

Possible Project Topics

- Based on Hong's research interests and (perhaps biased) perspectives on research/project subjects
- **NOT** a complete list (though)

Image Processing and Analysis

Single Image Dehazing



Colorization



Color Harmonization

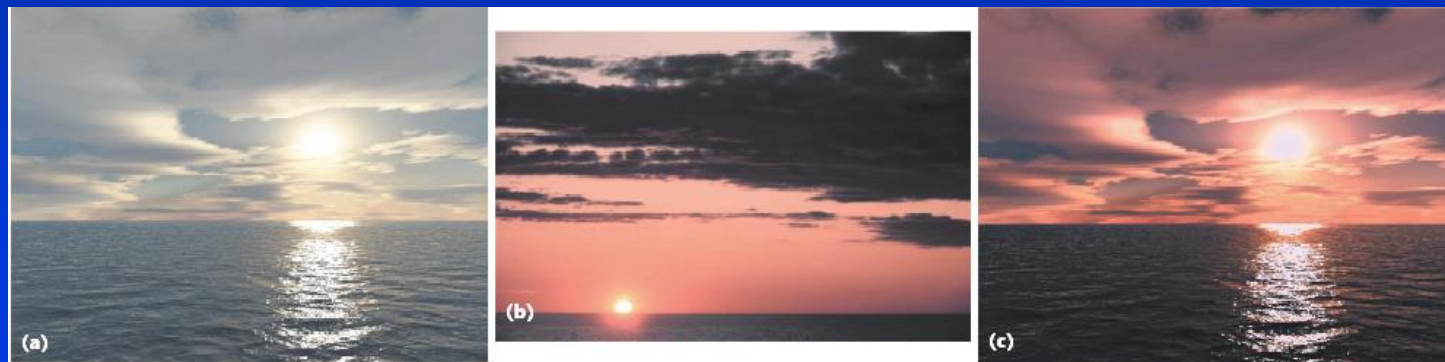


original image



harmonized image

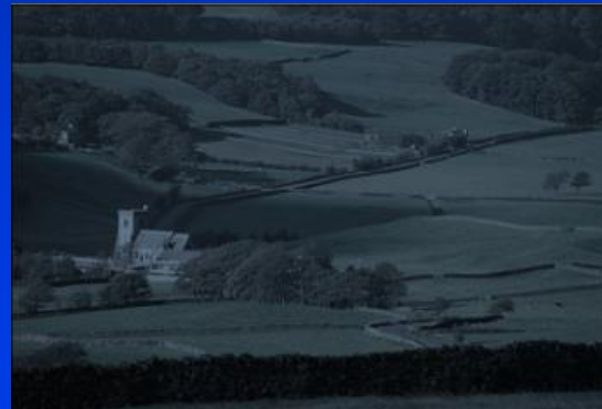
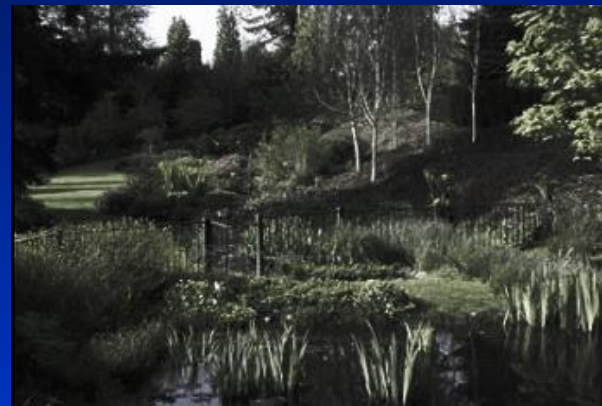
Color Transfer



source

target

Color Analogy and Transfer



Color Analogy and Transfer

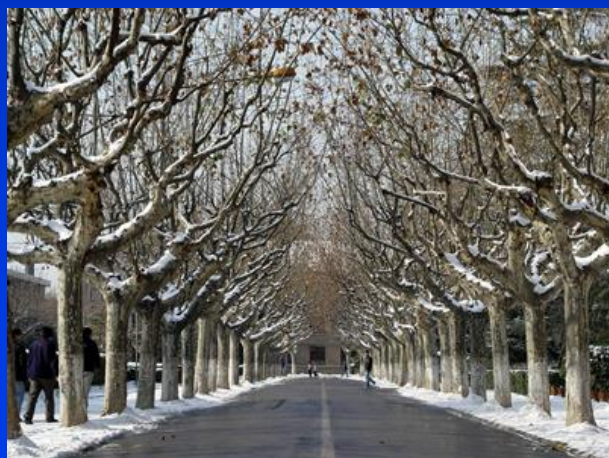
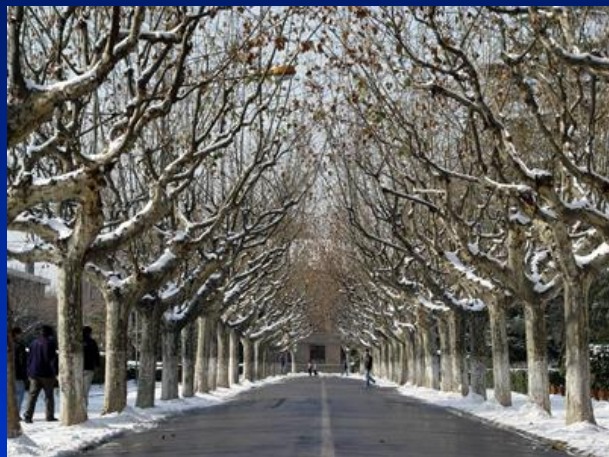


Image Completion



Poisson Image Editing



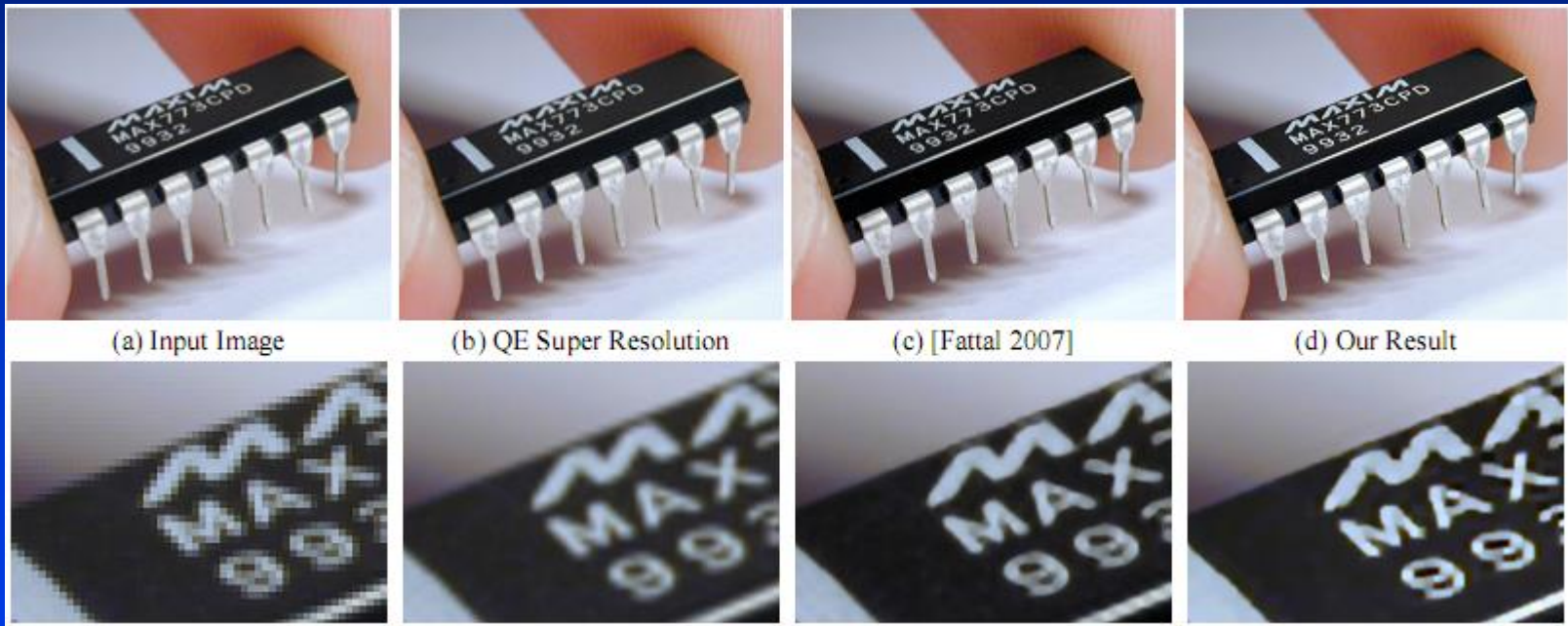
+



Poisson Image Editing



Image Deconvolution



Example-based Texture Synthesis

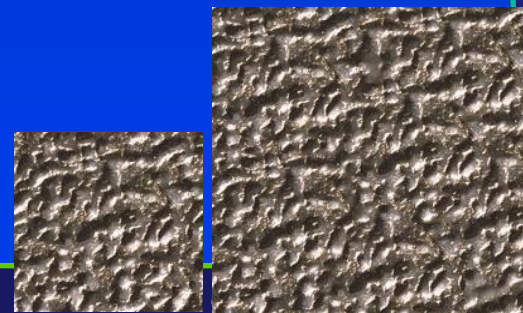
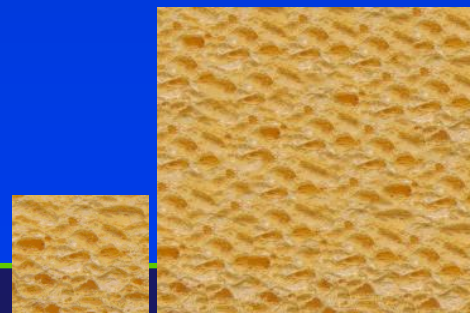
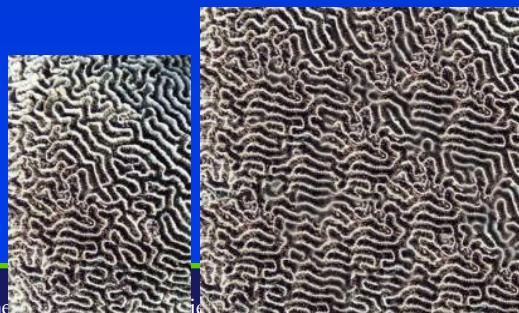
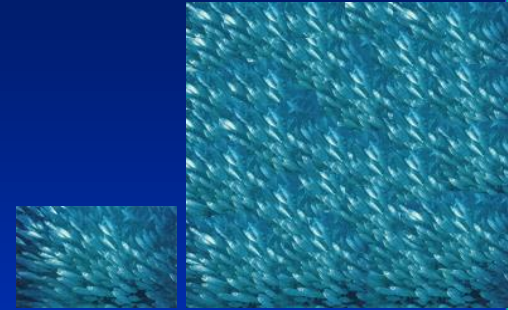
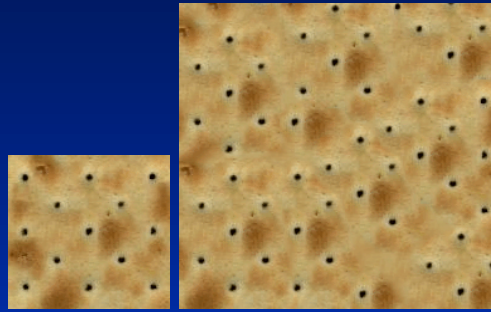
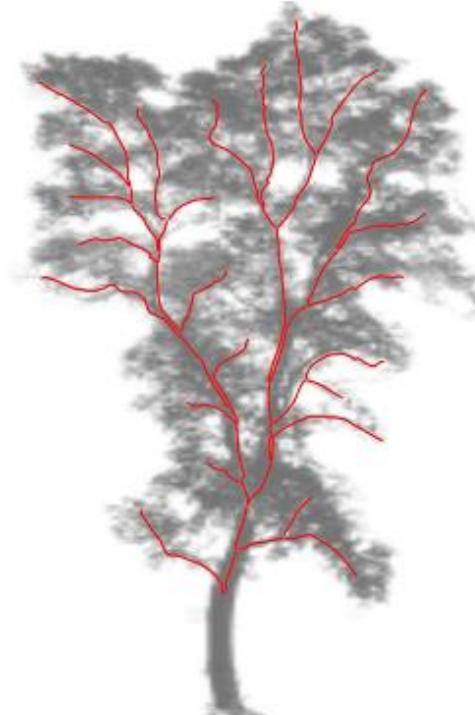


Image-based Modeling for Trees



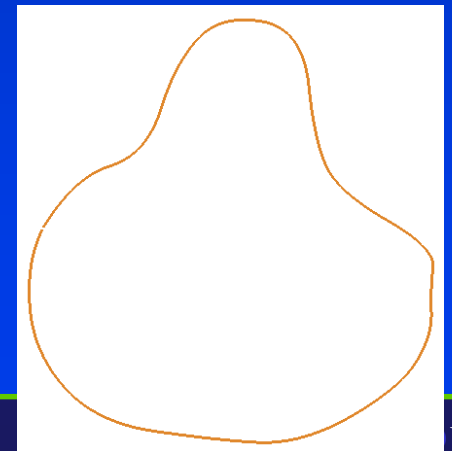
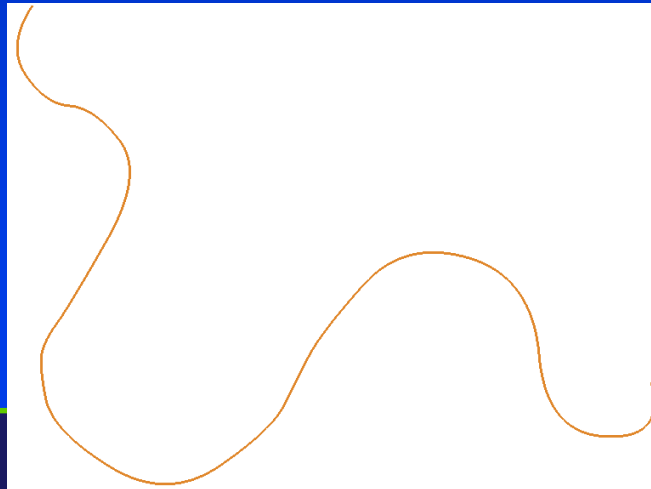
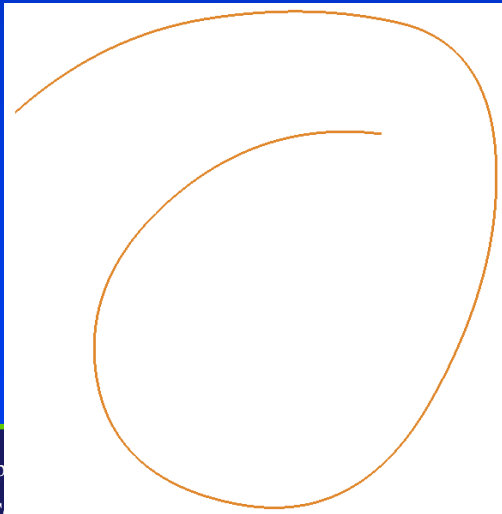
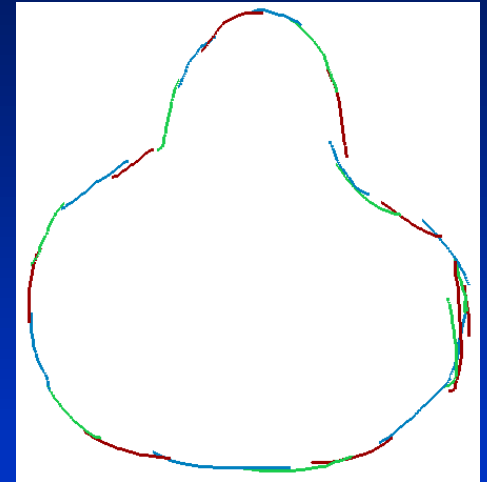
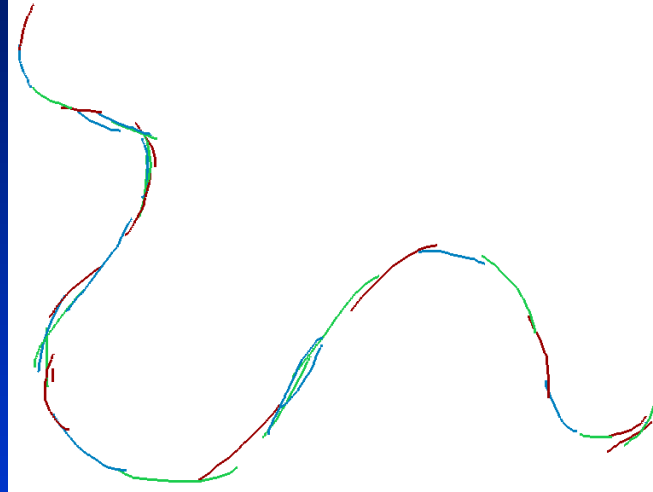
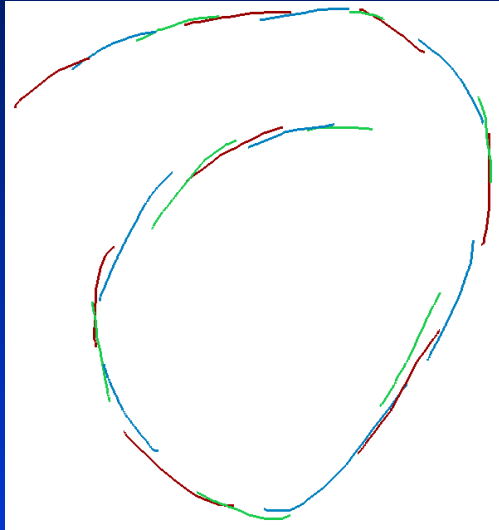
(a)



