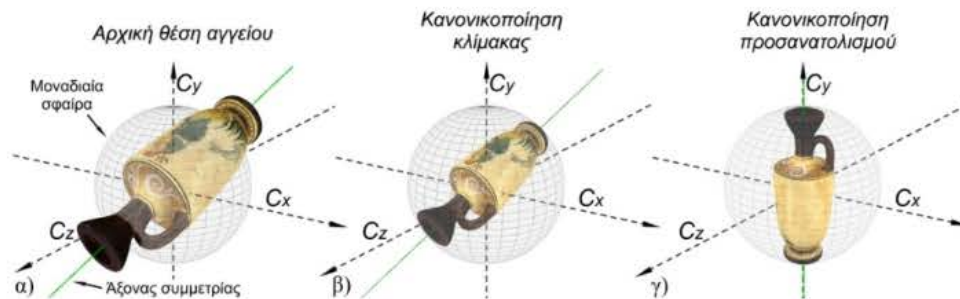
α) Μονοδιάστατο διάγραμμα χαρακτηριστικών του προφίλ (32 επίπεδα χάραξης)



β) Διαδικός Πίνακας Θέσης Προσαρτημάτων (32x16)

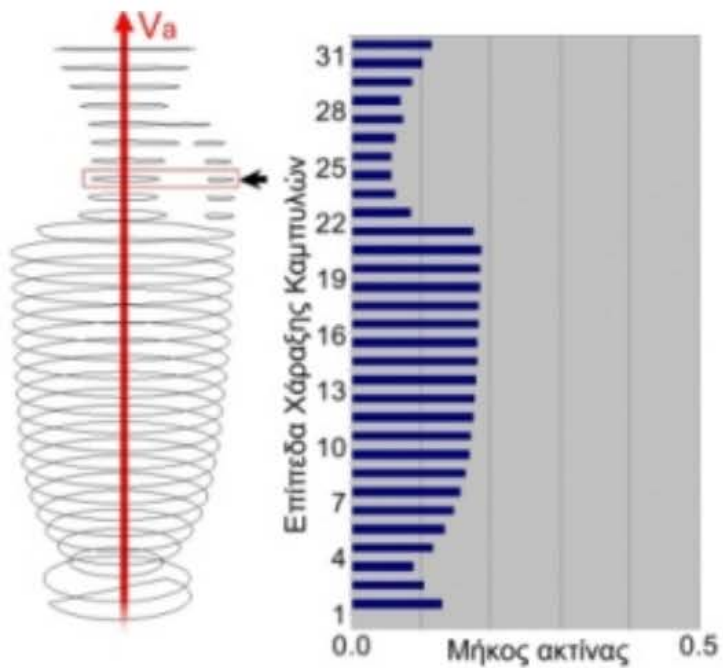
Method for partial/complete identification of morphological features of 3D pottery

Αγγείο επερώτηση	Κοντινότερος γείτονας				

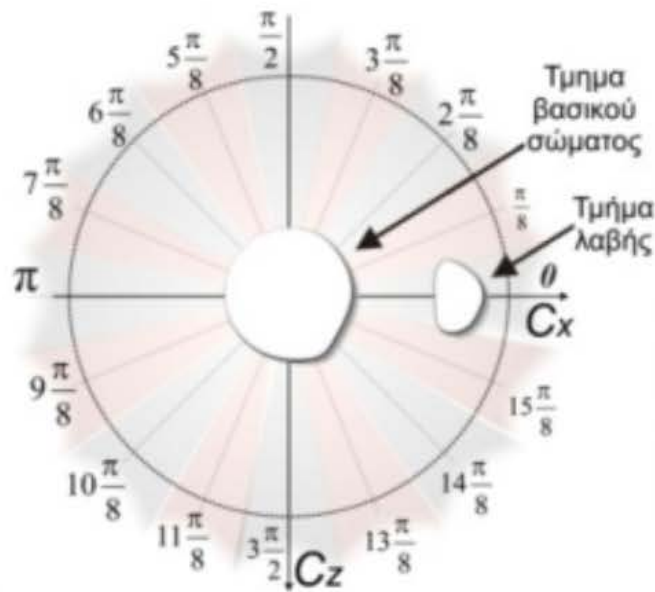


<http://www.ipet.gr/3DPSE>

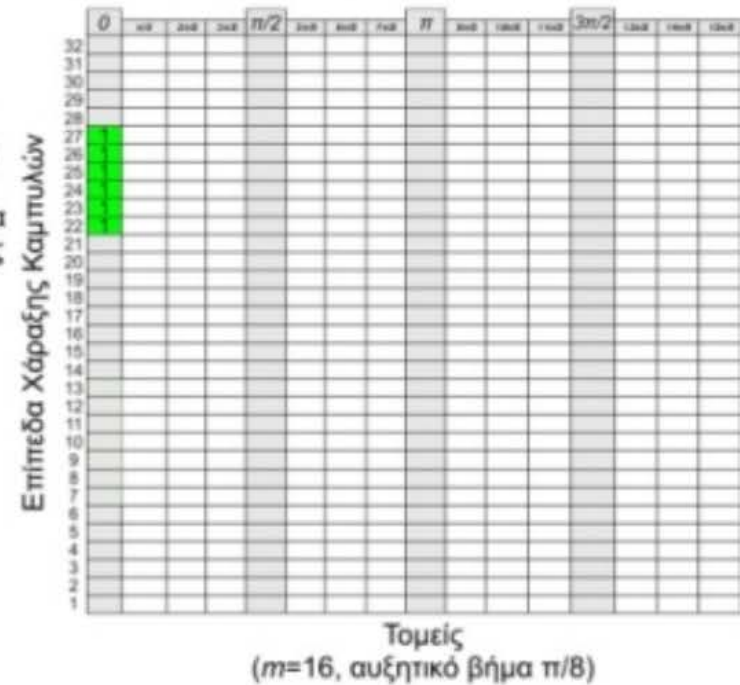
...to match the 1x



α) Μονοδιάστατο διάνυσμα χαρακτηριστικών του προφίλ (32 επίπεδα χάραξης)



β) Δυαδικός Πίνακας Θέσης Προσαρτημάτων (32x16)



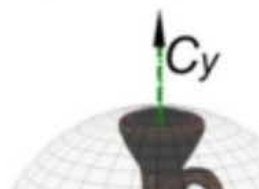
Αρχική θέση αγγείου



Κανονικοποίηση κλίμακας

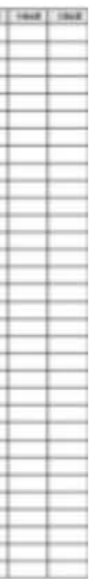


Κανονικοποίηση προσανατολισμού



Αγγείο
επερώτηση

Κοντινότερος
γείτονας



More semantic descriptions

Even more content-based descriptions

3D scenes

- monuments
- architectural
- urban areas
- open spaces



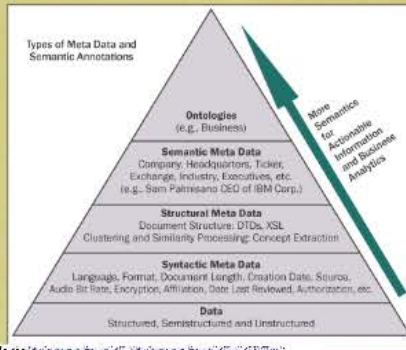
Annotation of 3D scenes to empower (semantic with hierarchies)

- content-based retrieval / navigation within 3D scenes
- predefined queries
- topological or map-based queries
- instant region of interest navigation
- web-based access

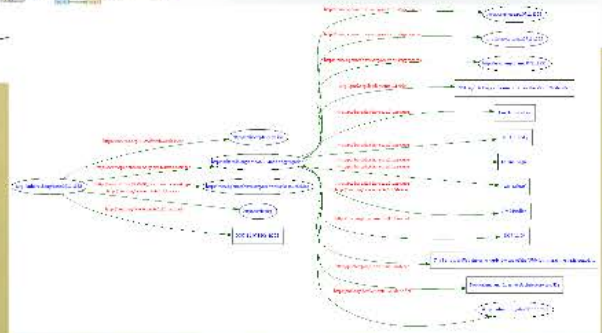
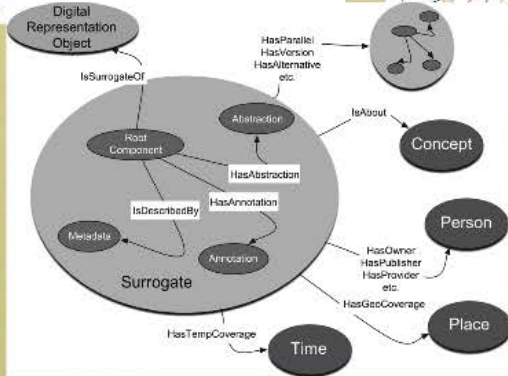
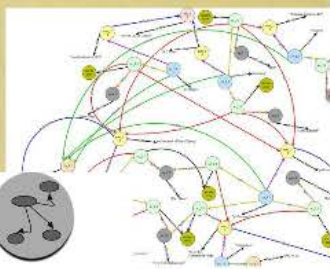


