3D shape description and matching based on properties of real functions

Conclusions and future perspectives

Eurographics 2007 Tutorial T12

Speaker

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AIM@SHAPE

The third dimension of media

- 3D content is becoming the new wave of media

- 3D shapes can be easily digitised or designed
- New and consolidate application fields
- New categories of users

- 3D data deluge
- 3D content creation is still very time consuming

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Challenges

- To make the creation and modification of 3D shapes (with the associated knowledge) as easy as **cut & paste** for texts
- To make the retrieval of 3D shapes as easy as with *Google* for texts

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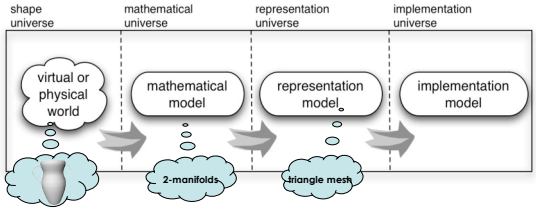
3D shapes and geometric models

- The tradition modelling pipeline is based on an abstraction of the **geometric** nature of shapes



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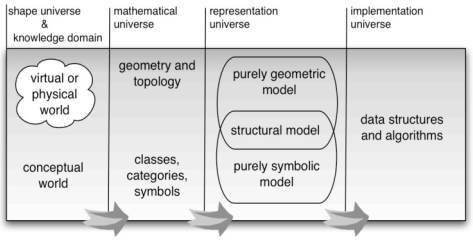
… but also **semantics** !



The geometry (real/virtual) universe should be coupled with a **semantic** one

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.. but what do we mean by *similarity*?

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Shape similarity: different *flavours*

geometric congruence

structural equivalence

functional equivalence

"class" equivalence

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New Trends

- A shift towards the development of appropriate knowledge representations and data structures for **intelligent** 3D shapes management
- 3D search engines based on shapes **similarity** matching
- New ways to identify regions in 3D digital shapes that correspond to regions of interest and tag them appropriately (**semantic annotation**)

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Network of Excellence AIM@SHAPE

Advanced and **I**nnovative **M**odels **A**nd **T**ools for the development of **S**emantic based systems for **H**andling, **A**cquiring, and **P**rocessing knowledge **E**mbedded in multidimensional digital objects

EU FP6 Contract no. 506766 - Key Action: 2.3.1.7 Semantic-based knowledge systems

Bianca Falcidieno, Coordinator
CNR IMATI-Genova Italy

13 partners
4 years (2004-2008)
100 researchers
85 PhD students

Web site: *www.aimatshape.net*

Information Society

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AIM@SHAPE Consortium

- **CNR-IMATI-Italy** *(Bianca Falcidieno)*
  - **DISI – Italy** *(L. De Floriani)*
  - **EPFL – Switzerland** *(D. Thalmann)*
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  - **UU – The Netherlands** *(R. Veltkamp)*
  - **Weizmann – Israel** *(R. Basri)*

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AIM@SHAPE Mission & Goals

- Representing, Modelling, & Processing knowledge related to digital shapes (digital objects having a visual appearance which exist in 2, 3 or higher dimensional spaces)
- Focus on 3D or 3D time varying shapes as the new wave of multimedia communication

- Represent shape semantics
- Maximise automation of the shape knowledge lifecycle
- Design common infrastructures for sharing shape models and tools

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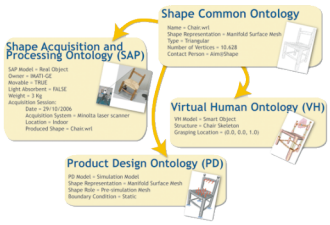
AIM@SHAPE Research Goal

What: shape knowledge modelling and processing

How: Ontologies for digital shapes.