(b)

Figure 2: (a) Input image; (b) tree density estimation with corresponding attractor graph.

From Strokes to Curves

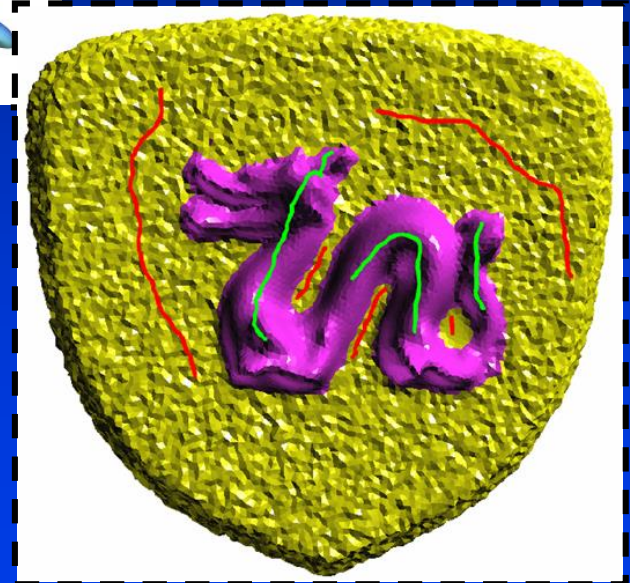
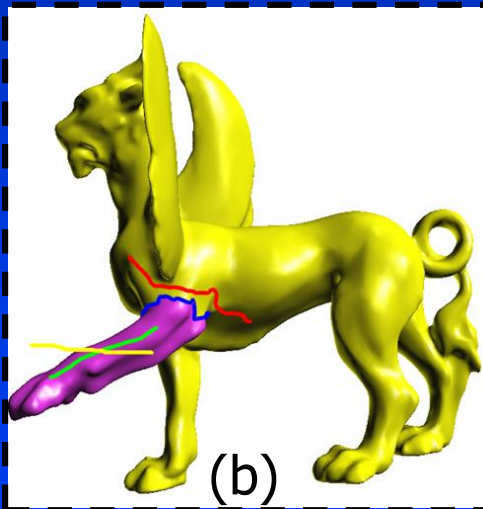
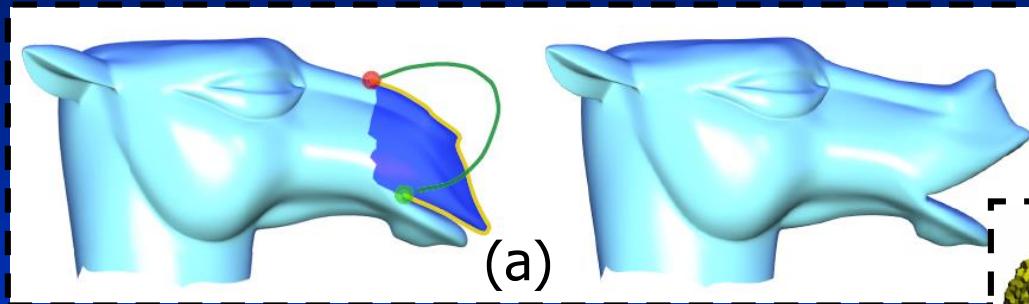


Interface Design

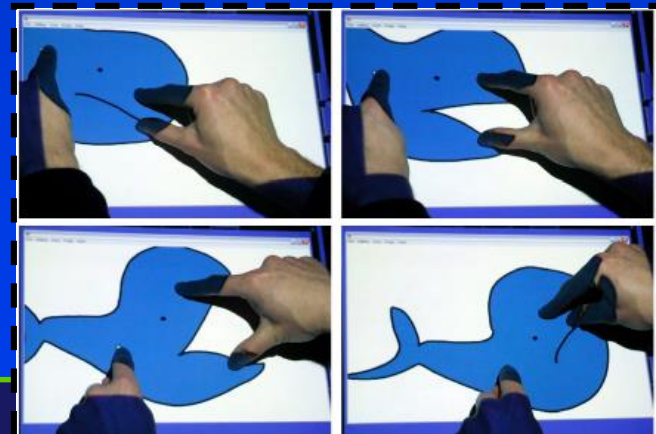
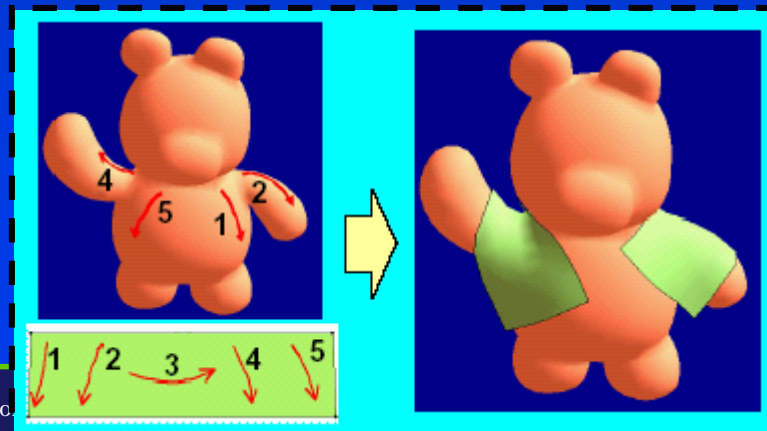
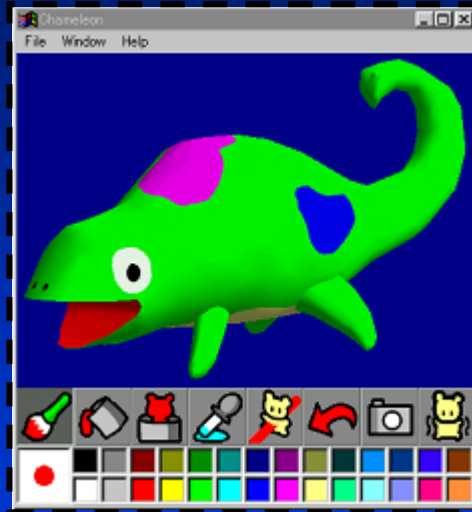
Sketch-based Interface