<http://www.ipet.gr/3DSSE>

Data and metadata



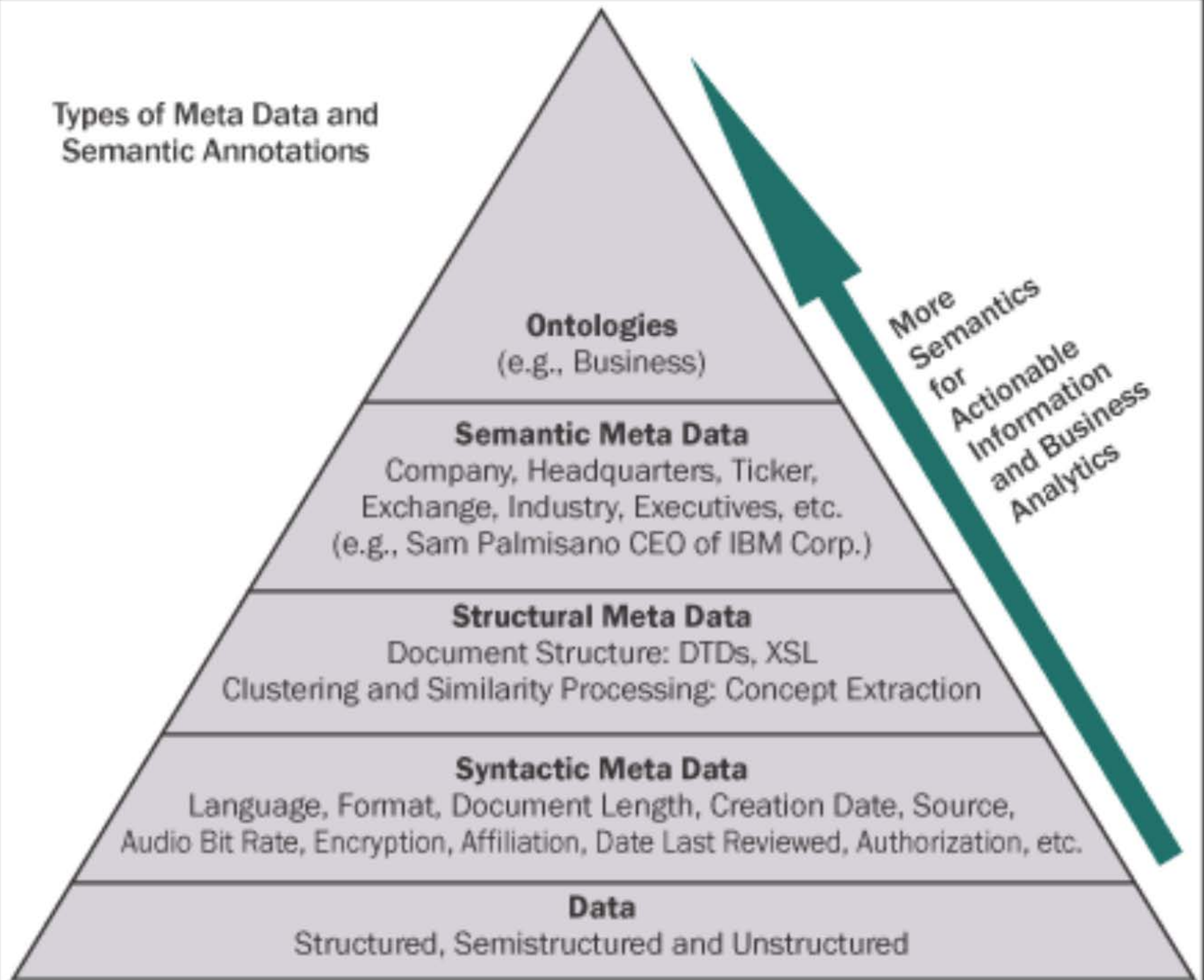
2007-08-15 10:10:10 AM
1. Introduction
2. Metadata
3. Digital Representation
4. Abstraction
5. Annotation
6. Surrogate
7. Concept
8. Person
9. Place
10. Time