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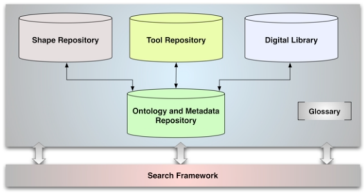
the AIM@SHAPE Digital Shape Workbench (DSW)

What: common infrastructure for integrating, adapting, enhancing software tools and shape databases

How: the Shape Repository, the Tool Repository, the Digital Library, and the Ontology and Metadata Repository



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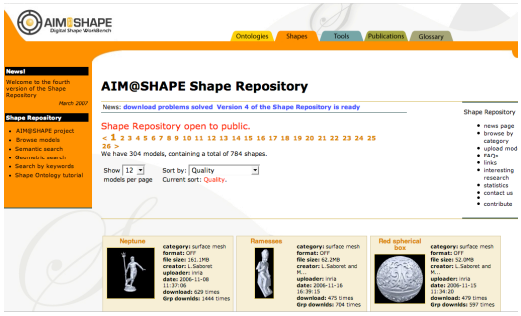
Shape Repository



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Shape Repository

- ✓ Publicly available
- ✓ **784** digital shapes (single and groups)

Emphasis on quality:

- ✓ all shapes documented with ontology-driven metadata
- ✓ for benchmark

http://shapes.aimatshape.net/

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Evaluation and benchmarking

- ✓ SHREC'07 - Shape Retrieval Contest 2007 promoted by AIM@SHAPE, and coordinated by Remco Veltkamp (UU)
  - Organized **every year**, in conjunction with Shape Modeling International – SMI – (next year, Stony Brook, June 2008)
  - **Multi-track**: this year 7 tracks for watertight models, partial matching, protein models, CAD models, relevance feedback, similarity measures, 3D faces

`http://www.aimatshape.net/event/SHREC`

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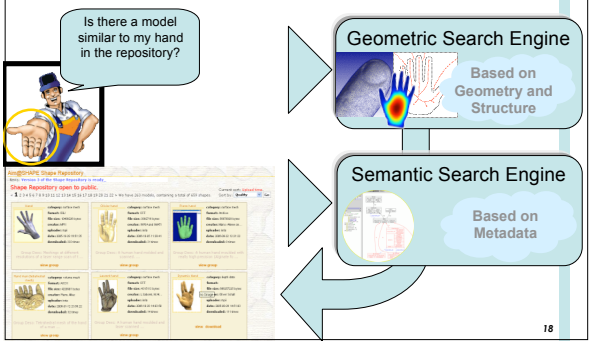
Advanced Search Engines for Digital Shapes



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How to embed semantics in Shape M&R?

- ✓ All methods use semantics/knowledge in the shape description process ***only implicitly***
- ✓ Reasoning at a semantic level (e.g., logic based reasoning) on shape similarity requires the annotation of shapes and/or shape parts
- ✓ How can we associate semantic "tags" to shapes or shape parts and use them in a Shape M&R sessions ?

… starting from the shape description step …

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Shape Annotator

- *Is it possible to push the automatic extraction of metadata one step further wrt "simple" geometric attributes ?*
- Semi-automatic shape annotation system
- Use multiple segmentations algorithms as a toolbox for supporting the **annotation** of a shape **model** or its **parts**
- Identify **relevant features** (mesh segments) and associate them to a **concept in an ontology** (instances)

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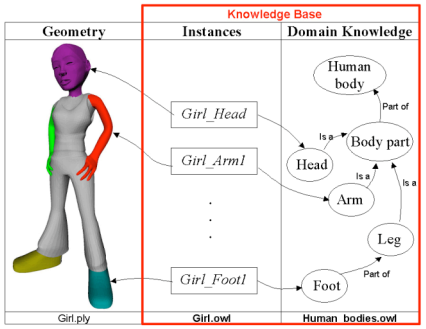
Shape Annotator



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Shape Annotator

- The result of the process is an *annotated shape model*, represented by traditional geometric data (eg, VRML) and augmented with an XML description of the content in terms of concepts of an ontology

support to next-generation search engines for 3D content able to mix geometric and semantic search

M. Attene, F. Robbiano, M. Spagnuolo and B. Falcidieno
Part-based Annotation of Virtual 3D Shapes, NASAGEM'07 Workshop "New Advances in Shape Analysis and Geometric Modeling" (NASAGEM), Hannover, October, 2007

M. Attene, F. Robbiano, M. Spagnuolo and B. Falcidieno,
Semantic Annotation of 3D Surface Meshes based on Feature Characterization, Semantic and Digital Media Technologies, LCNS 4816, Genova, December 2007

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... the end ...

Questions?

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- **NIG**: **N**etwork **I**ndustrial **G**roup
- **NIRG**: **N**etwotk **I**nterested **R**esearchers' **G**roup
- **AIM@SHAPE** association (from 2008)

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