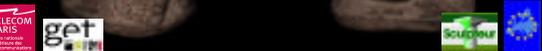


Indexing and 3D-Modeling Developed in SCULPTEUR Project

Francis SCHMITT
Carlos Hernandez Esteban
Tony Tung

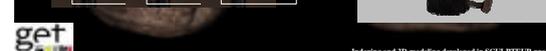
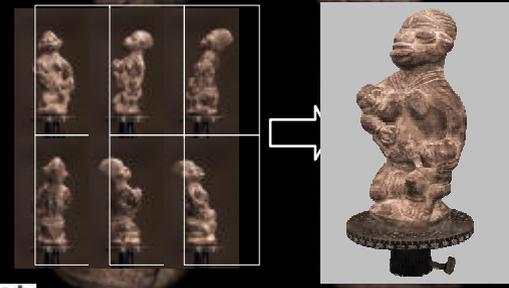
Digital Semantic Content across Cultures
May 4-5, 2006, Paris, the Louvre



Art object 3D digitization and modeling



Image-based approach Computer vision – Computer graphics



Stereo-silhouette fusion problem

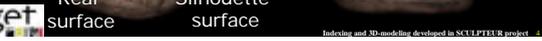
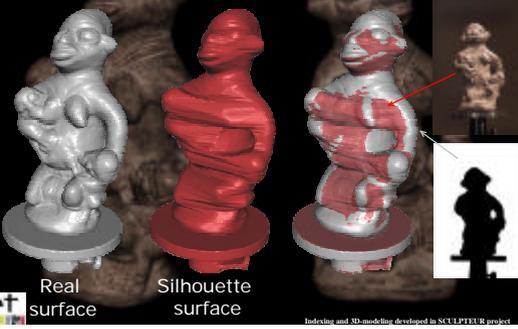


Image-based 3D object Modeling



Image acquisition Camera calibration 3D reconstruction Texture map creation



Image Acquisition

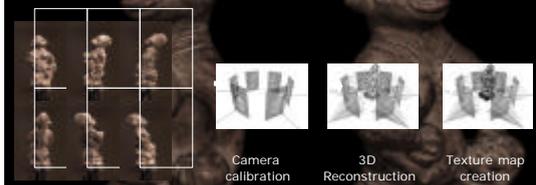


Image acquisition Camera calibration 3D Reconstruction Texture map creation

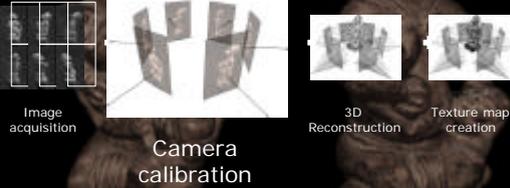


Image Acquisition



Indexing and 3D-modelling developed in SCULPTEUR project

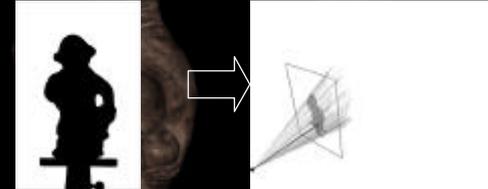
Camera Calibration



get

Indexing and 3D-modelling developed in SCULPTEUR project

3D Constraints of n silhouettes (visual hull)

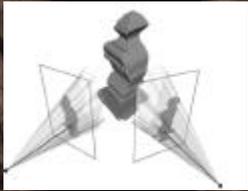


get

Indexing and 3D-modelling developed in SCULPTEUR project

3D Constraints of n silhouettes (visual hull)

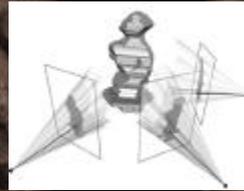
- Intersection of retro-projected silhouettes



Indexing and 3D-modelling developed in SCULPTEUR project

3D Constraints of n silhouettes (visual hull)

- Intersection of retro-projected silhouettes

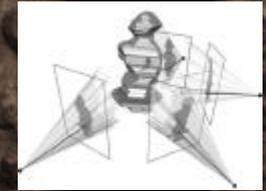


get

Indexing and 3D-modelling developed in SCULPTEUR project

3D Constraints of n silhouettes (visual hull)