Sketch-based Interface



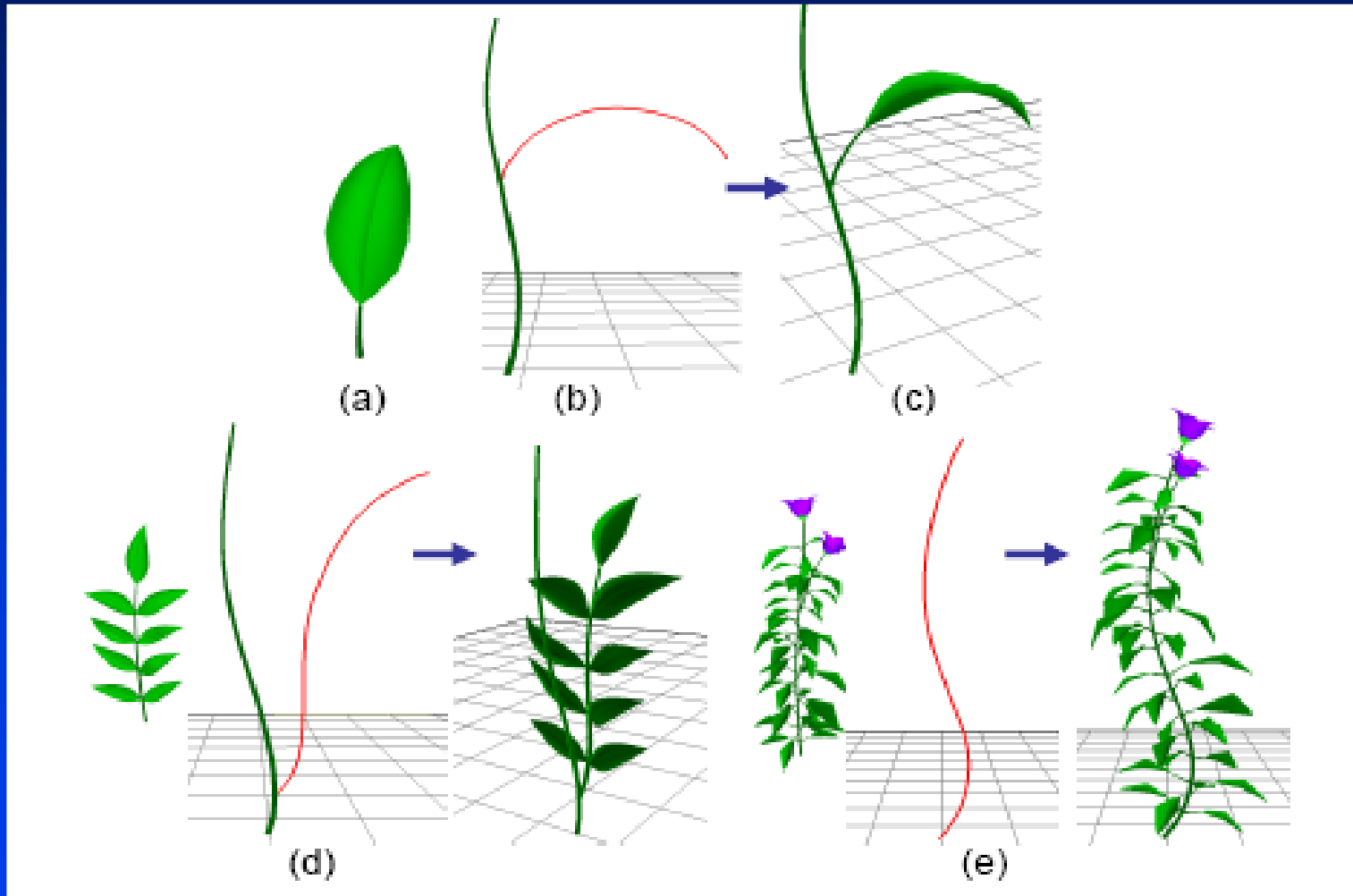
Sketch-based Interface



Sketch-based Tree Modeling



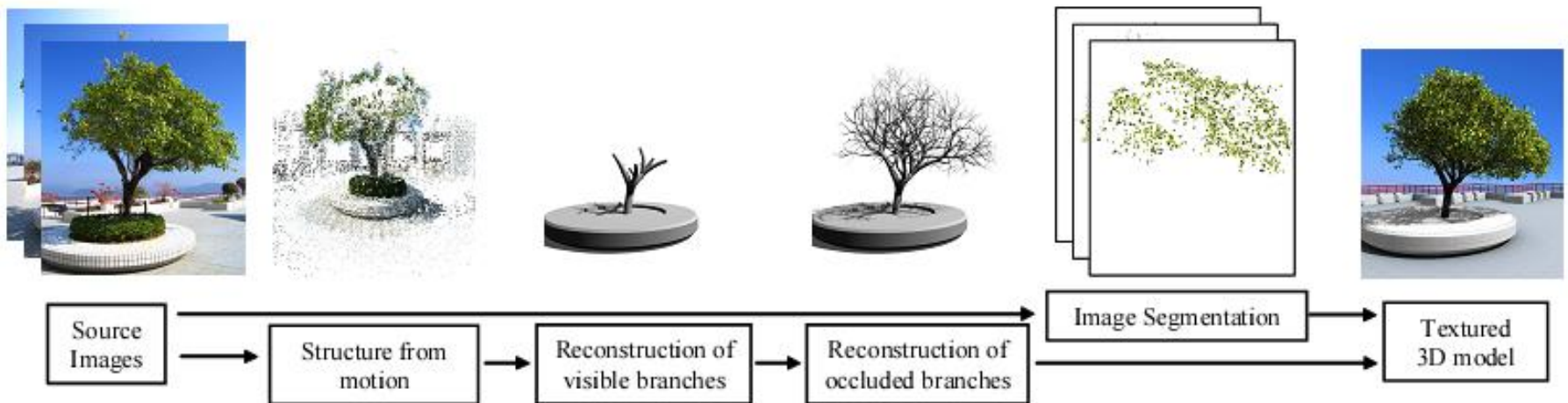
Sketching Plants



Digital Bas-relief



Image-based Tree Modeling



Terrain, Plants

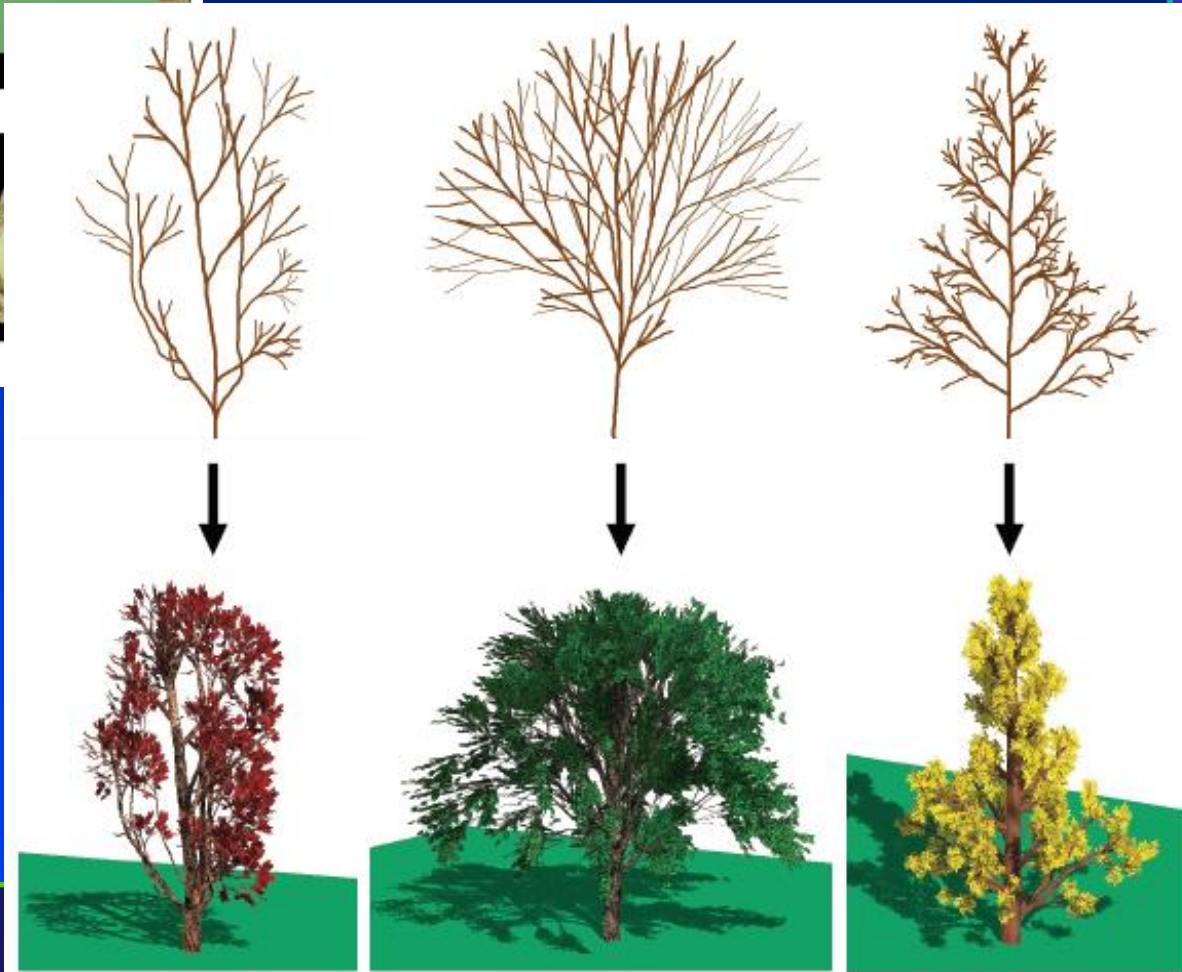
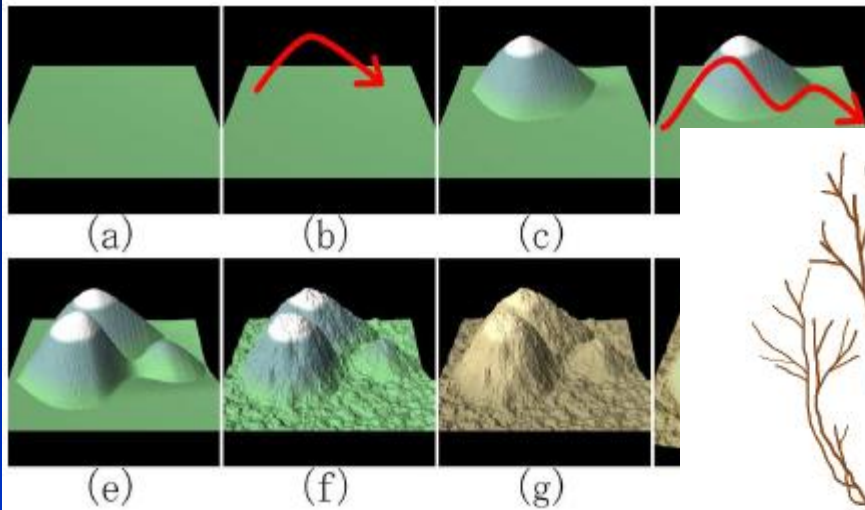


Image-based Tree Modeling



Plant Ecosystems



(a)

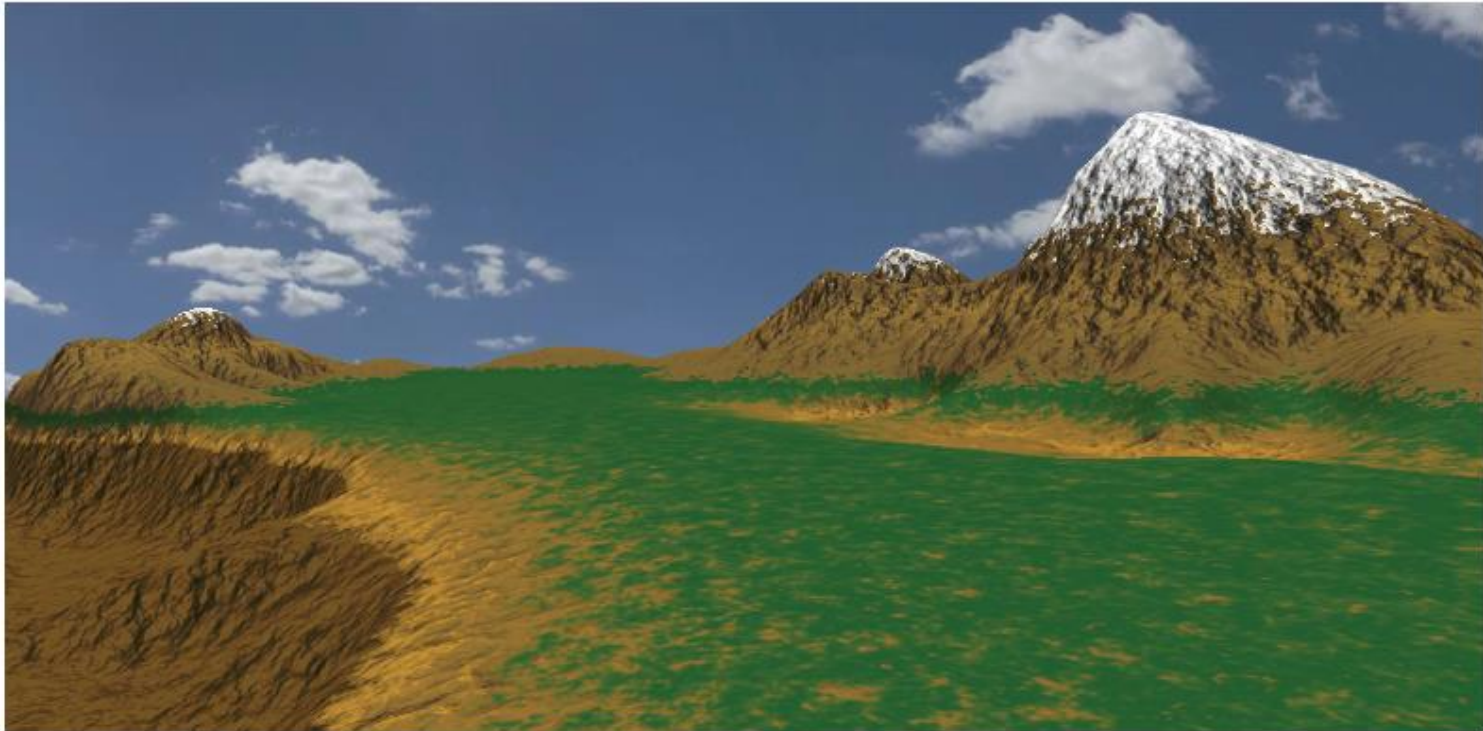


(b)

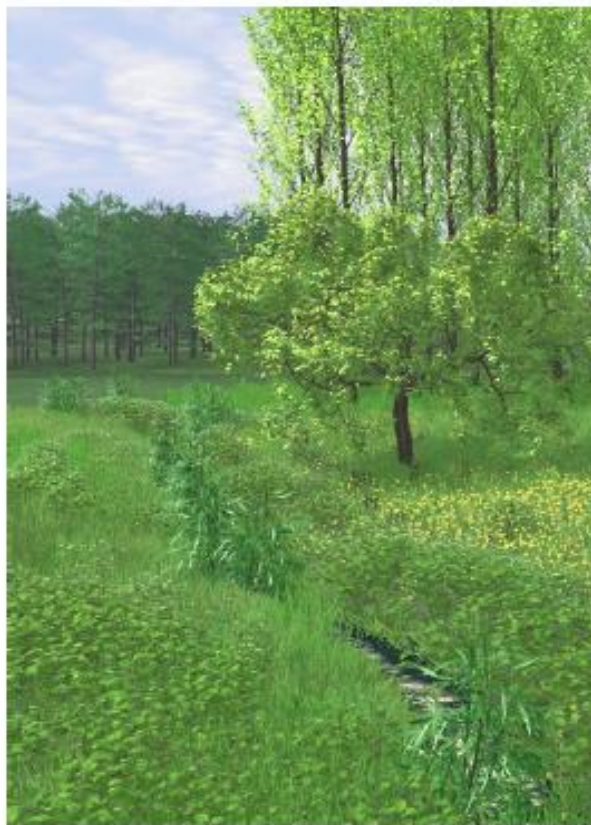
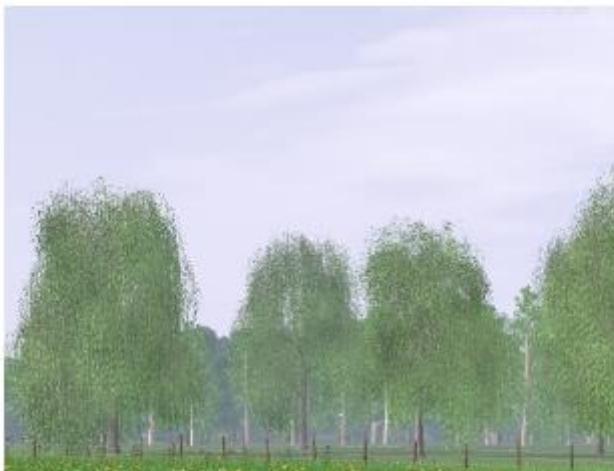
Figure 7: a) Outdoor scene, rendered with typically 8-10 Hz, original model size: 120 million triangles, image: 795x700 ; b) sunflower field, rendered with 3-4 Hz average, original model size: 70 million triangles, image: 729x536