Management



Types of Meta Data and Semantic Annotations



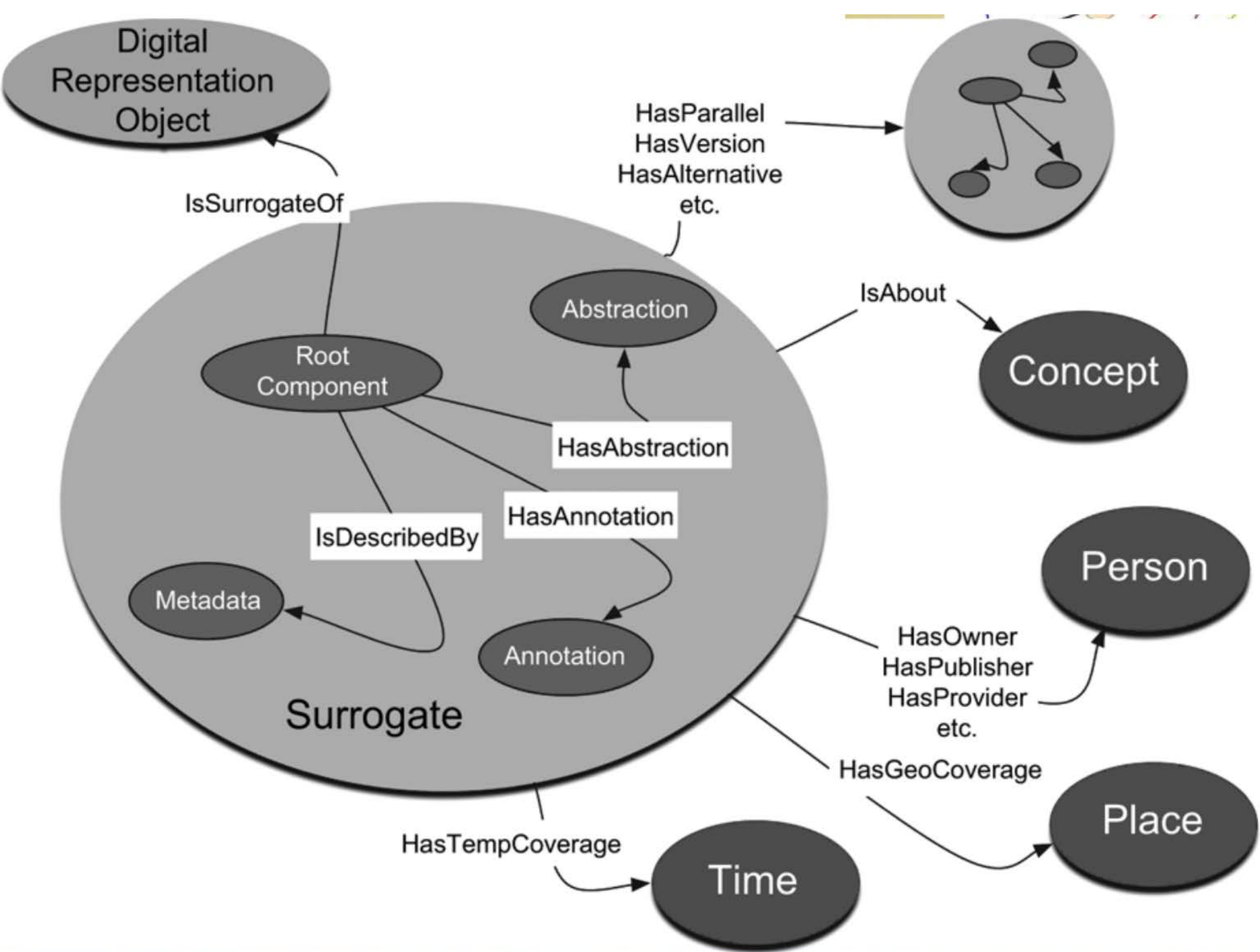
Data

Structured, Semistructured and Unstructured

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  <responseDate>2011-06-02T05:15:56Z</responseDate>
  <request>http://archive-it.org/oai</request>
- <GetRecord>
  - <record>
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    </header>
  - <metadata>
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      <dc:subject>photo</dc:subject>
    - <dc:description>
      Images of Space. Pulled from International Government, Amateur, and Hobby sites.
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      <dc:type>Collection</dc:type>
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  </metadata>
</record>
</GetRecord>
</OAI-PMH>
```

Digital
Representation
Object

HasParallel
HasVersion
HasAlternative





<http://www.openarchives.org/ore/terms/aggregates>

<http://arxiv.org/ps/0711.1533>

<http://www.openarchives.org/ore/terms/aggregates>

<http://arxiv.org/pdf/0711.1533>



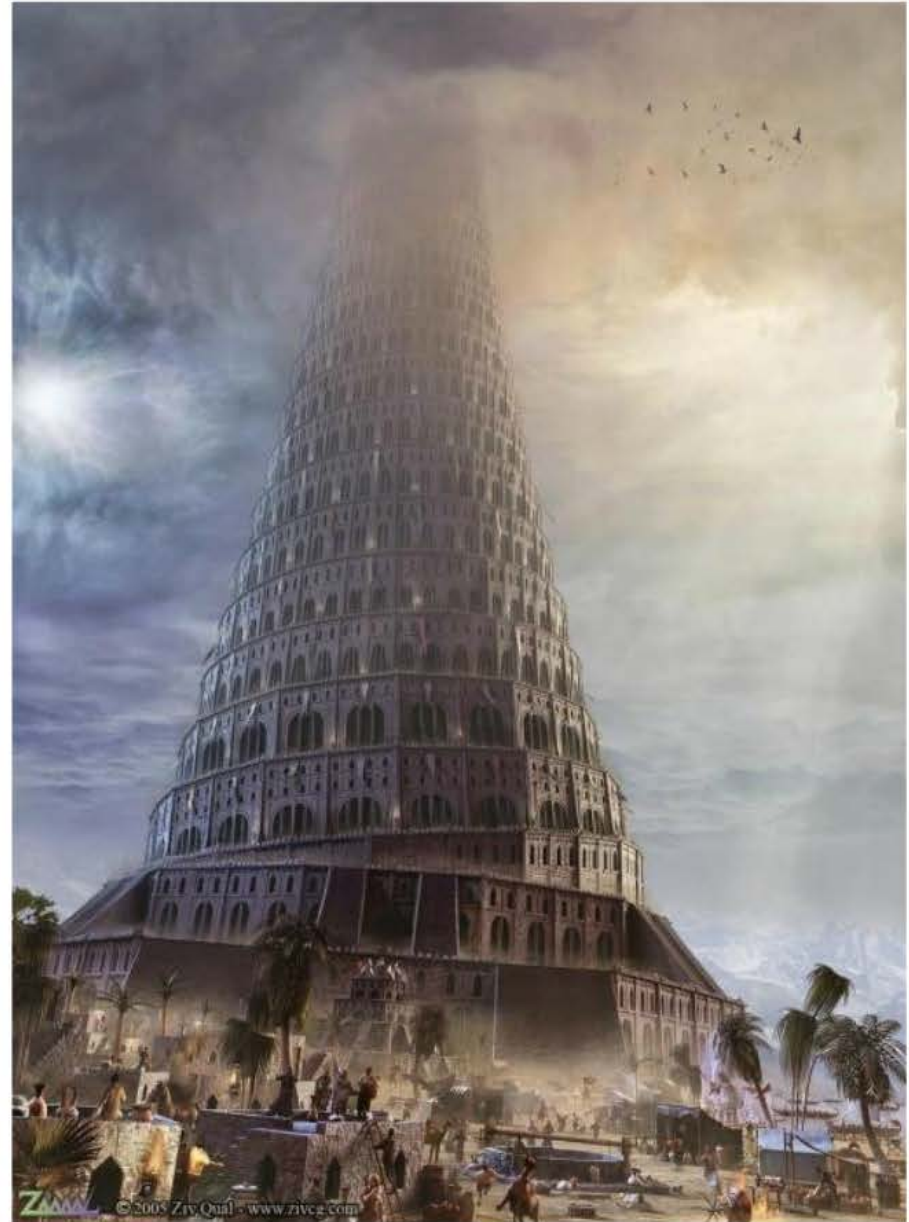


The Tower of Babel

Zillions of cultural data
that keep piling up

But who can access and use
all these data?

Do we, again, stand before
a tower of Babel?

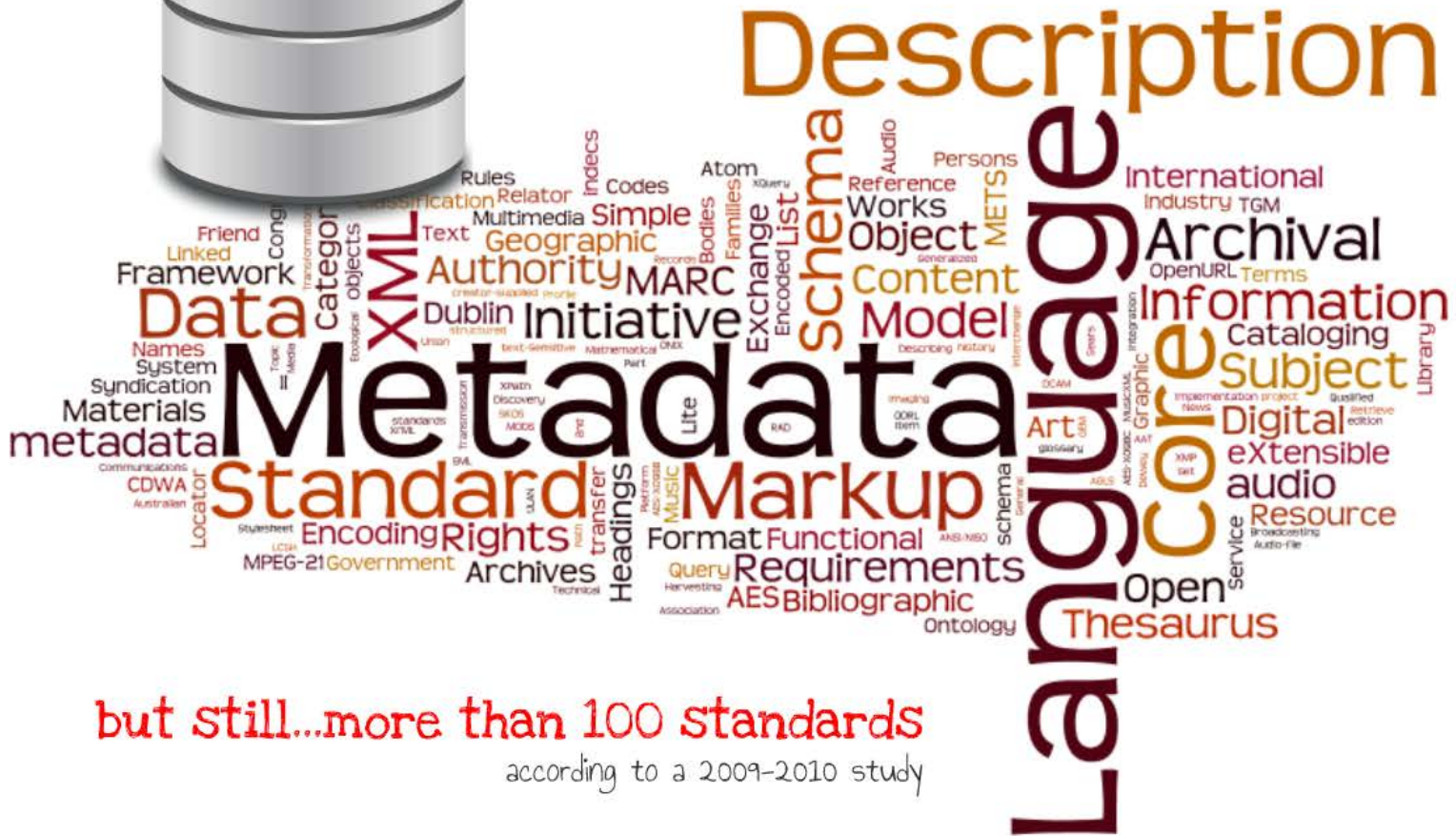


Standardization

with ontology defining the domain



Interoperability

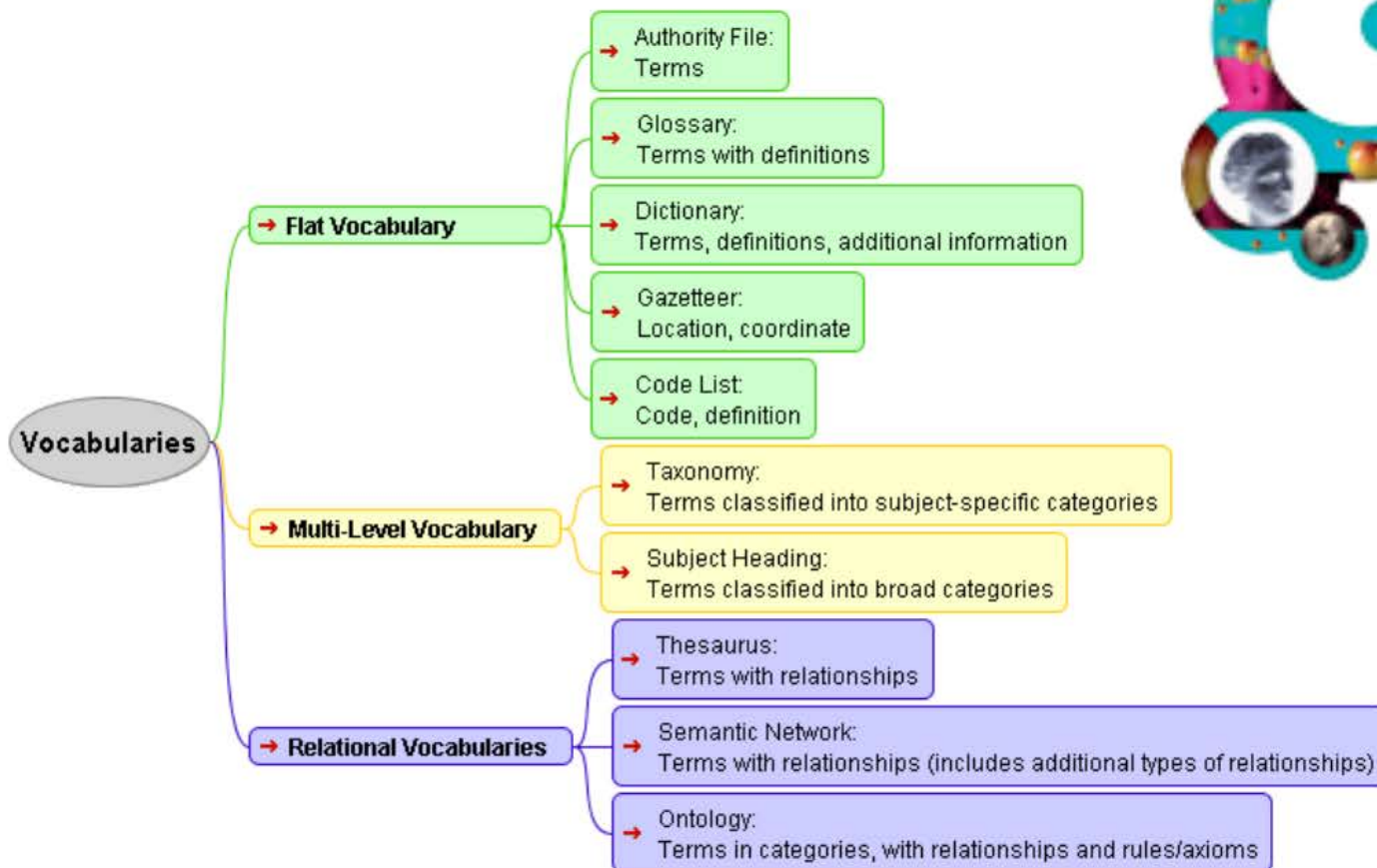




Not yet...still one thing is missing!

Wrap it up

with controlled vocabularies





Storage

Factors that influence the selection of a storage system