- Intersection of retro-projected silhouettes

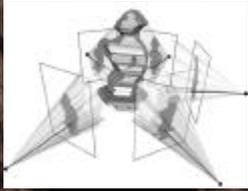


get

Indexing and 3D-modelling developed in SCULPTEUR project

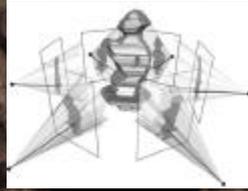
3D Constraints of n silhouettes (visual hull)

- Intersection of retro-projected silhouettes



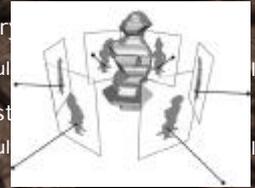
3D Constraints of n silhouettes (visual hull)

- Intersection of retro-projected silhouettes



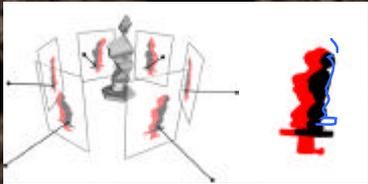
Relation Between Visual Hull and Silhouettes

- In theory, Visual hull = \bigcap silhouettes
- By construction, Visual hull \supseteq silhouettes
- In practice, Visual hull silhouettes $\hat{=}$ Original silhouettes

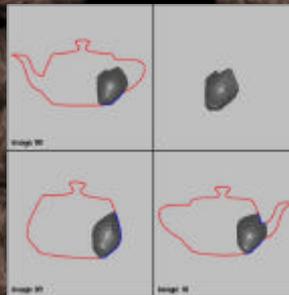


A Silhouette Coherence Measure

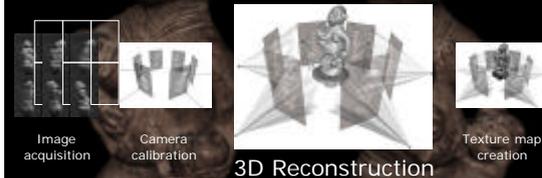
- Length of the common contours {original silhouettes - visual hull silhouettes}



Silhouette Coherence Applied to Calibration



3D Reconstruction

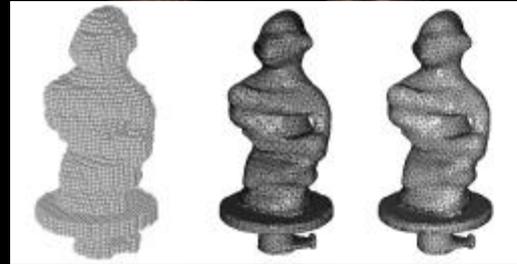


3D Reconstruction

3D Object Reconstruction

- Deformable model initialisation
- Internal force
- Texture driven force
- Silhouettes driven force

Visual Hull Construction

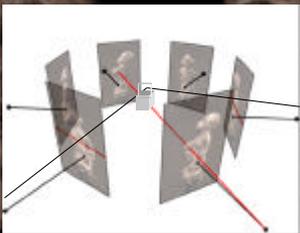


3D Object Reconstruction

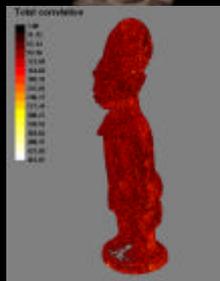
- Deformable model initialisation
- Internal force
- Texture driven force
- Silhouettes driven force

Texture Driven Force

- 3D volume of multi stereo correlations

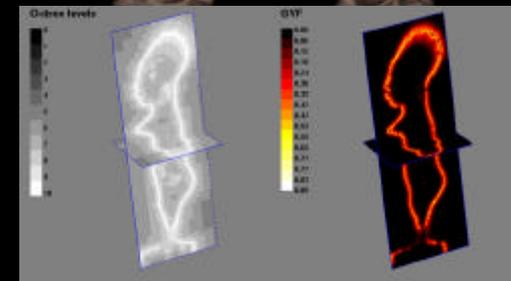


Texture Driven Force



Shaded view (after binarization)