Procedural Terrain

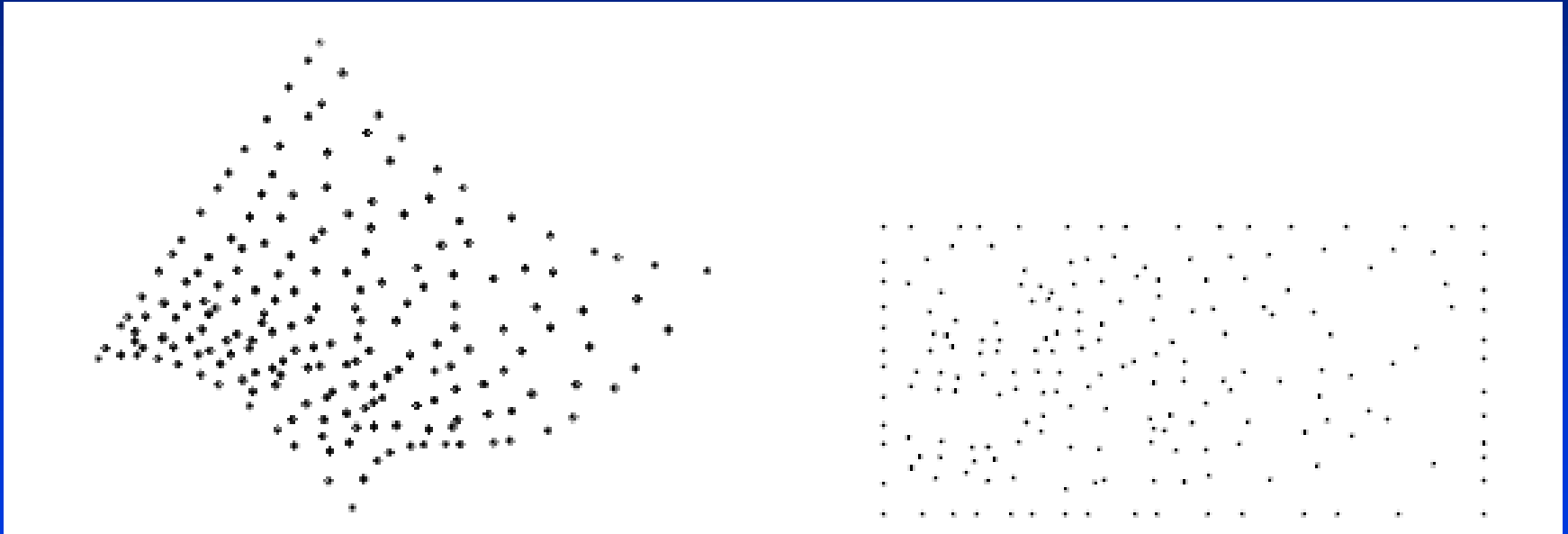


Procedural terrain



Geometry Processing & Analysis

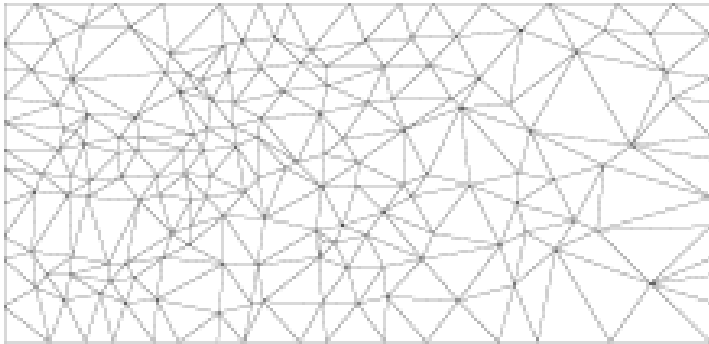
Meshless Parameterization



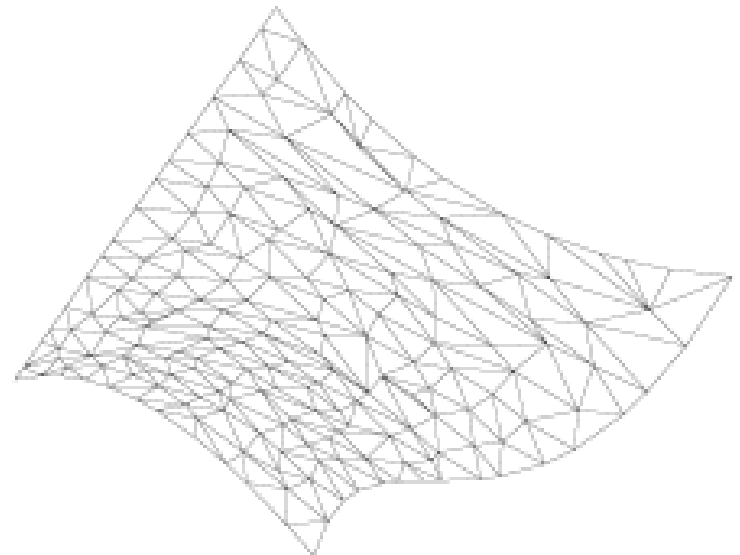
Point set

Meshless parameterization

Triangulation

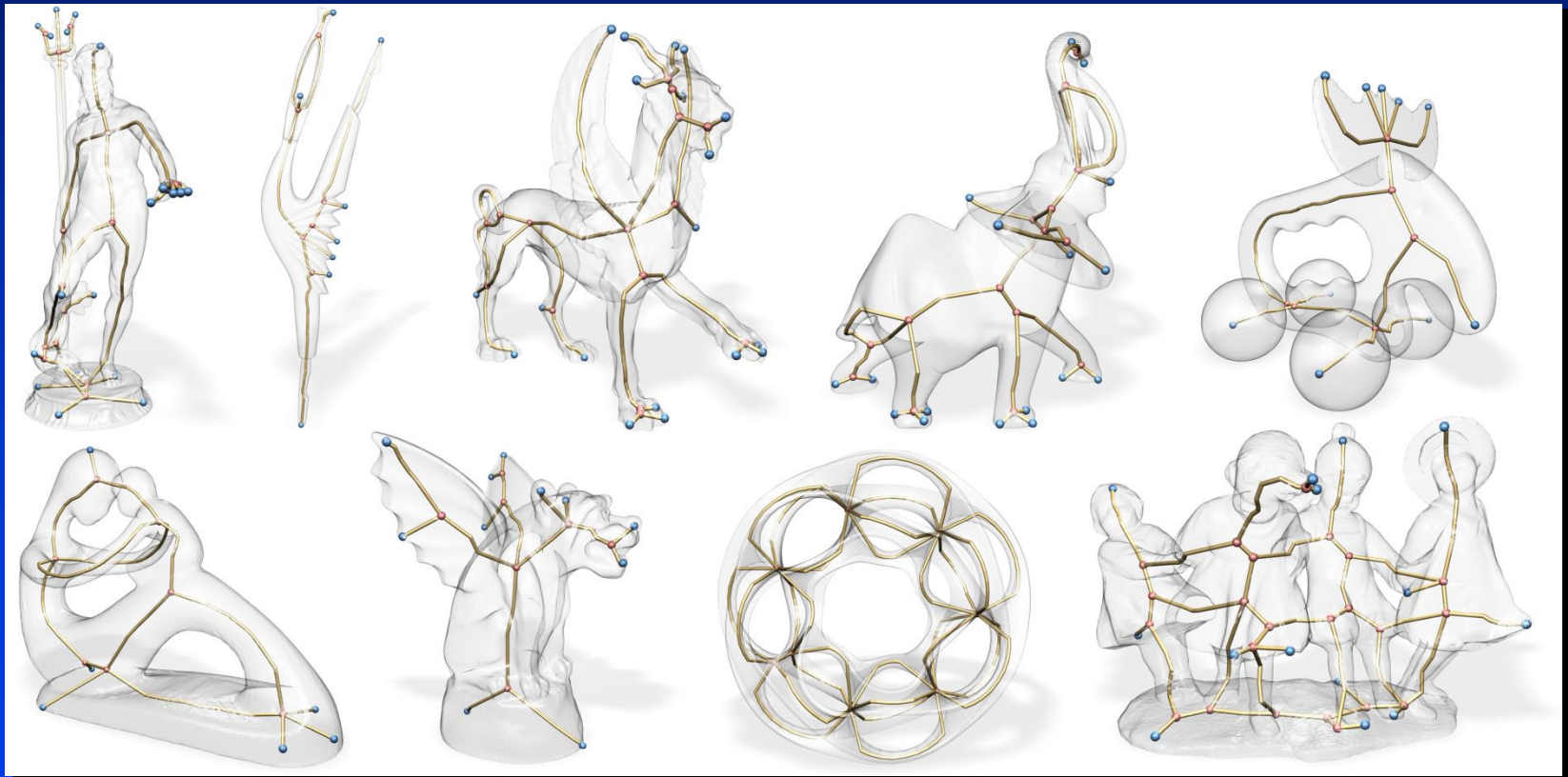


Delaunay triangulation

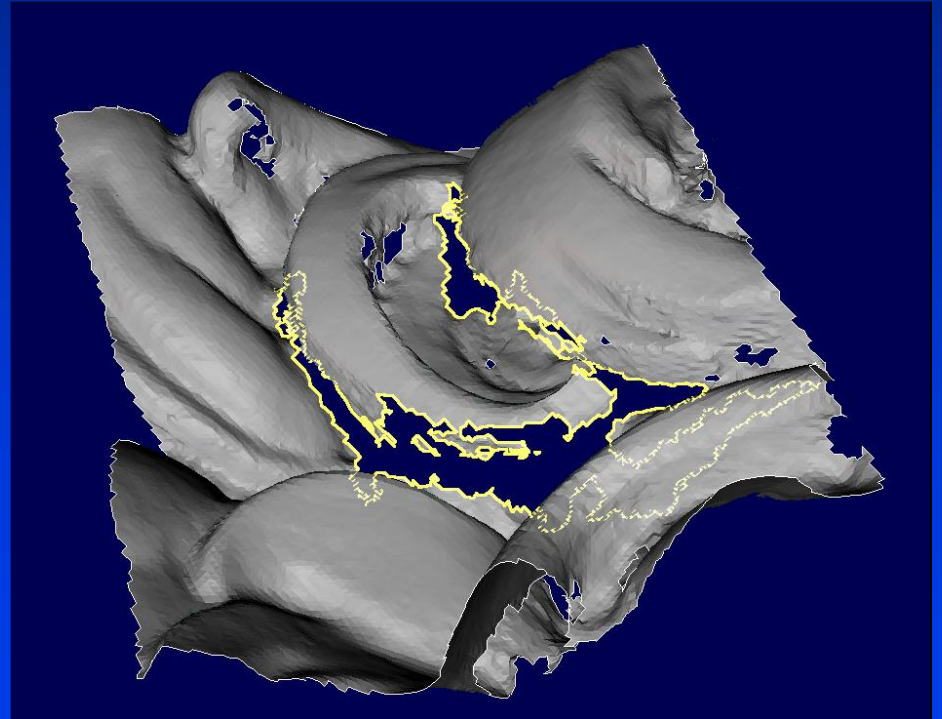
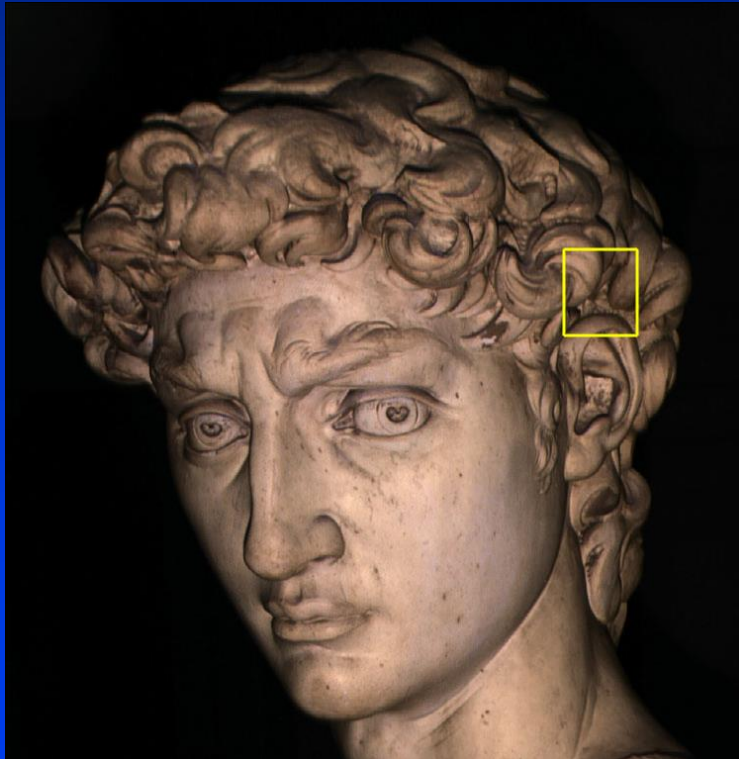


Surface triangulation

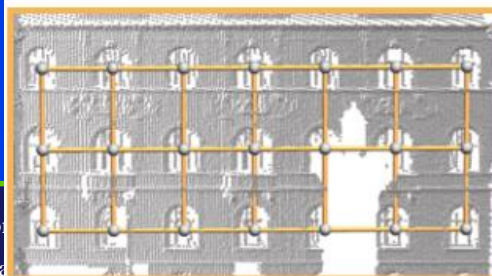
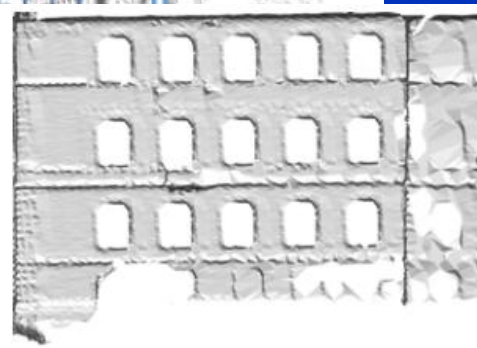
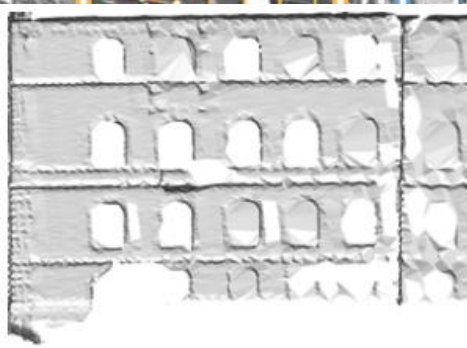
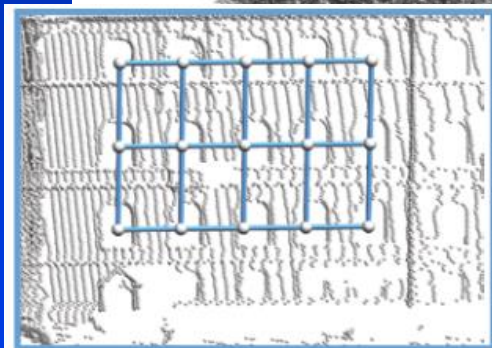
Skeleton Extraction