- Access times
- Data rates
- Multi-user access
- Capacity
- Usage frequency
- Lifetime of the medium
- Storage and usage conditions
- Cost per storage unit



Today there is also...



Digital curation

- Collecting verifiable digital assets
- Providing digital asset search and retrieval
- Certification of the trustworthiness and integrity of the collection content
- Semantic and ontological continuity and comparability of the collection content

Warning!

- Storage format evolution and obsolescence
- Rate of creation of new data and data sets
- Broad access and searching flexibility and variety
- Comparability of semantic and ontological definitions of data sets

Visualization / Presentation of 3D data



Immersive environments

- User loses connection to reality
- User wears HUD and acts in controlled environment



Non-immersive desktop environments

- 3D presentation on screen
- User usually has to wear glasses (colored/shutter/polarizer)



Projected environments

- Virtual environment is projected in real controlled space
- User typically uses glasses (polarizer)



Augmented environments

- Virtual objects are being projected on real-world images

Visualization / Presentation of 3D data

Immersive environments



Factors to consider

- Audience size
- To immerse or not
- Interaction level
- Costs

Projected environments



Non-immersive desktop environments



Augmented reality



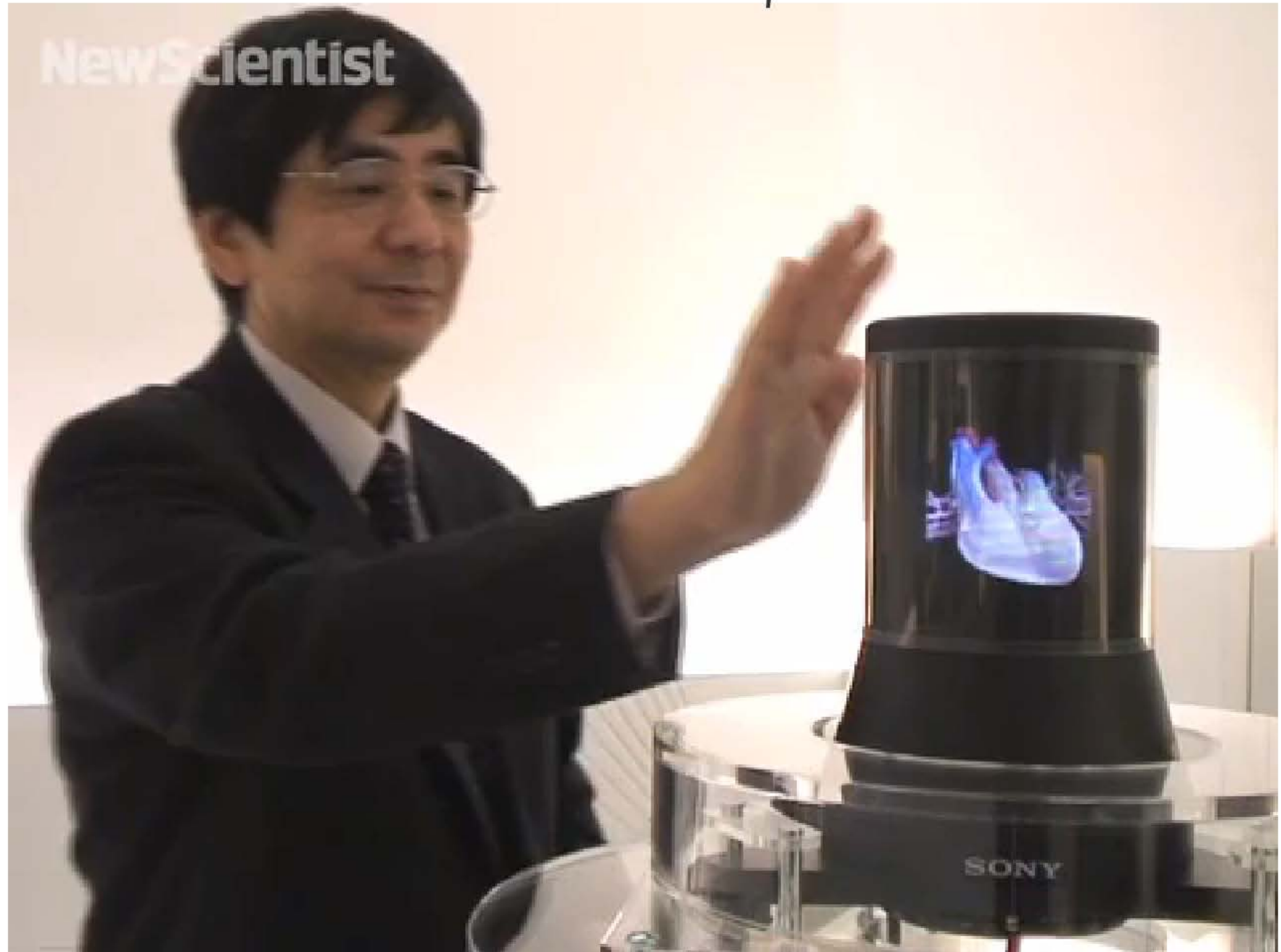
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Immersive environments