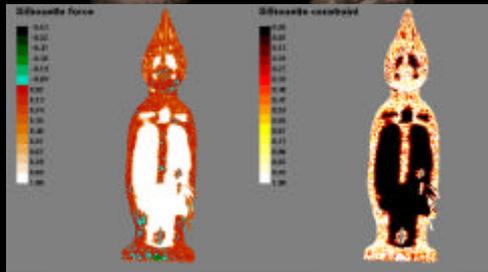
Texture Driven Force



Octree partition

GVF computation

Silhouette driven force



$d_s(v)$
distance to silhouettes

$a(v)$
silhouettes satisfied

Indrino and 3D-modelling developed in SCULPTUR project 25

Deformable Model Iteration

$$v_i^{k+1} = v_i^k + \Delta t (F_{tex}(v_i^k) + \mathbf{b} F_{sil}(v_i^k) + \mathbf{g} F_{int}(v_i^k))$$

\mathbf{b} : silhouette weight

\mathbf{g} : regularisation weight

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Indrino and 3D-modelling developed in SCULPTUR project 26

Image-based 3D object Modelling



Image acquisition

Camera calibration

3D reconstruction

Texture map creation

get

Indrino and 3D-modelling developed in SCULPTUR project 27

Texture Map Creation

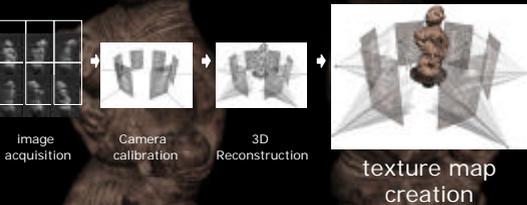


image acquisition

Camera calibration

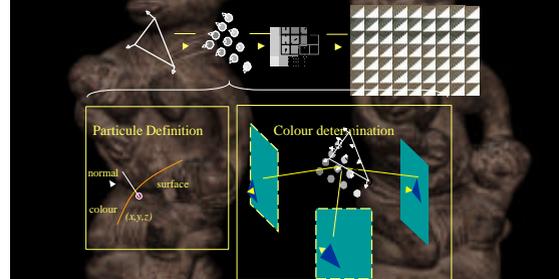
3D Reconstruction

texture map creation

get

Indrino and 3D-modelling developed in SCULPTUR project 28

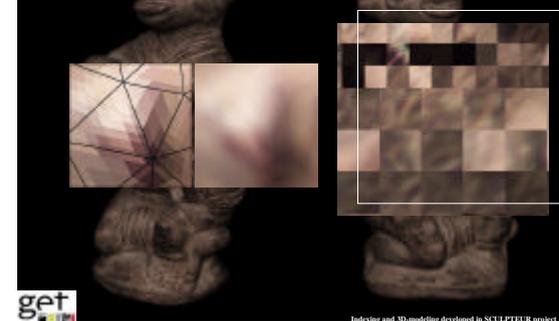
Texture Map Creation



get

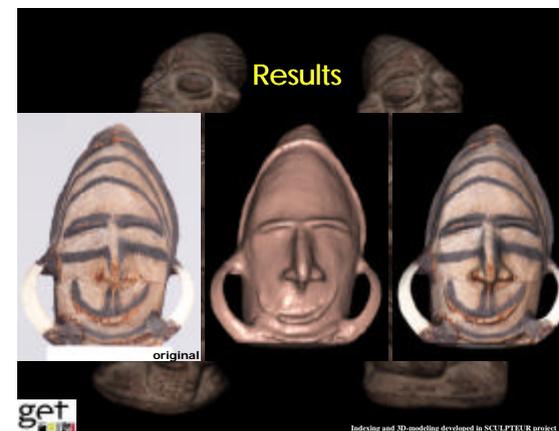
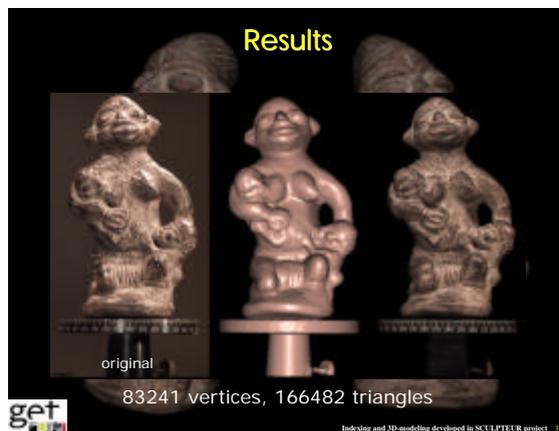
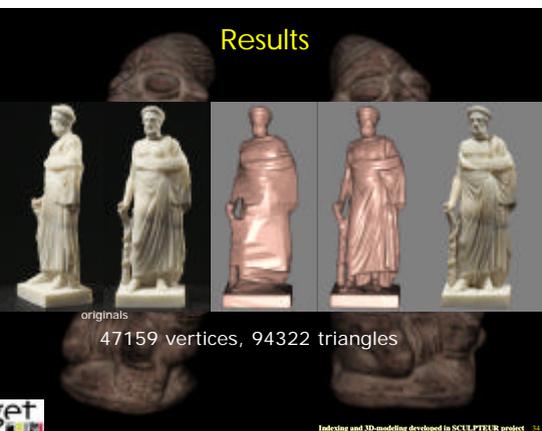
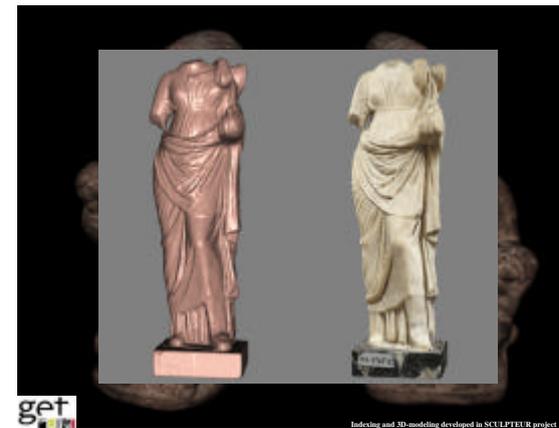
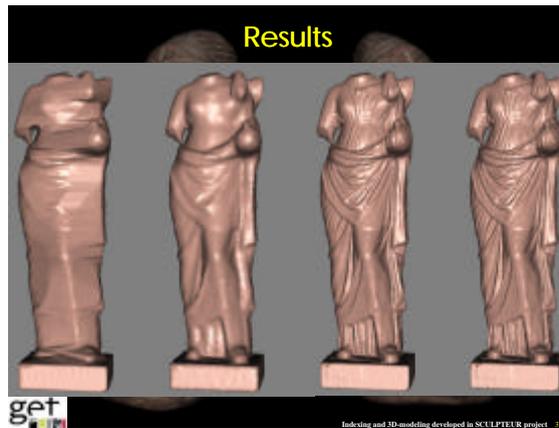
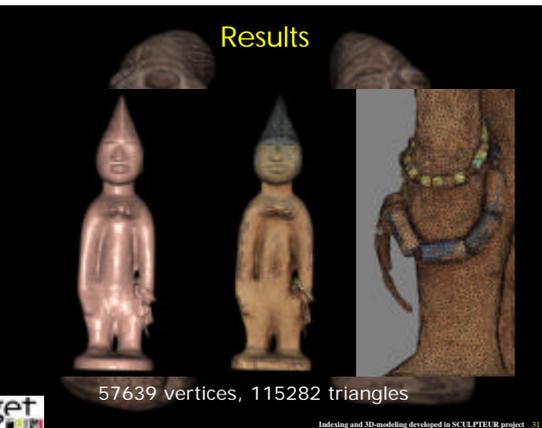
Indrino and 3D-modelling developed in SCULPTUR project 29