Surface Completion

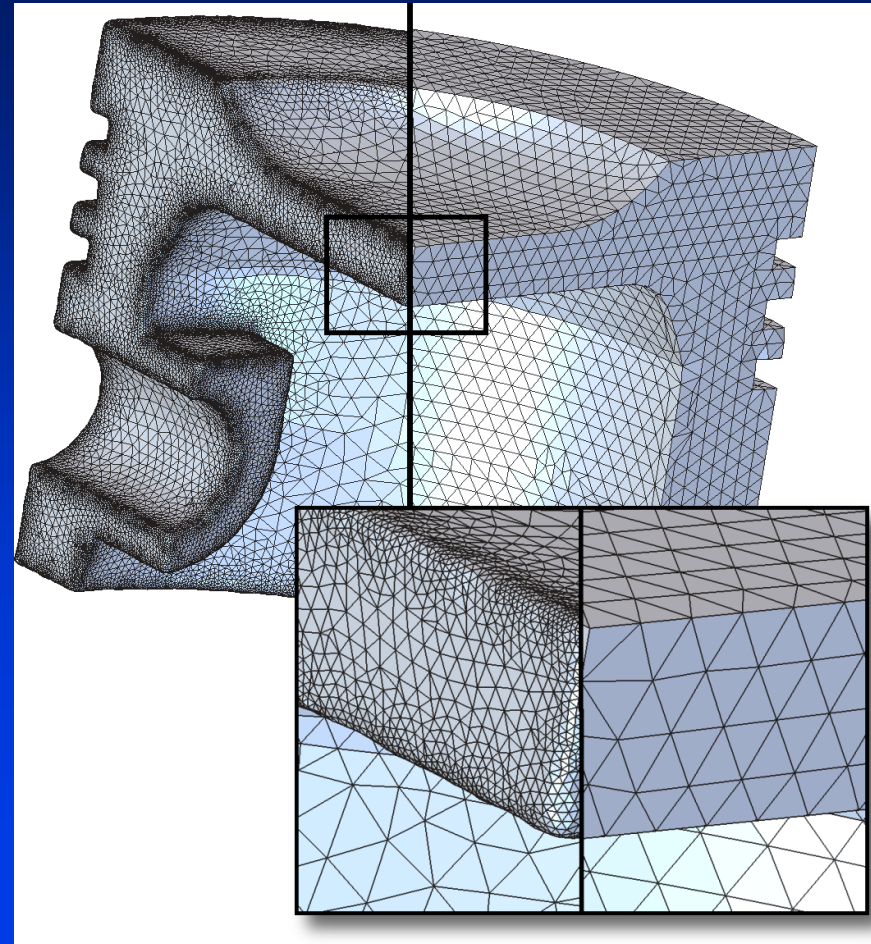


Scan Completion

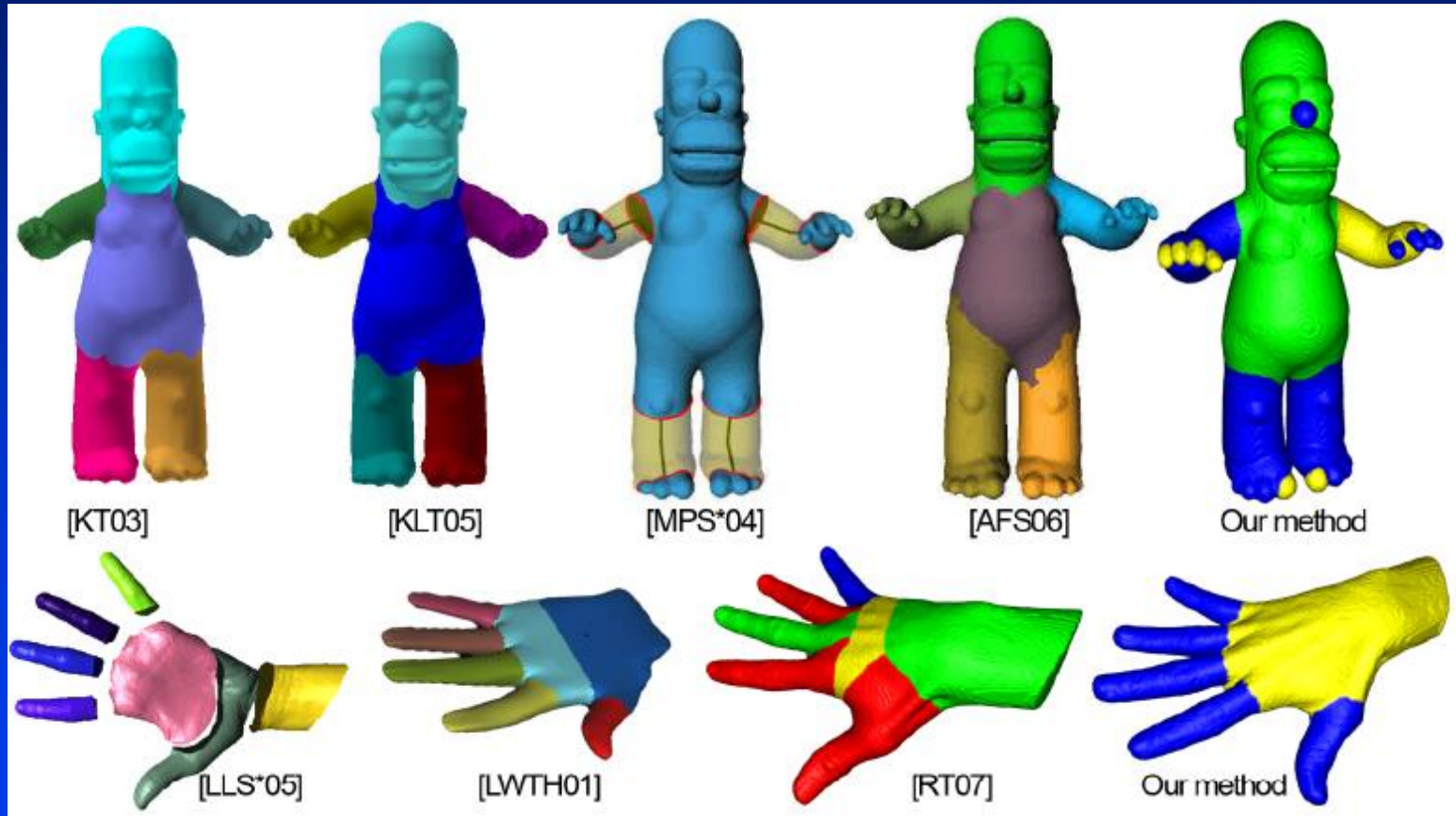


Remeshing with Features

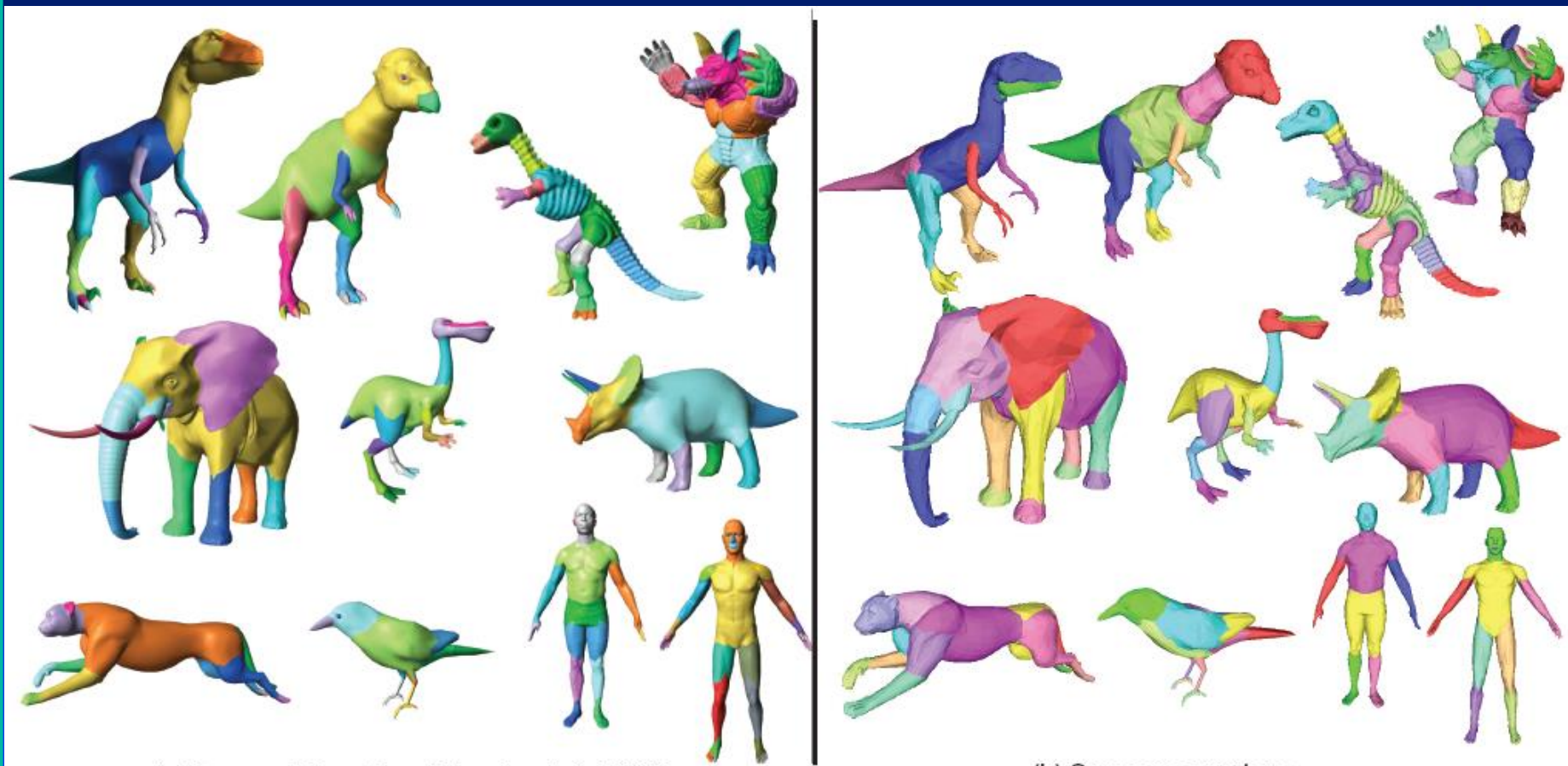
- **Remesh segmented regions**
 - The feature polylines seed the *Afront* triangulation algorithm [Schreiner:2006]
 - Achieve sharp features without modification of algorithm
- **Reduced triangle count**
 - Triangle sizes are determined by the curvature *along* the feature edge rather than *across* it!



Model Segmentation



Segmentation

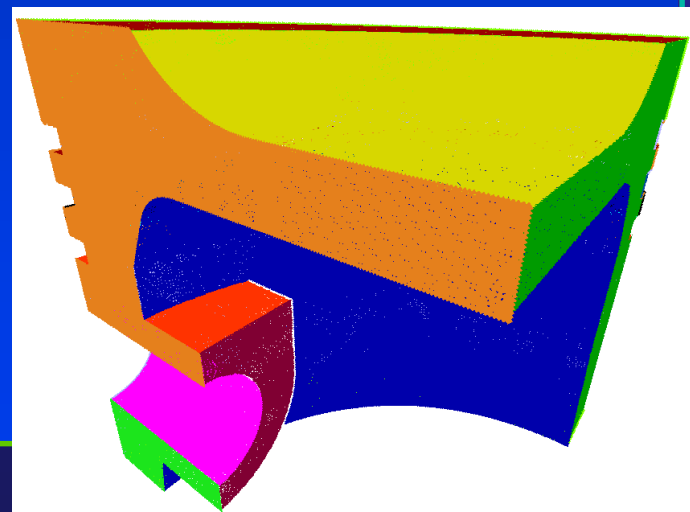
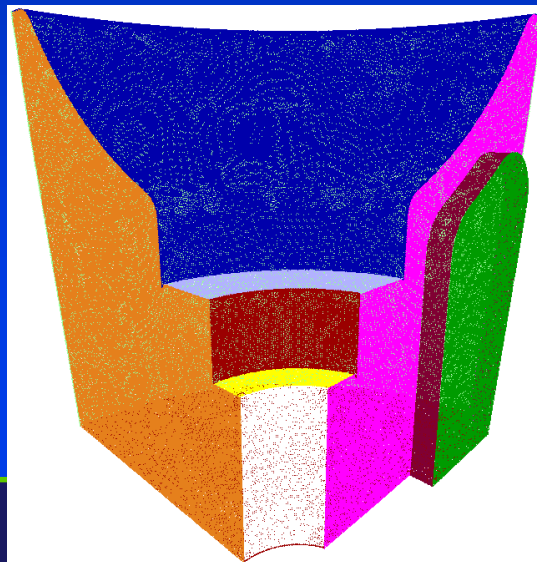
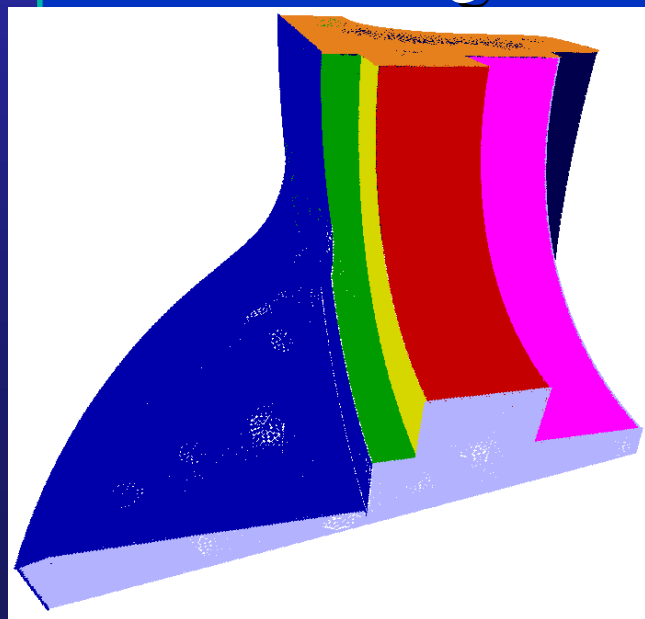


(a) Segmentations from [Shapira et al. 2008]

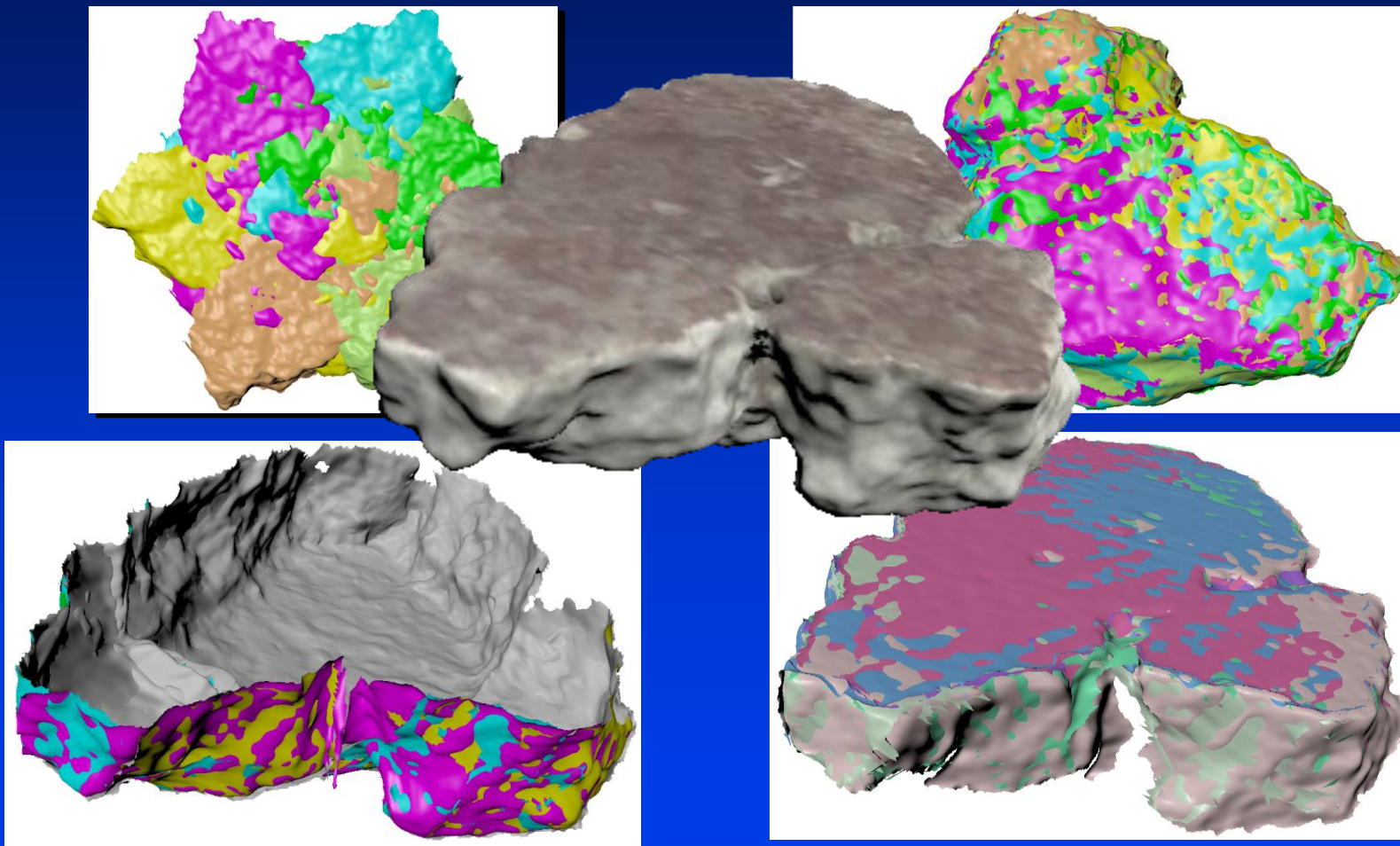
(b) Our segmentations

Segmentation

- **Closed loop region segmentation**
 - Seed with a random point
 - Grow outwards adding neighbors until feature points found
 - Add neighbors using RMLS neighborhood statistics



3D Model Alignment



Shape Registration



80%



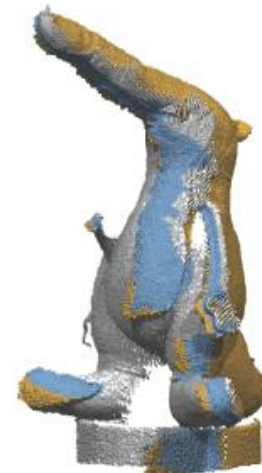
70%



60%



50%



40%



model P

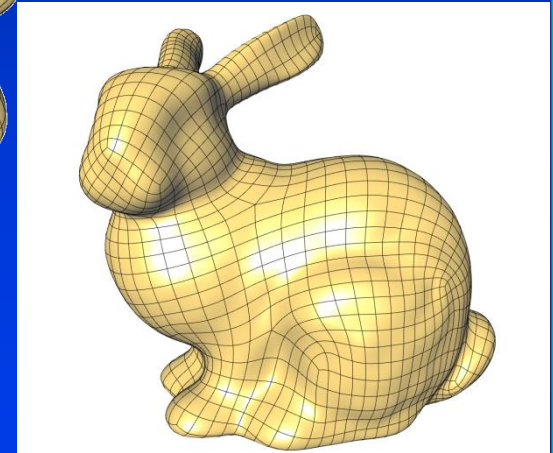
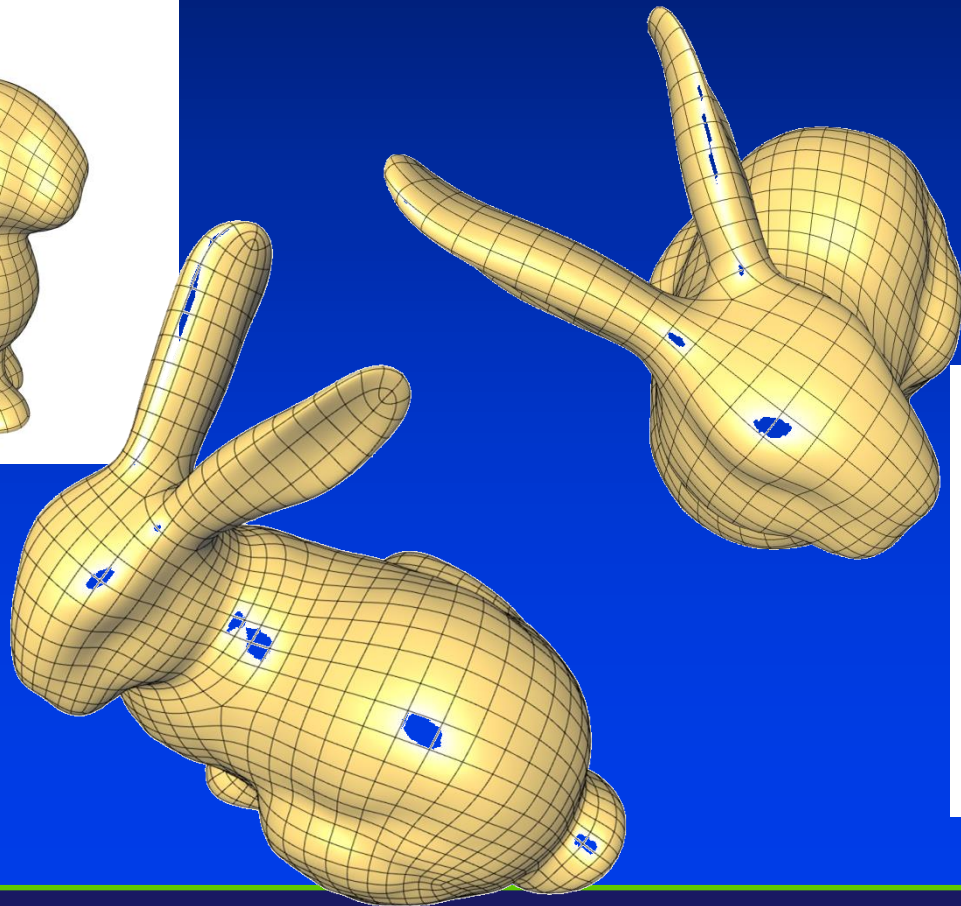
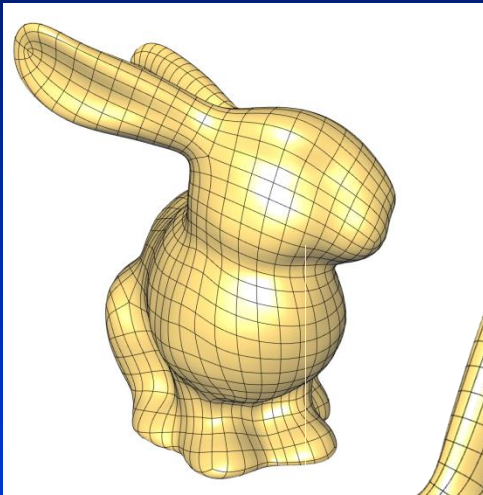