Non-immersive desktop environments



Projected environments



Augmented reality



Visualization / Presentation of 3D data

Immersive environments



Factors to consider

- Audience size
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Projected environments



Non-immersive desktop environments

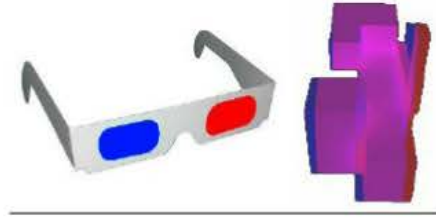


Augmented reality



Stereo vision

Colored glasses (red-green/blue-cyan)



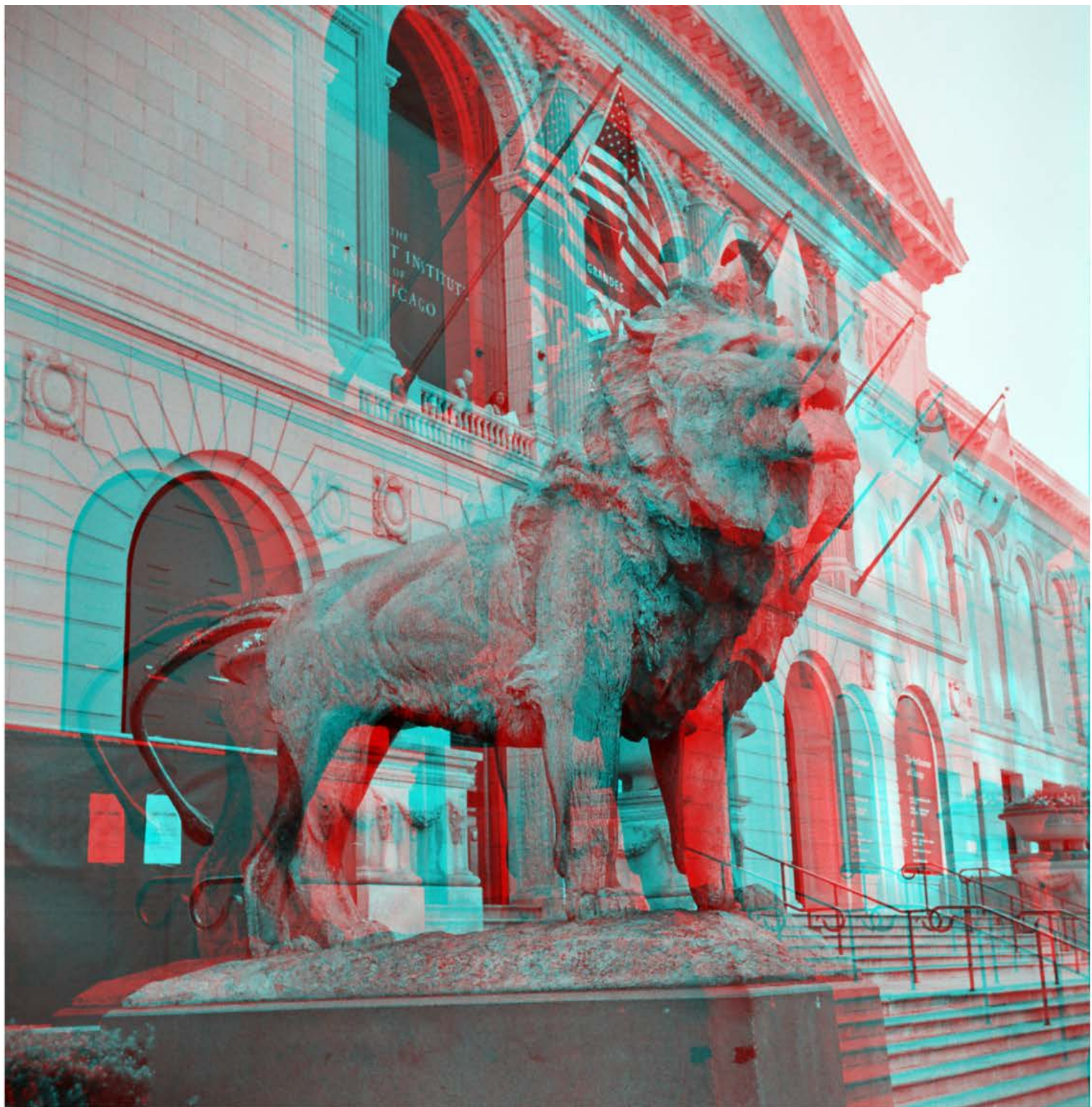
Polarizer glasses



Shutter glasses



an)

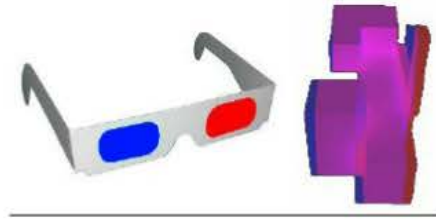






Stereo vision

Colored glasses (red-green/blue-cyan)



Polarizer glasses

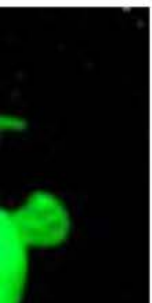
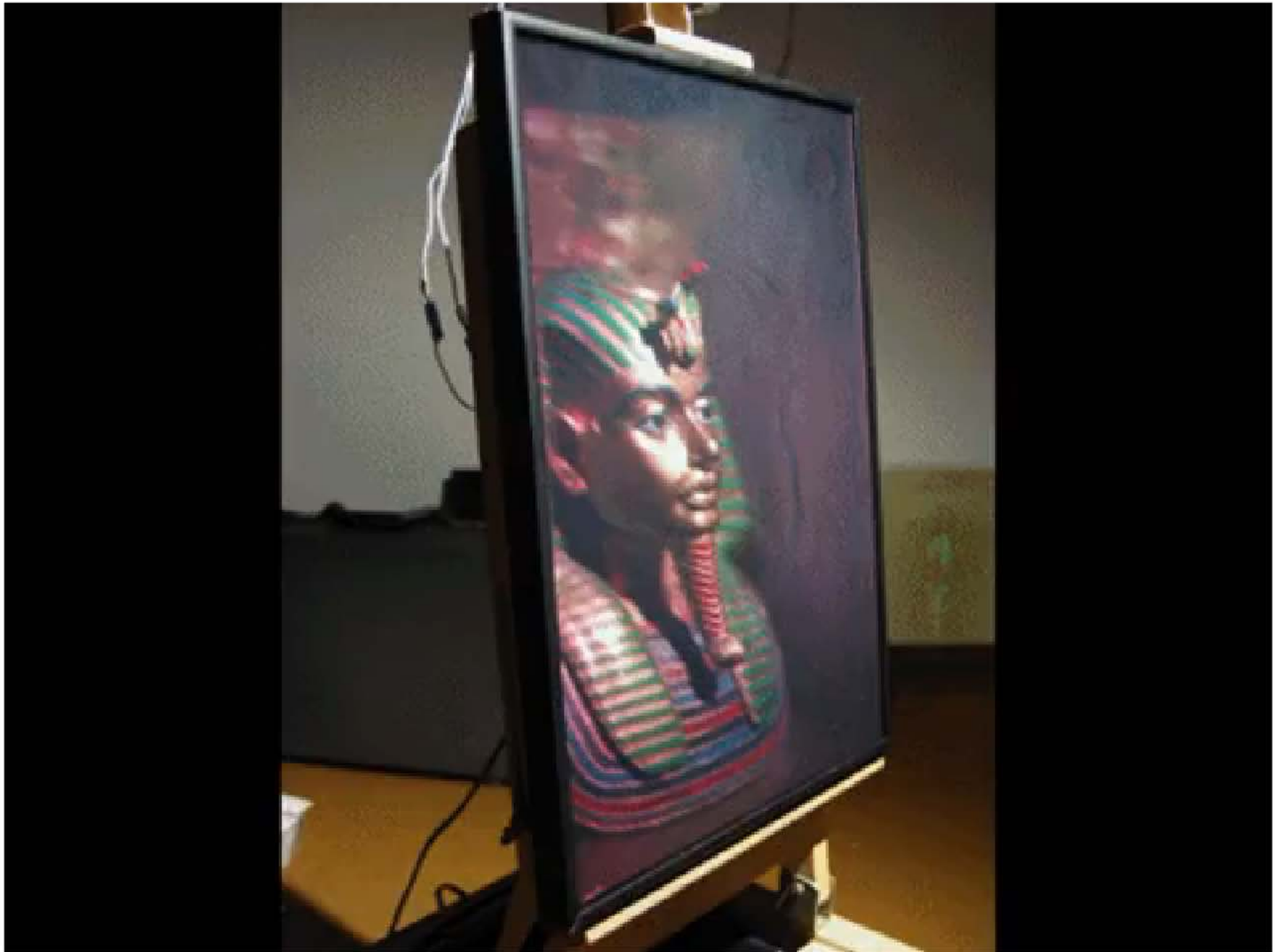


Shutter glasses



Holography





Holography



Reproduction



3D milling



3D deposition



Stereolithography

QUESTION



Reproduction



3D milling

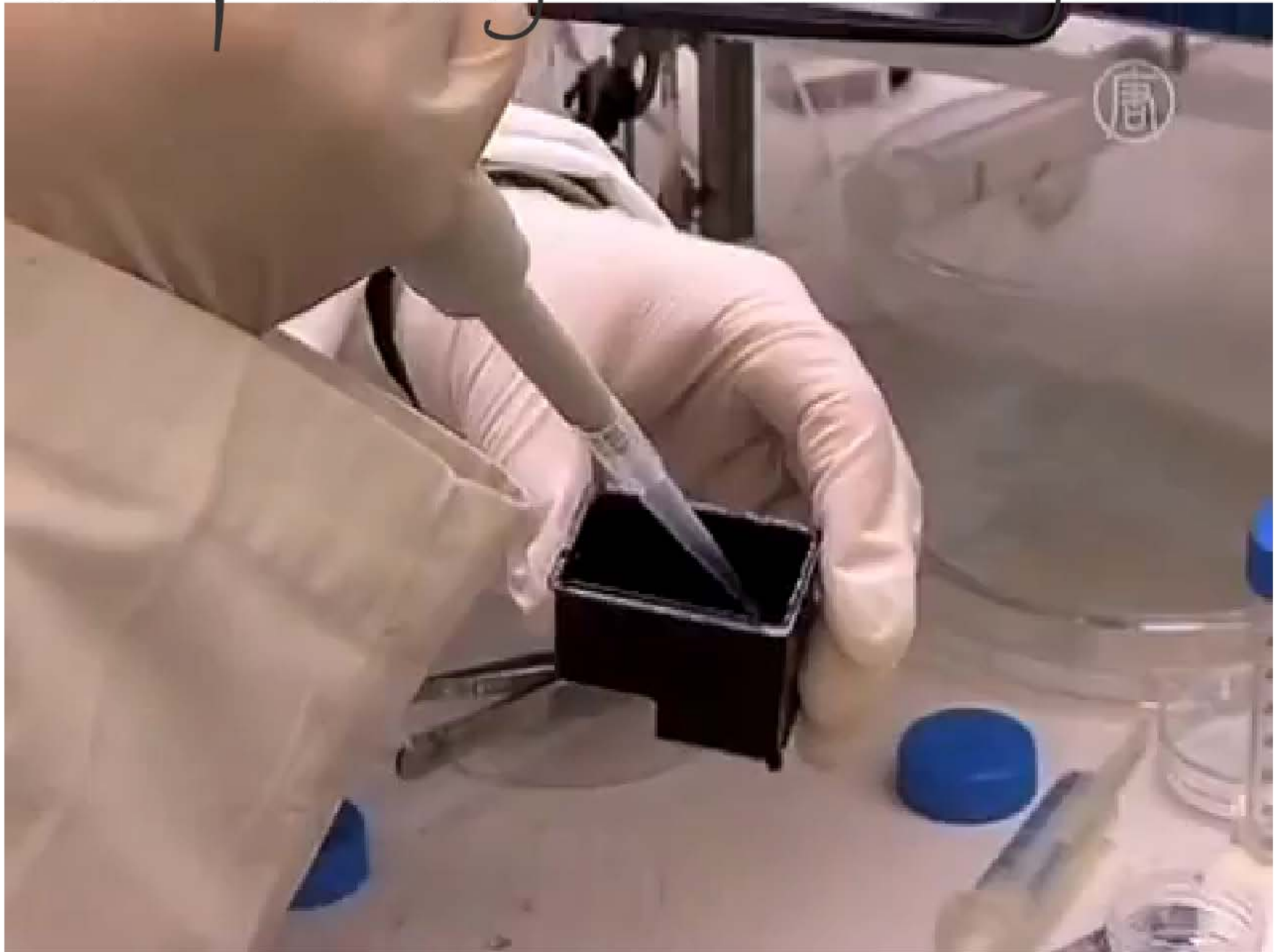


3D deposition



Stereolithography

3D printing human organs!



Reproduction



3D milling



3D deposition

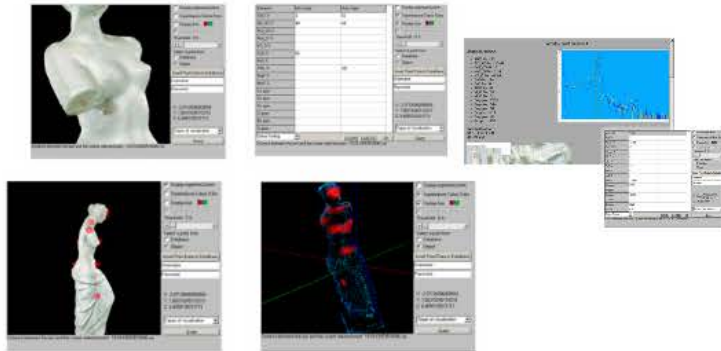


Stereolithography

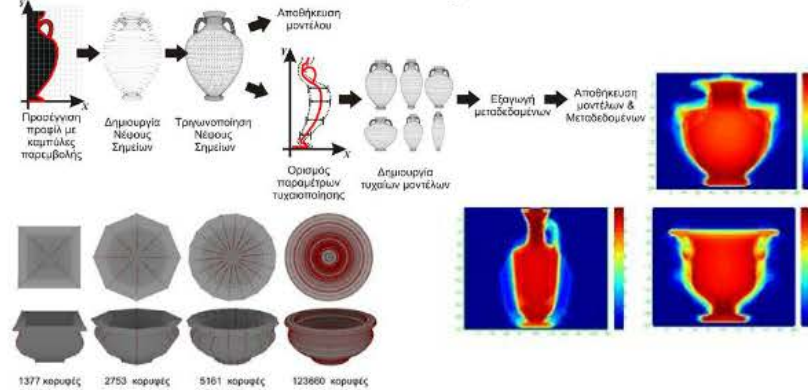
Applications for the experts

ReSeArch tools for modeling, analysis and feature identification

3D GIS-like representations and queries on artifacts

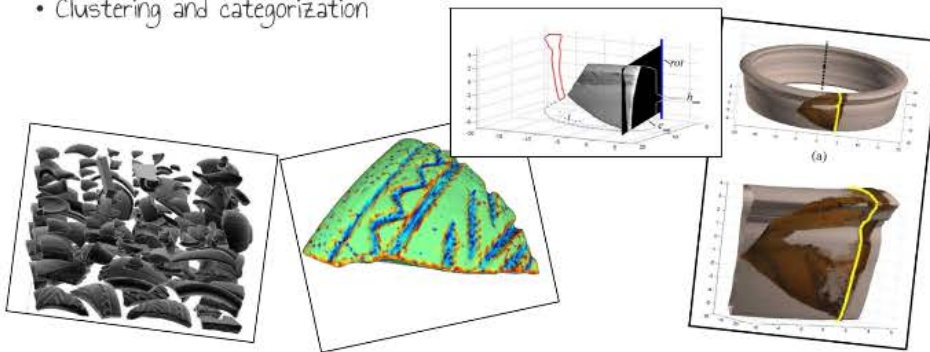


QP - Semi-automated 3D vessel modeling

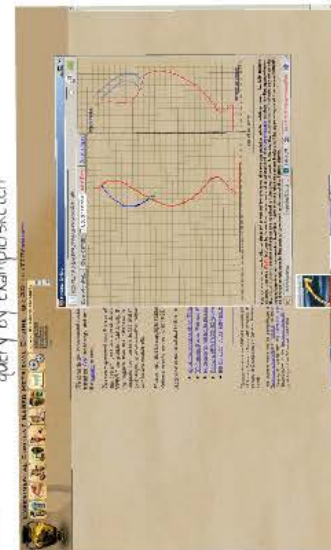


Enhancement of the study of artifacts

- Automated or semi-automated reconstruction from fragments
- 3D modeling of vessels from fragments and photos