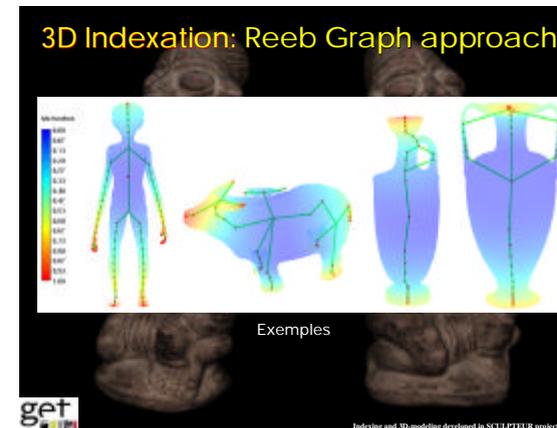
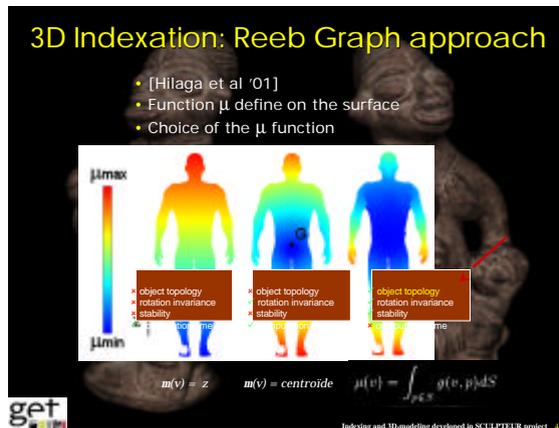
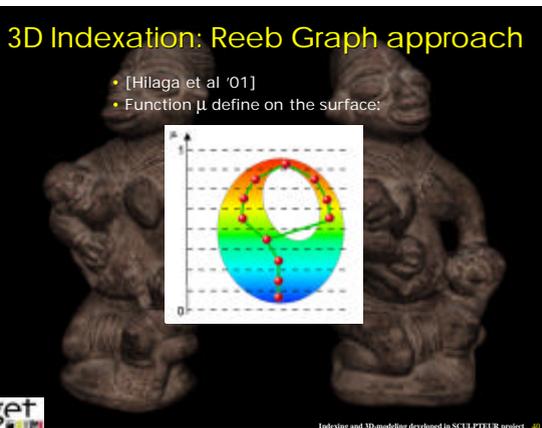
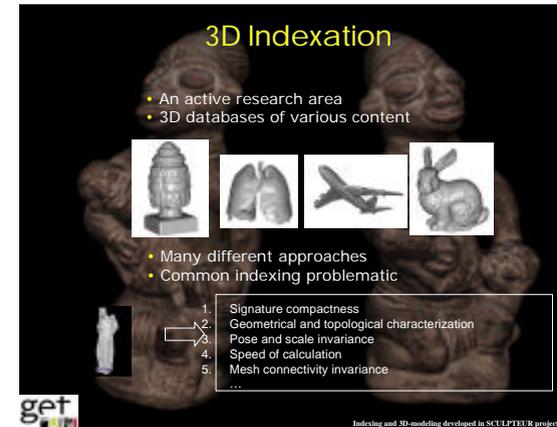
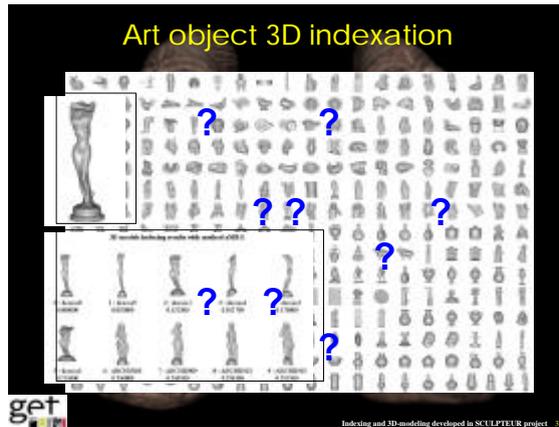
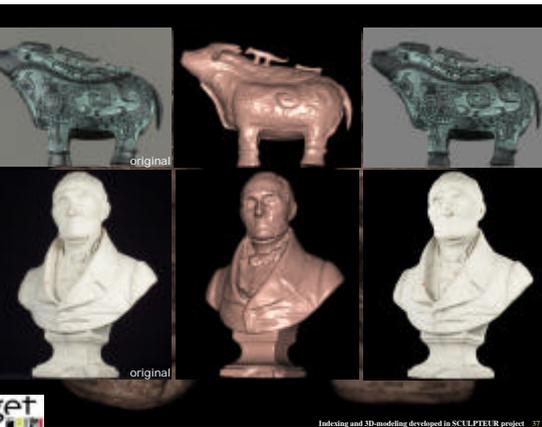
Texture Map Creation