model Q

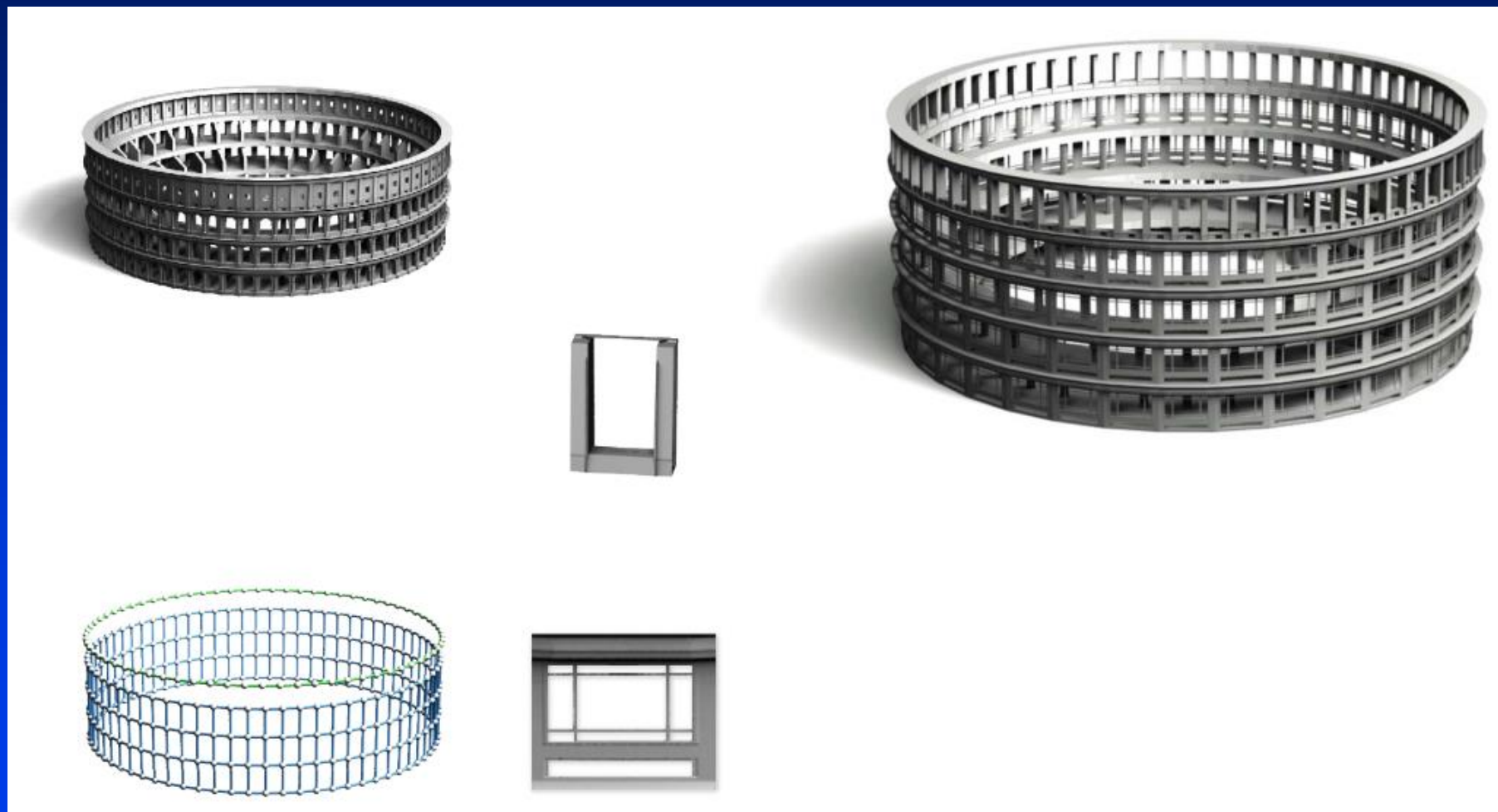


affine 4PCS

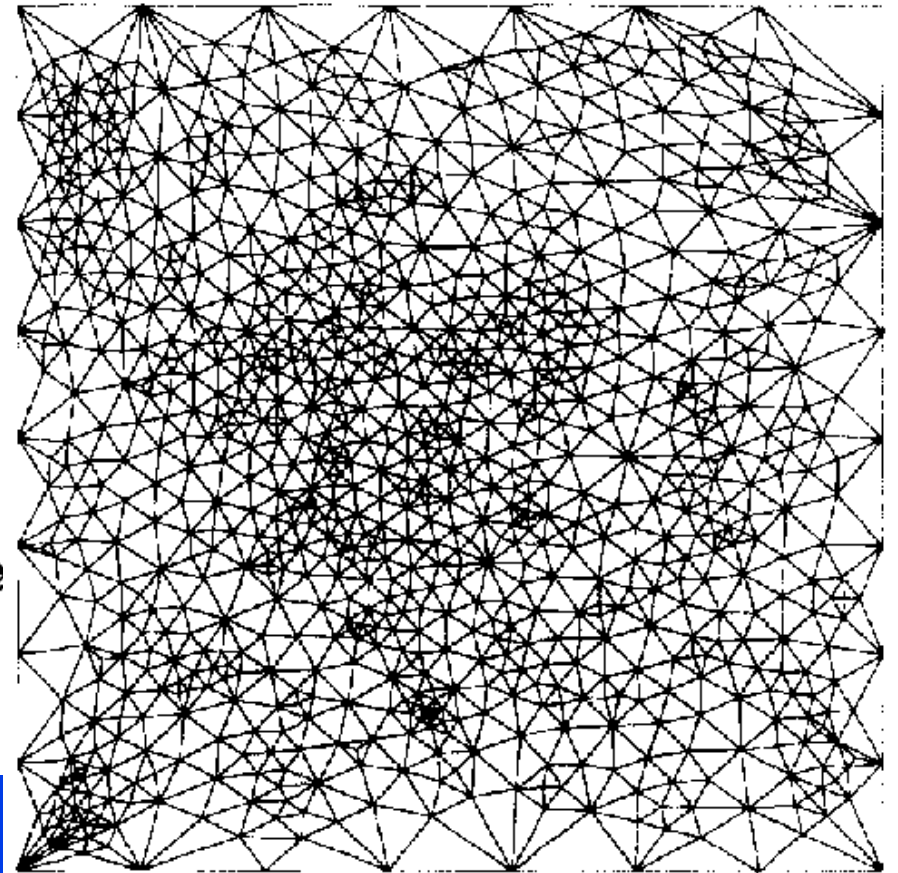
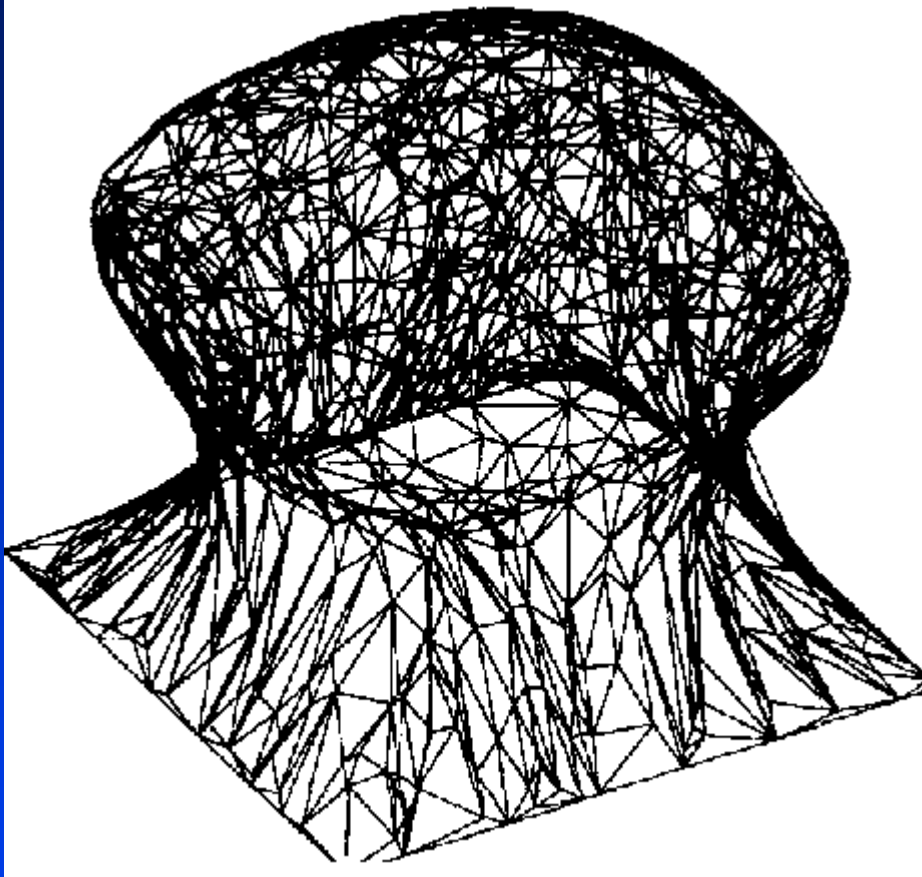
Meshing



Shape Synthesis



Parameterization based on PDEs

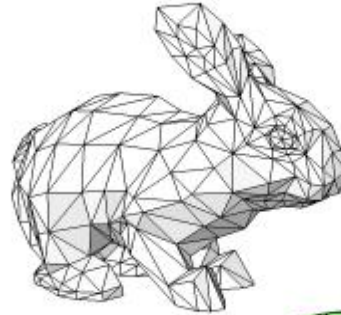


Spherical Parameterization

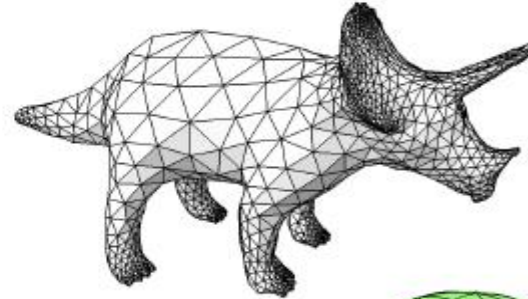
Pawn (154 vertices)



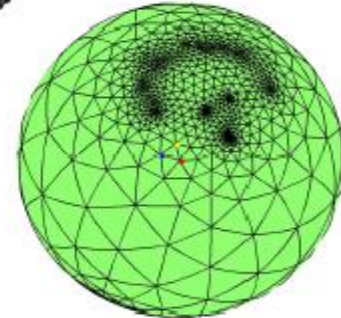
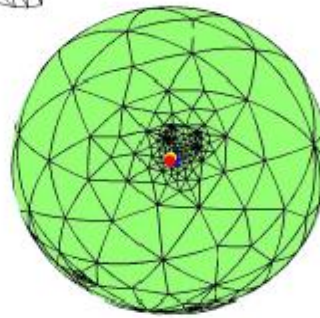
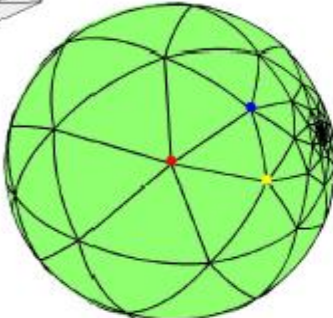
Rabbit (543 vertices)



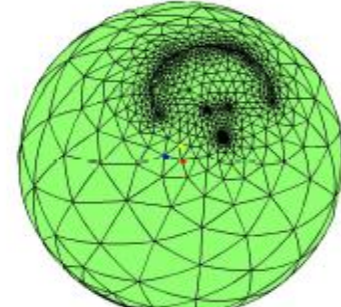
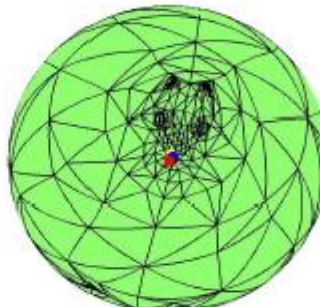
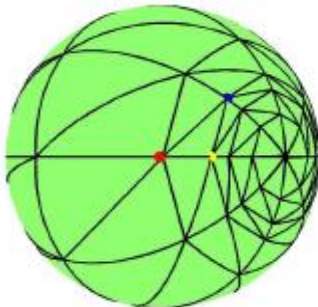
Triceratops (1,727 vertices)