- Curvature analysis - symmetry defects identification
- Geometric measurements and calculations
- Clustering and categorization



query by example/sketch



A real reconstruction problem

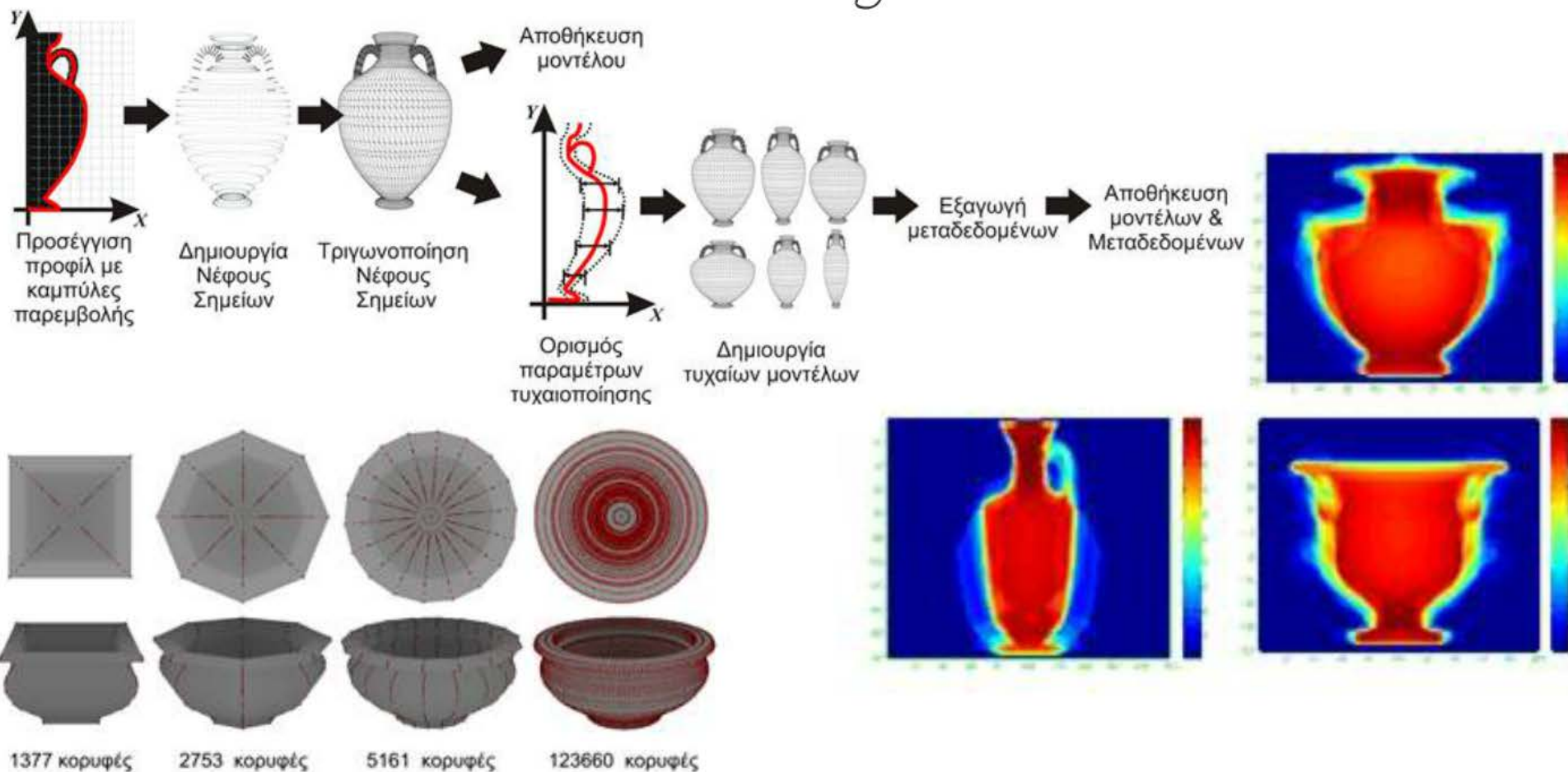


A real reconstruction solution



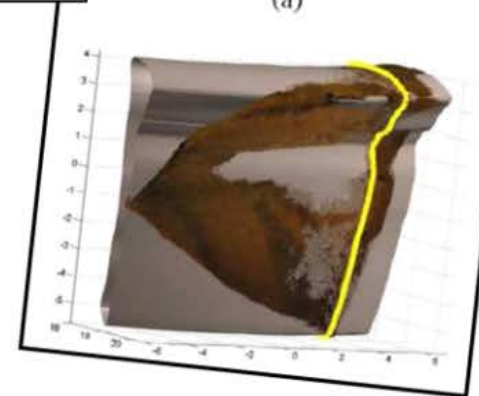
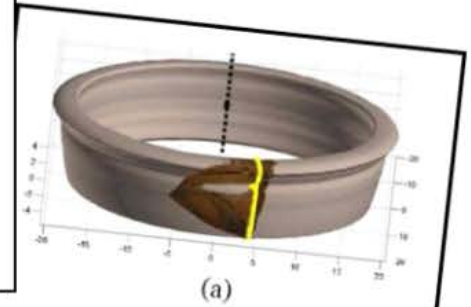
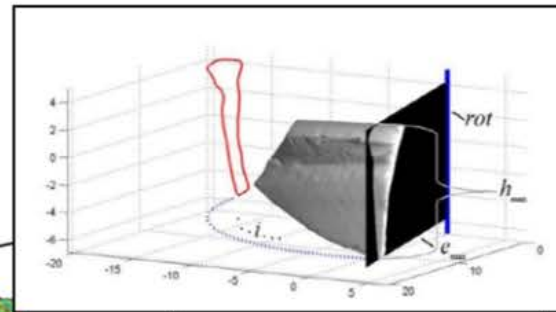
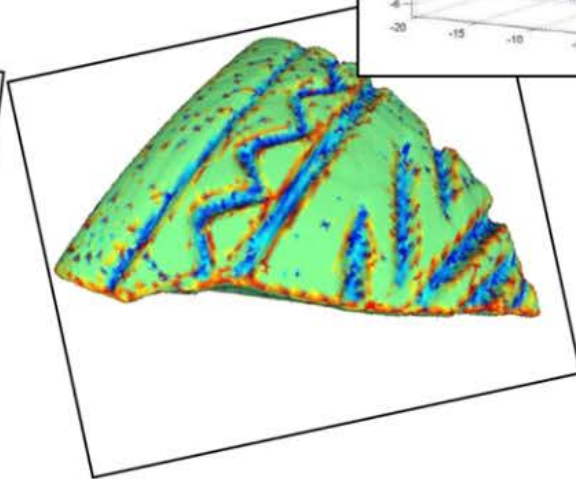
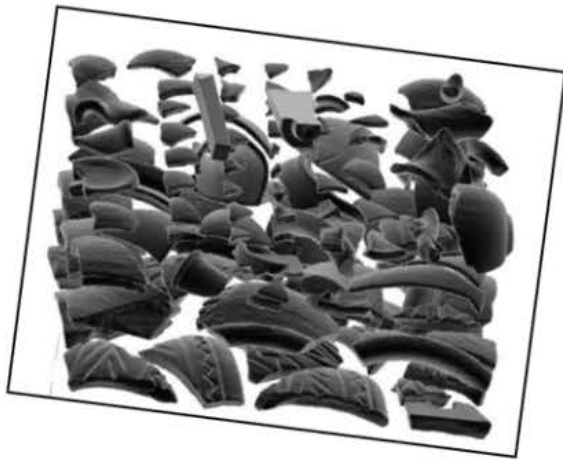
Shape identification

QP - Semi-automated 3D vessel modeling



Enhancement of the study of artifacts

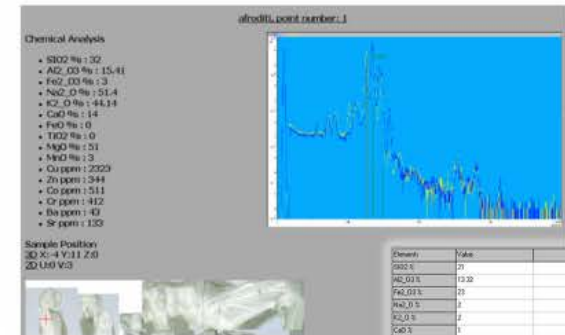
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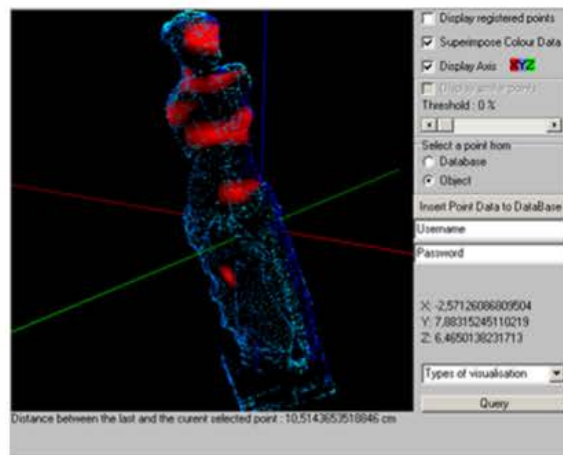
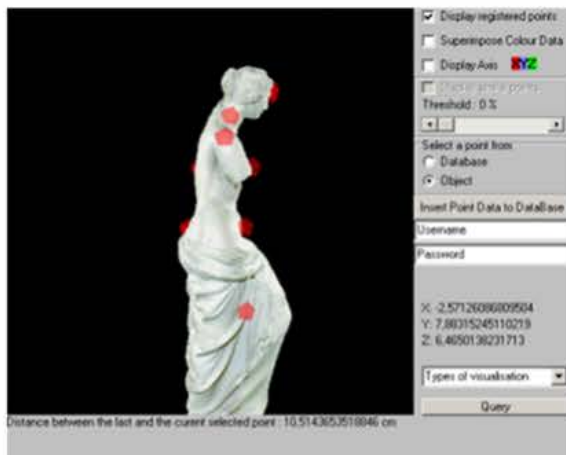
3D GIS-like representations and queries on artifacts



Elements	Min Value	Max Value
SiO2 %	3	52
Al2O3 %	44	44
Fe2O3 %		
Na2O %		
K2O %		
CaO %	66	
FeO %		
TO2 %		22
MgO %		
MnO %		
Ov ppm		
Zn ppm		
Co ppm		
Cr ppm		
Ba ppm		
Sr ppm		



Elements	Value
SiO2 %	32
Al2O3 %	15.41
Fe2O3 %	3
Na2O %	31.4
K2O %	44.14
CaO %	14
FeO %	0
TiO2 %	0
MgO %	51
MnO %	3
Cu ppm	2229
Zn ppm	344
Co ppm	511
Cr ppm	182
Ba ppm	49
Sr ppm	120



query by example/sketch

EXPERIMENTAL CONTENT BASED RETRIEVAL ENGINE FOR 3D POTTERY (MPEG-7 enabled)

QUERY BY SHAPE CATEGORY:
Alabastron
Amphora
Aryballos
Koraike

We come to the experimental content based or *PHP* technology and on the *igraph* is used.