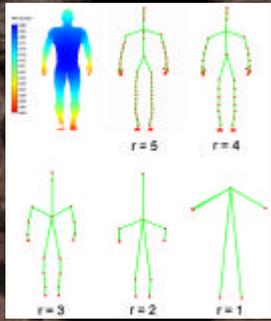
get

Indrino and 3D-modelling developed in SCULPTUR project 30

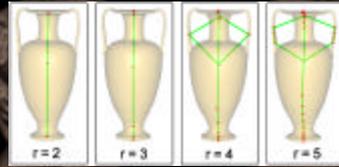




Augmented multiresolution Reeb Graph

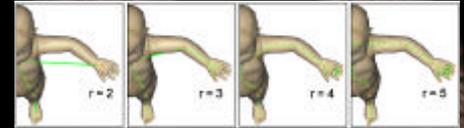


Augmented multiresolution Reeb Graph



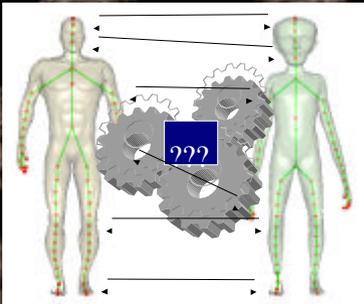
Multiresolution →

Augmented multiresolution Reeb Graph



Multiresolution →

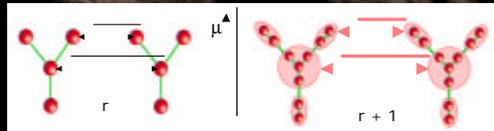
Graph similarity



Graph similarity

Strategy:

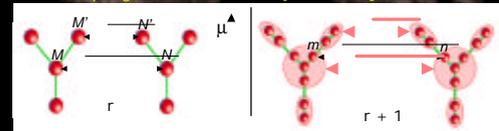
- Multiresolution-based:
 - from coarse-to-fine : $r = 0 \rightarrow r = R$



Graph similarity

Strategy:

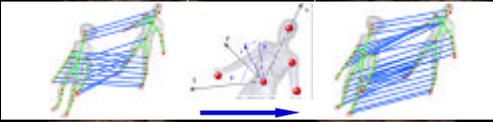
- Multiresolution-based:
 - from coarse-to-fine : $r = 0 \rightarrow r = R$
- Node matching:
 - topological criteria (consistency, # branchings, # terminal nodes)



Graph similarity

Strategy:

- Multiresolution-based:
 - from coarse-to-fine : $r = 0 \rightarrow r = R$
- Node matching:
 - topological criteria (consistency, # branchings, # terminal nodes)
 - **geometrical attributes**

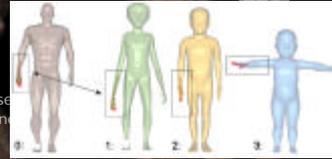


Industry and 3D-modelling developed in SCULPTUEUR project 49

Graph similarity

Strategy:

- Multiresolution-based:
 - from coarse-to-fine
- Node matching:
 - topological criteria (consistency, # branchings, # terminal nodes)
 - geometrical attributes



Subgraph matching

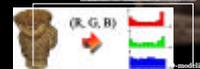
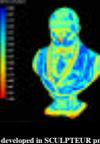
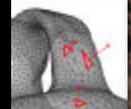
get

Industry and 3D-modelling developed in SCULPTUEUR project 50

Graph similarity

Strategy:

- Multiresolution-based:
 - from coarse-to-fine : $r = 0 \rightarrow r = R$
- Node matching:
 - topological criteria (consistency, # branchings, # terminal nodes)
 - geometrical attributes
- Similarity of node pairs
 - **3D geometrical attributes**
 - Ratio (volume²/surface³)
 - Cards histograms
 - Local curvatures
 - 3D Hough transform
 - **2D color texture**



get

Industry developed in SCULPTUEUR project 51

Results



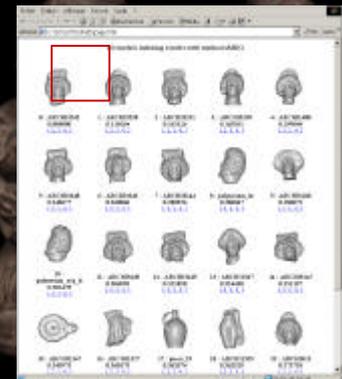
Industry developed in SCULPTUEUR project 52

Results



Industry developed in SCULPTUEUR project 53

Results



Industry developed in SCULPTUEUR project 54

Results



Results



Results



The end