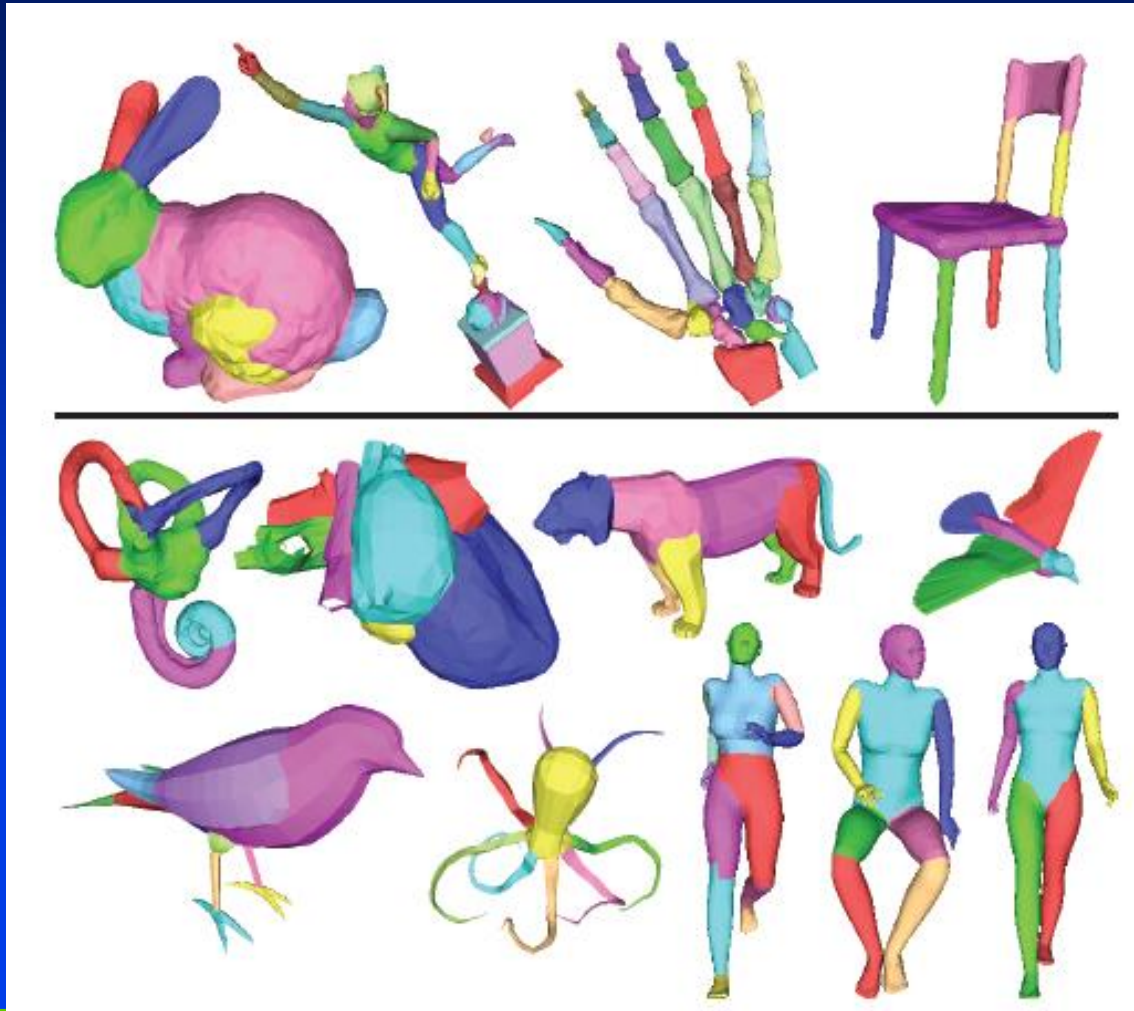
Tutte
Laplacian



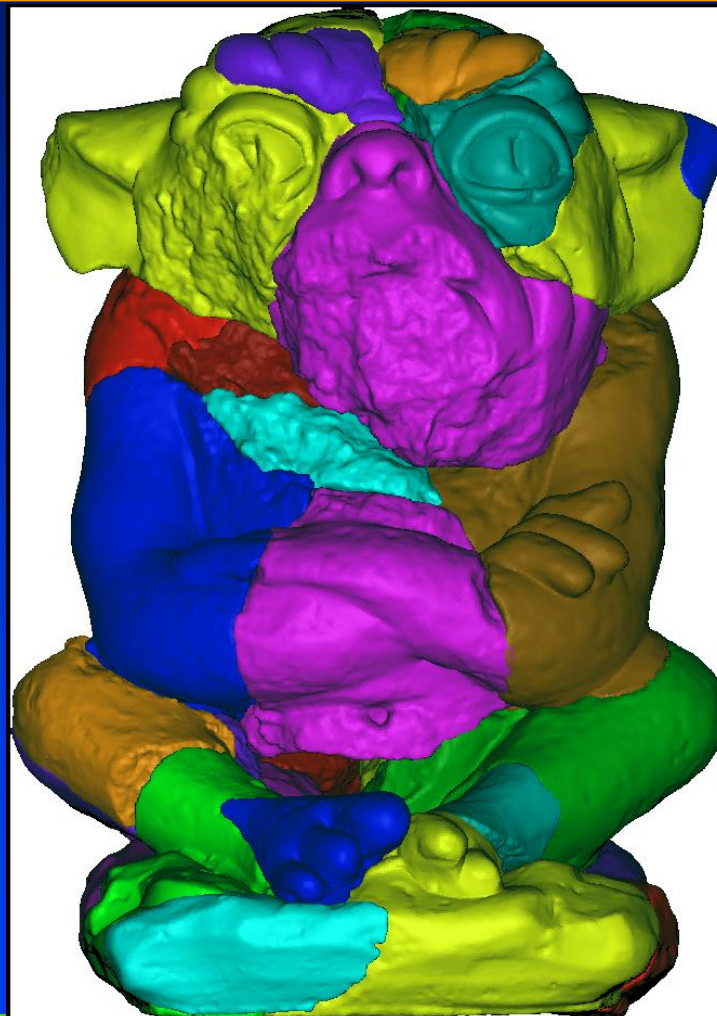
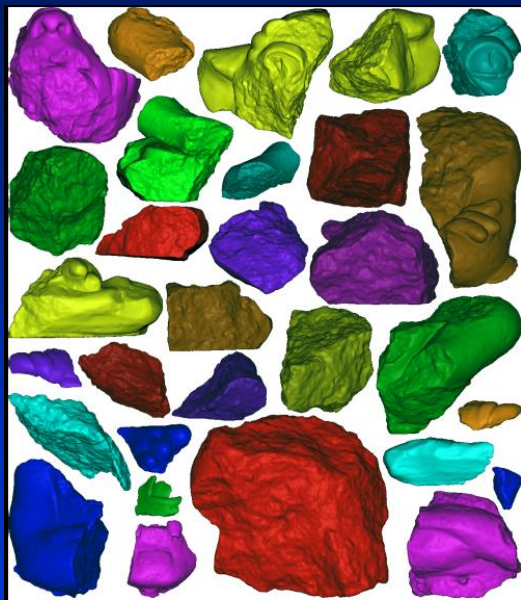
Conformal
Laplacian



Model Segmentation



Shape Matching



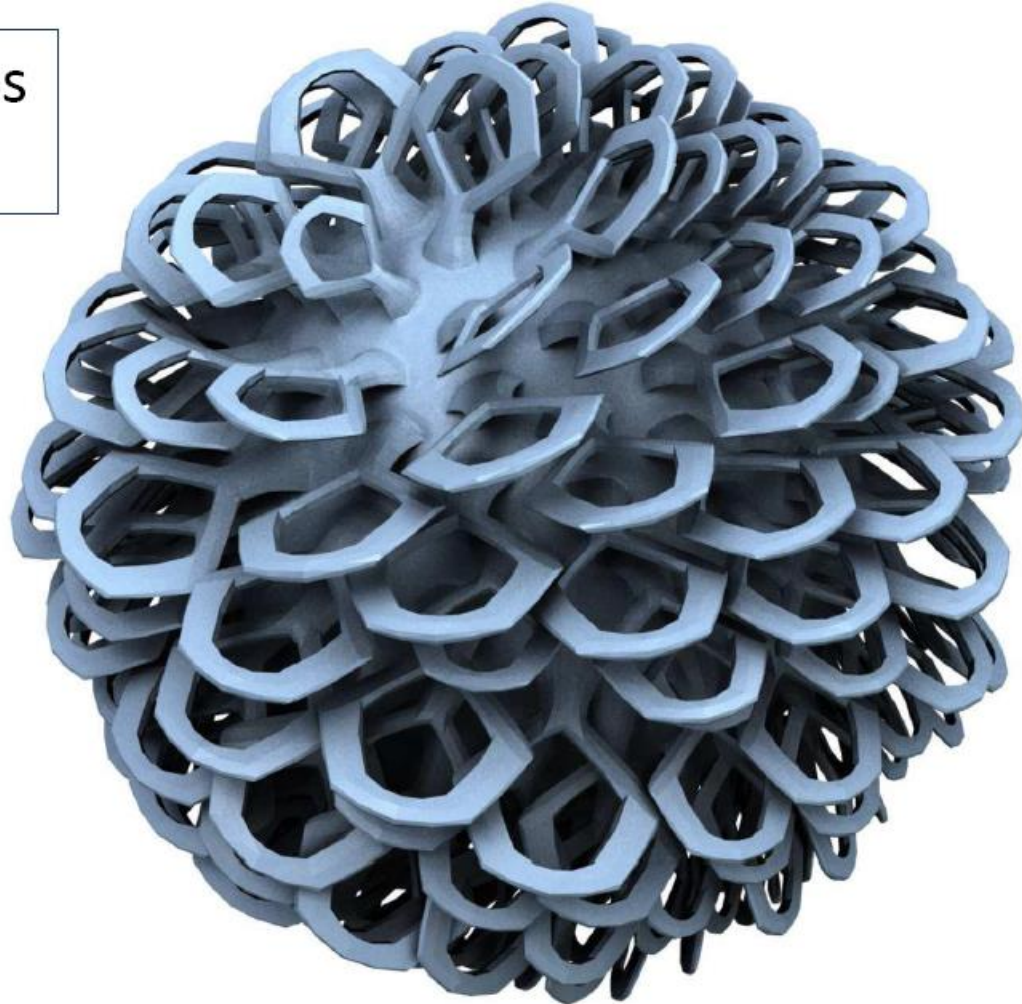
Building Reconstruction



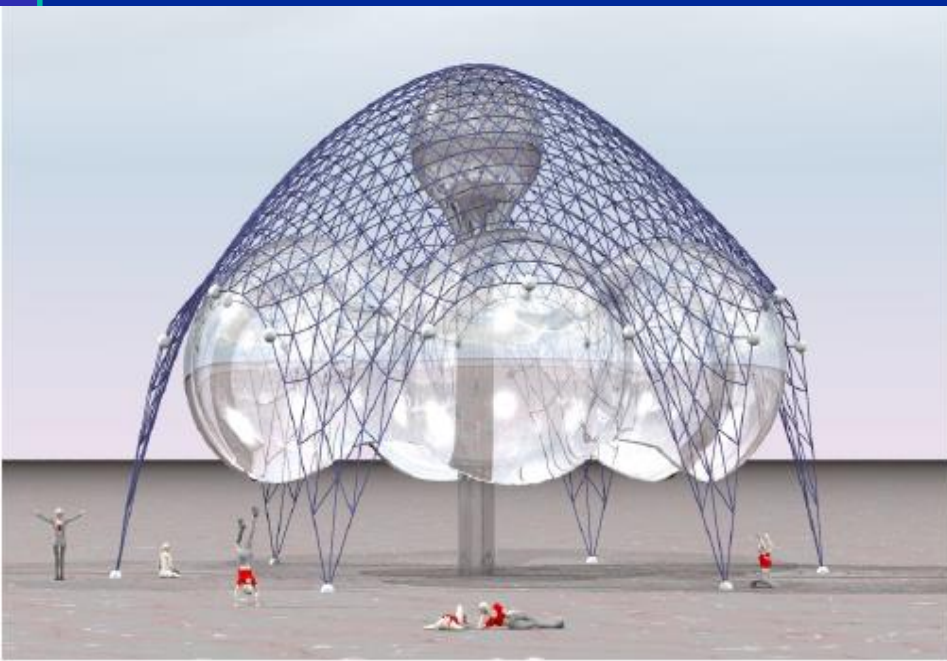
Figure 11: Additional reconstruction results using SmartBoxes. From left to right: real photograph, LiDAR scan, 3D reconstruction, and its textured version for a visual comparison with the photograph. The examples show reconstruction of complex buildings with some irregularity. Grouping and contextual force during drag-and-drop allow the reconstruction to deal with large-scale missing data (bottom row).