You can experiment with the system. The system uses our VMBA description MPEG-7 compatible. Additionally, if the website then the database is supports both content based and *query-by-example*, *query-by-sketch*, *retrieval-only-texture* models, etc.

Please note that for copyright reasons Retrieval results are restricted to 2D.

Additional material related to this project:

- [gg: A tool for generating 3D vessels](#)
- [3D Content Based Retrieval in](#)
- [Publications related to this project](#)
- [Cortona VRML/X3D 3D Viewer](#)
- [DS Contact - A 3D software for](#)

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The authors would like to acknowledge the [Technology Institute R.T.C. Athens](#) for their Gregory R. Crane from the [Computer Science Technologies of the Hampton Museum, U.K.](#) providing us their 3D vessel collection.

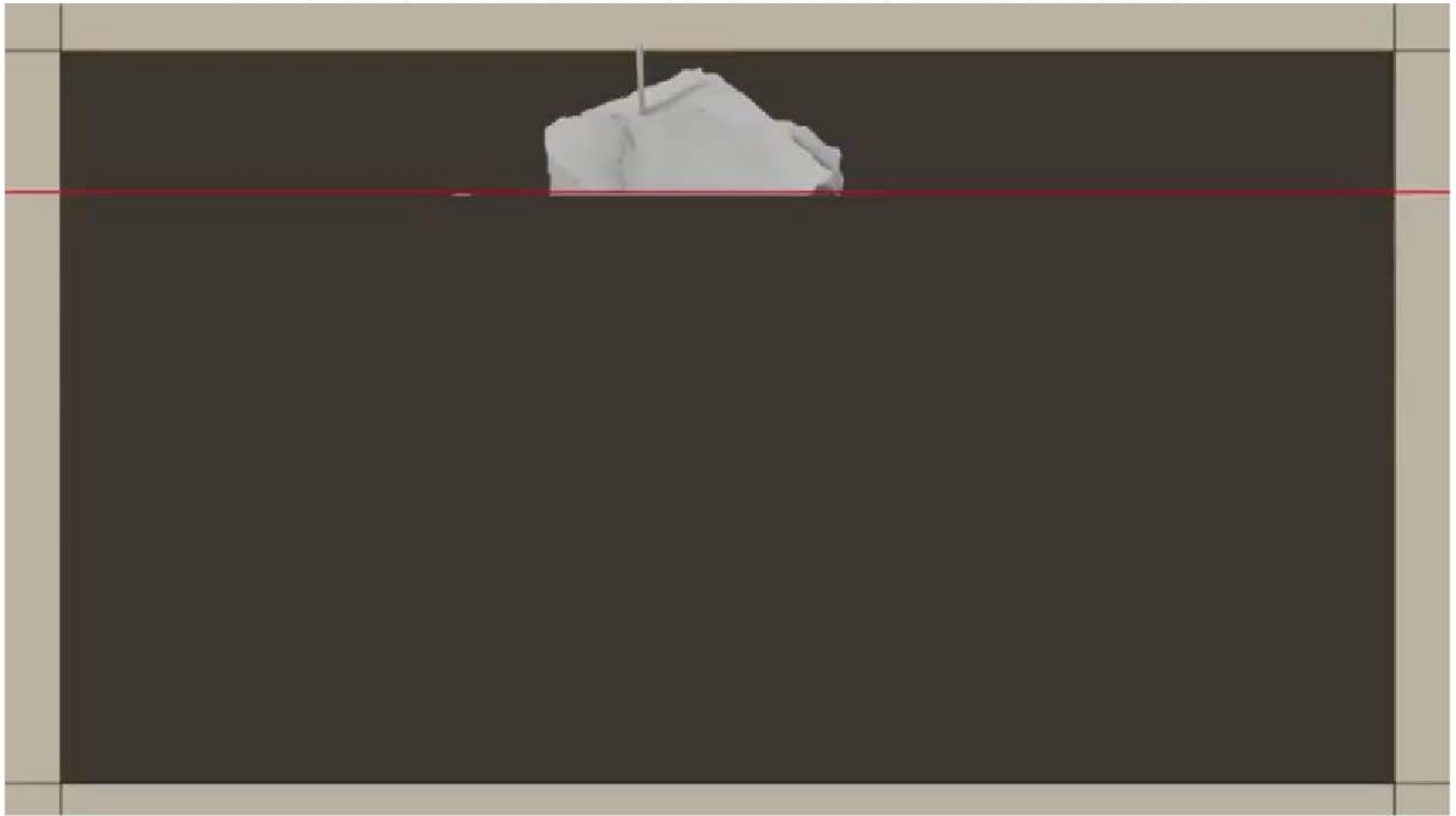
You can approximate the outline of a vessel by dragging the mouse pointer while holding down the left mouse button. Use the *Body* button to draw the main body of a vessel and the *Appendages* button for the appendages. The *Clear Canvas* button will reset the content of the sketch pad. Activate the *Double Handle* check box when the vessel carries two symmetric handles. Bear in mind that the main body and the appendages of the vessel should be drawn in relation to the axis of symmetry shown at the figure above.

NUMBER OF VESSELS WITHIN THE 3D REPOSITORY: 1012 - CONTACT ME AT (AKOUTSOU AT 1PET DOT GR)

A real reconstruction problem



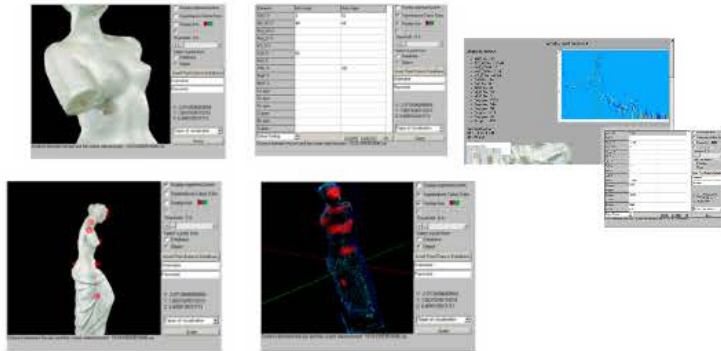
A real reconstruction solution



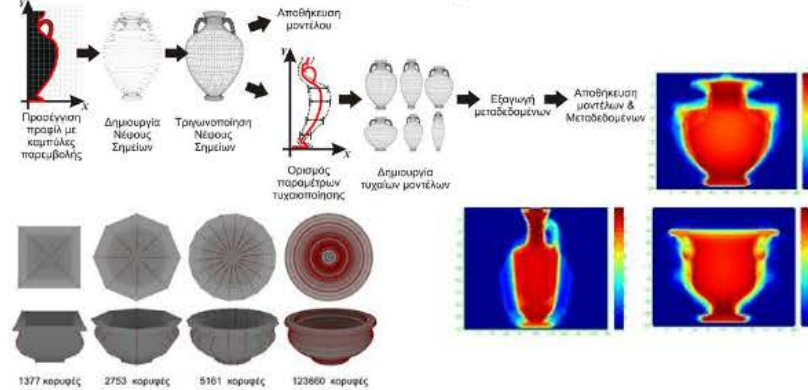
Applications for the experts

ReSeArch tools for modeling, analysis and feature identification

3D GIS-like representations and queries on artifacts

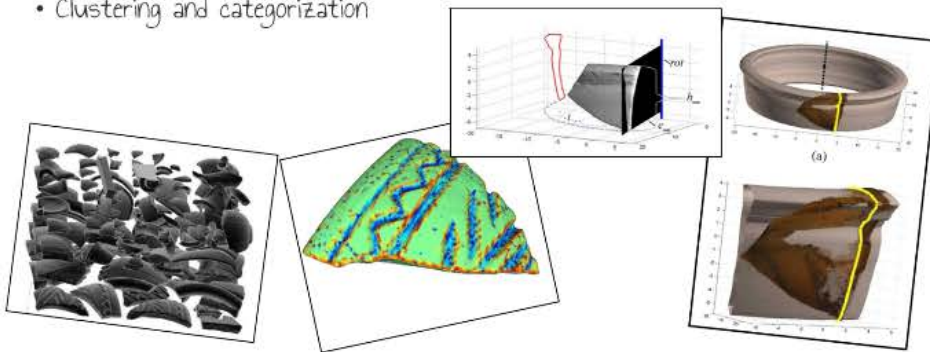


QP - Semi-automated 3D vessel modeling

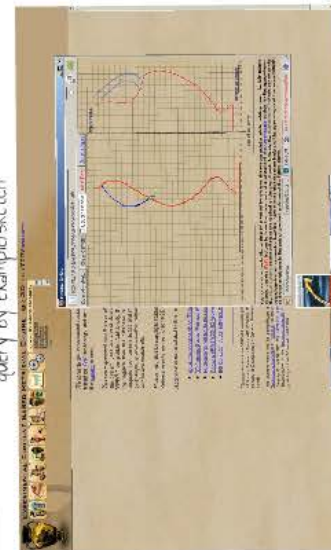


Enhancement of the study of artifacts

- Automated or semi-automated reconstruction from fragments
- 3D modeling of vessels from fragments and photos
- Curvature analysis - symmetry defects identification
- Geometric measurements and calculations
- Clustering and categorization



query by example/sketch



A real reconstruction problem



A real reconstruction solution



Applications for the rest of us

Informative, educational & recreational

Non-interactive representation movies



Realistic interactive walkthroughs for 3D TV applications



Content-based museum navigation



Realistic interactive walkthroughs



- Virtual reconstructions with environment/weather simulations
- Serious games (edutainment)

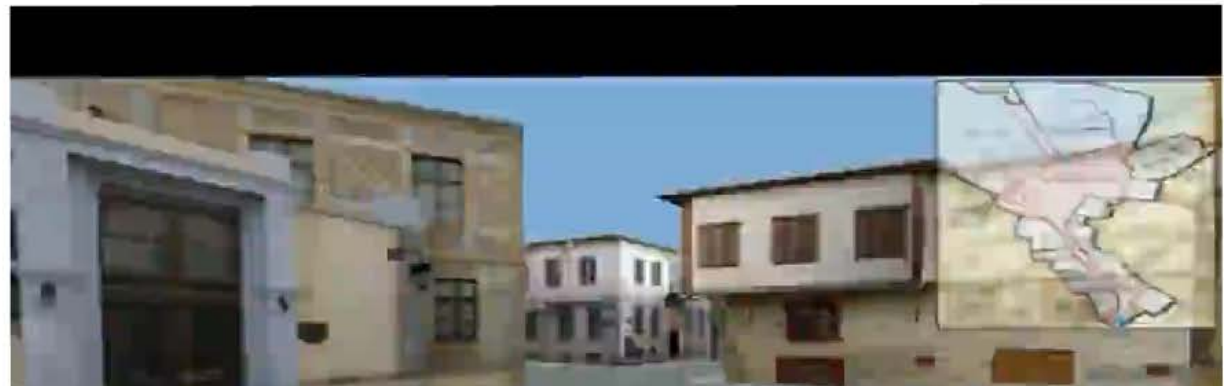


Non-interactive representation movies





Realistic interactive walkthroughs for 3D TV applications





Content-based museum navigation

Mode: Walking



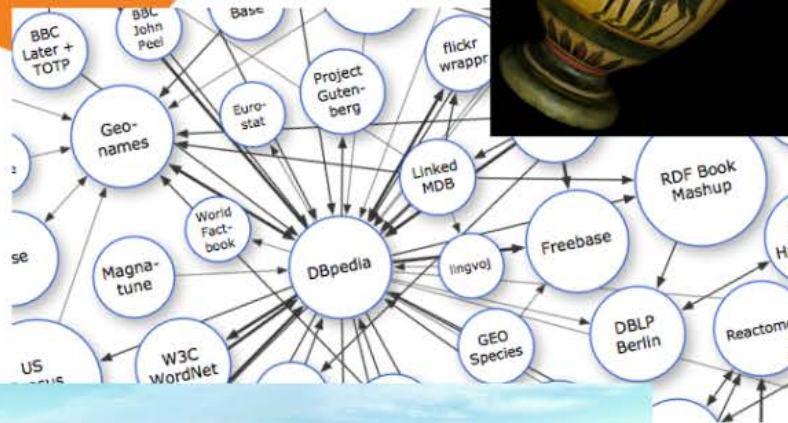
Realistic interactive walkthroughs



ons with environment/weather simulations

Wealth of data-numerous possibilities

- Open access
- Research enabled
- Tools/Services
- Story-telling
- Location-based
- Multi-layering
- Interoperability
- Reusability
- Repurposing



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