Geometry Texture Synthesis

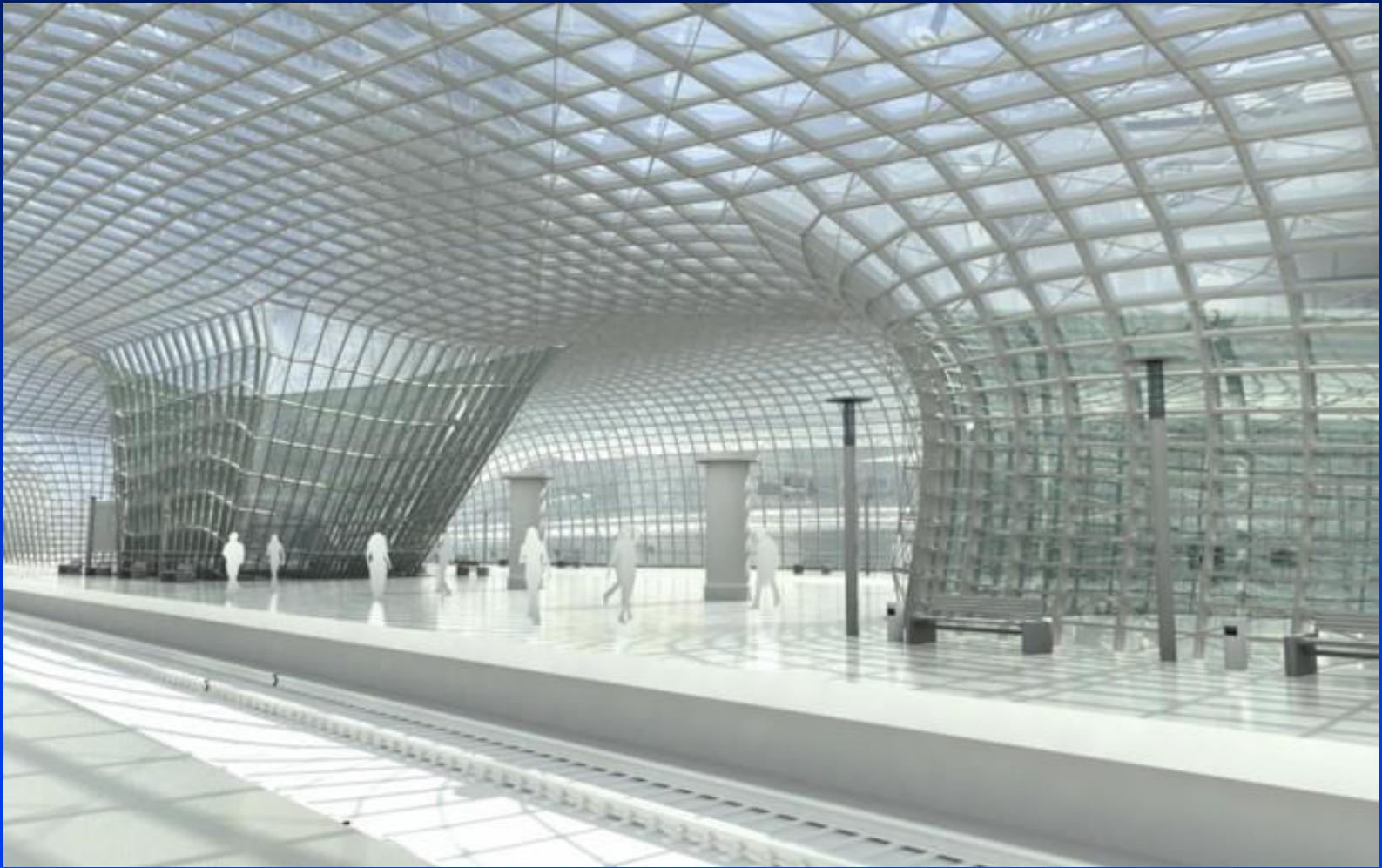
High genus
scales



Fair Surface Design

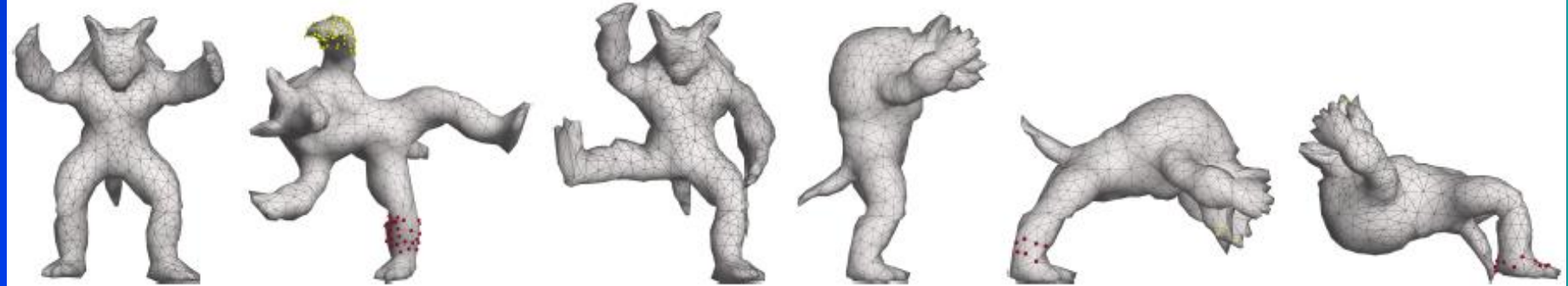
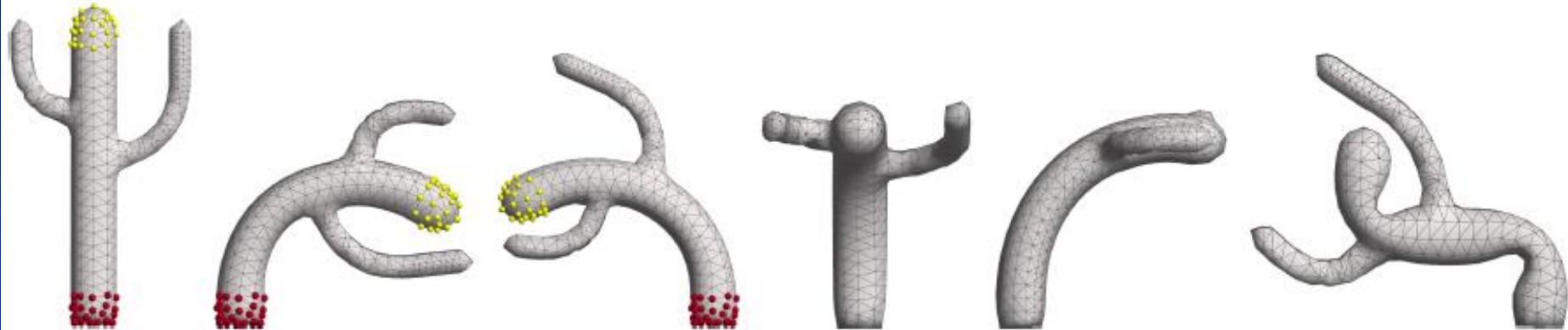


Architectural Geometry



Physically-based Modeling/Animation

As-rigid-as-possible Modeling



Simulation of Elastic Rods



Performance Capture and Mesh Animation



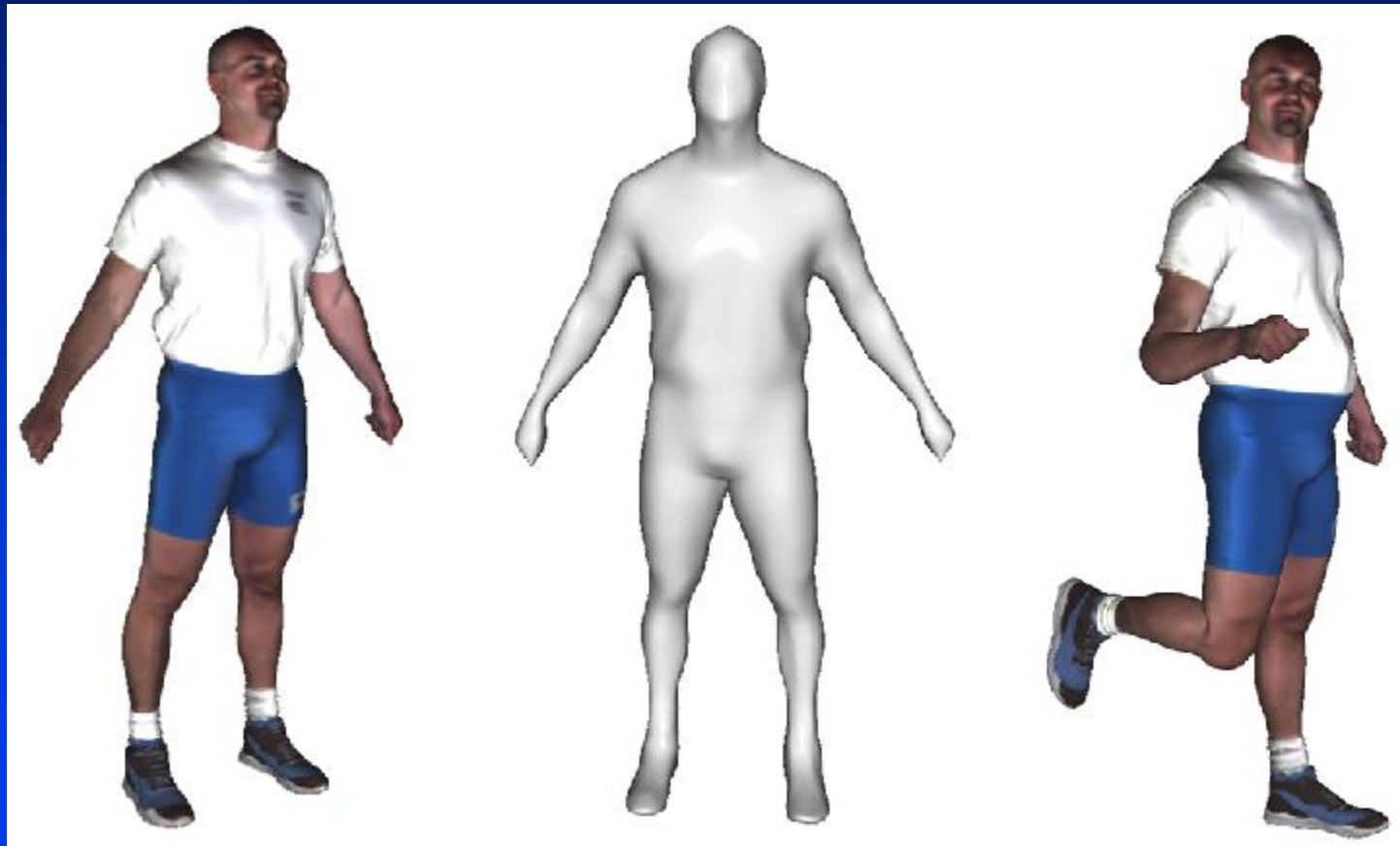
Geometry Synthesis of Human Hair



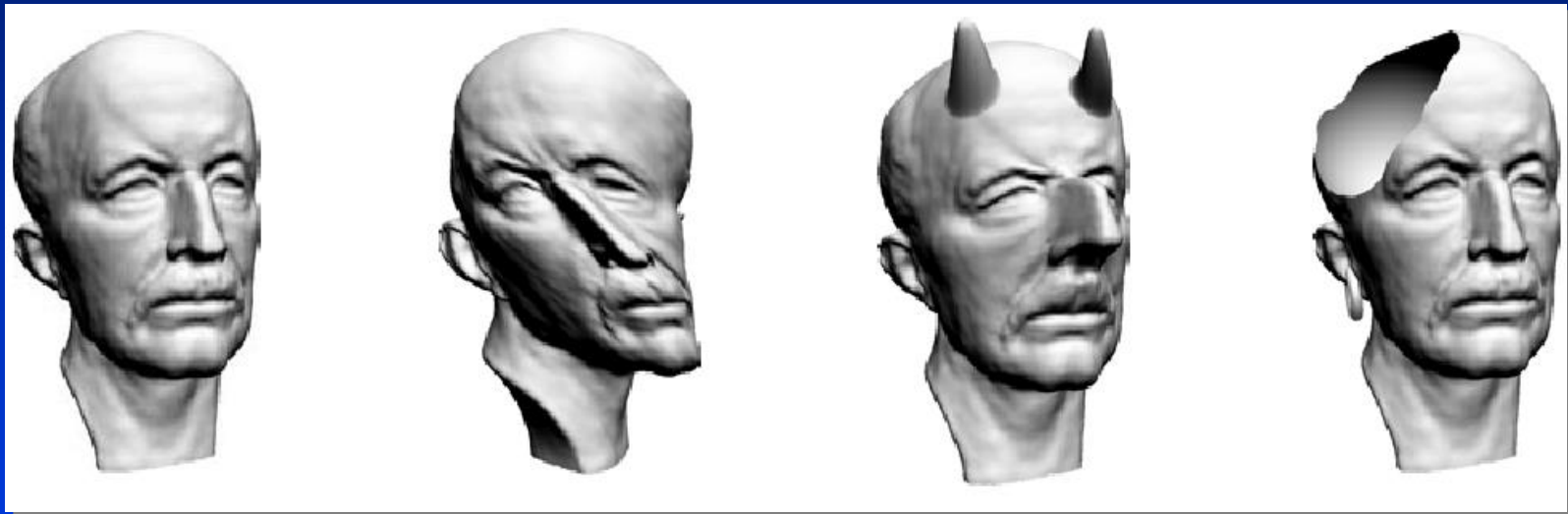
Facial Expression Acquisition and Synthesis



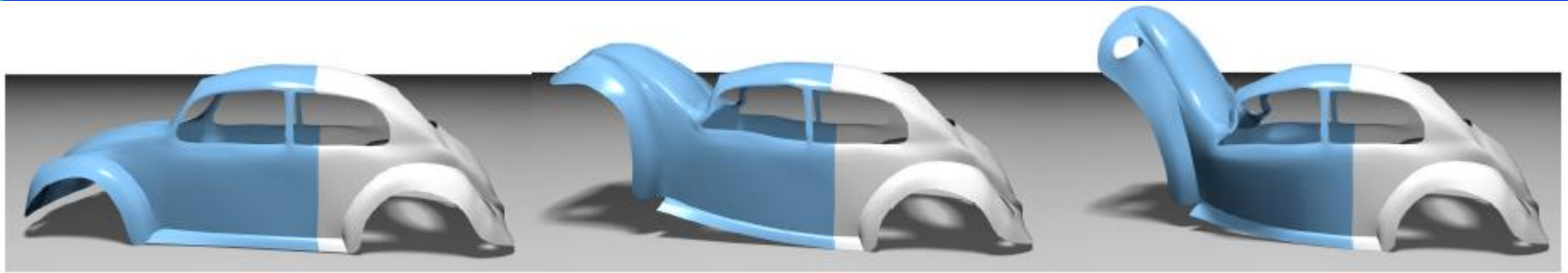
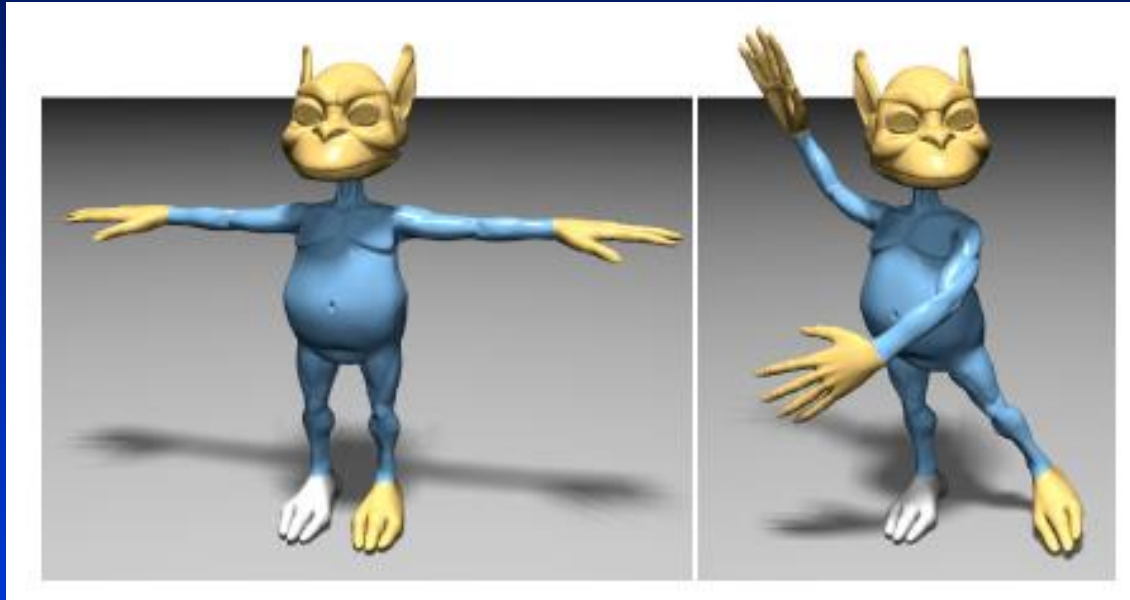
Motion Synthesis (Animation)



Shape Deformation and Editing



Shape Deformation



Tree Simulation



Finite Element Simulation

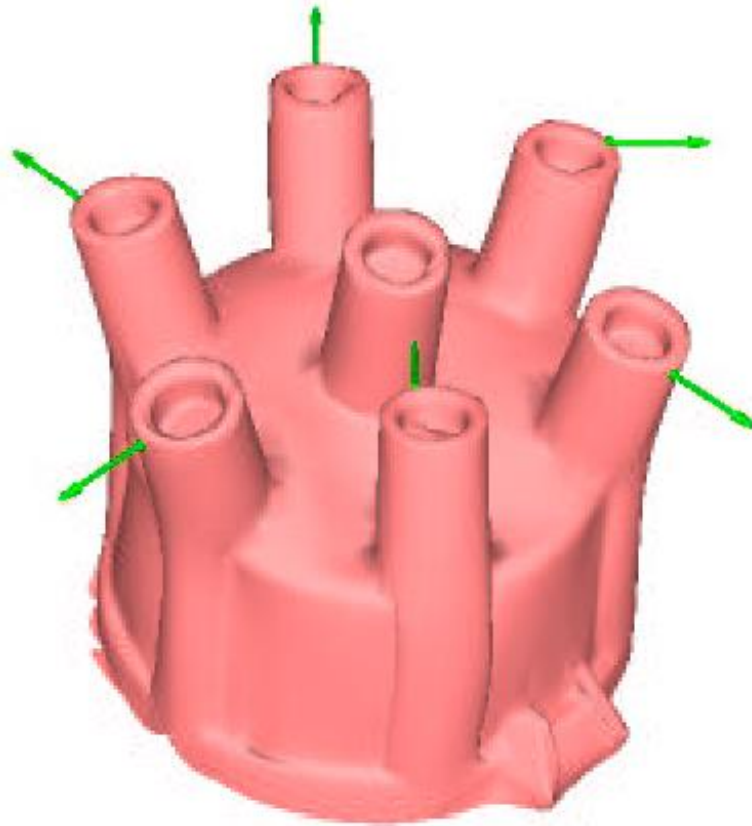
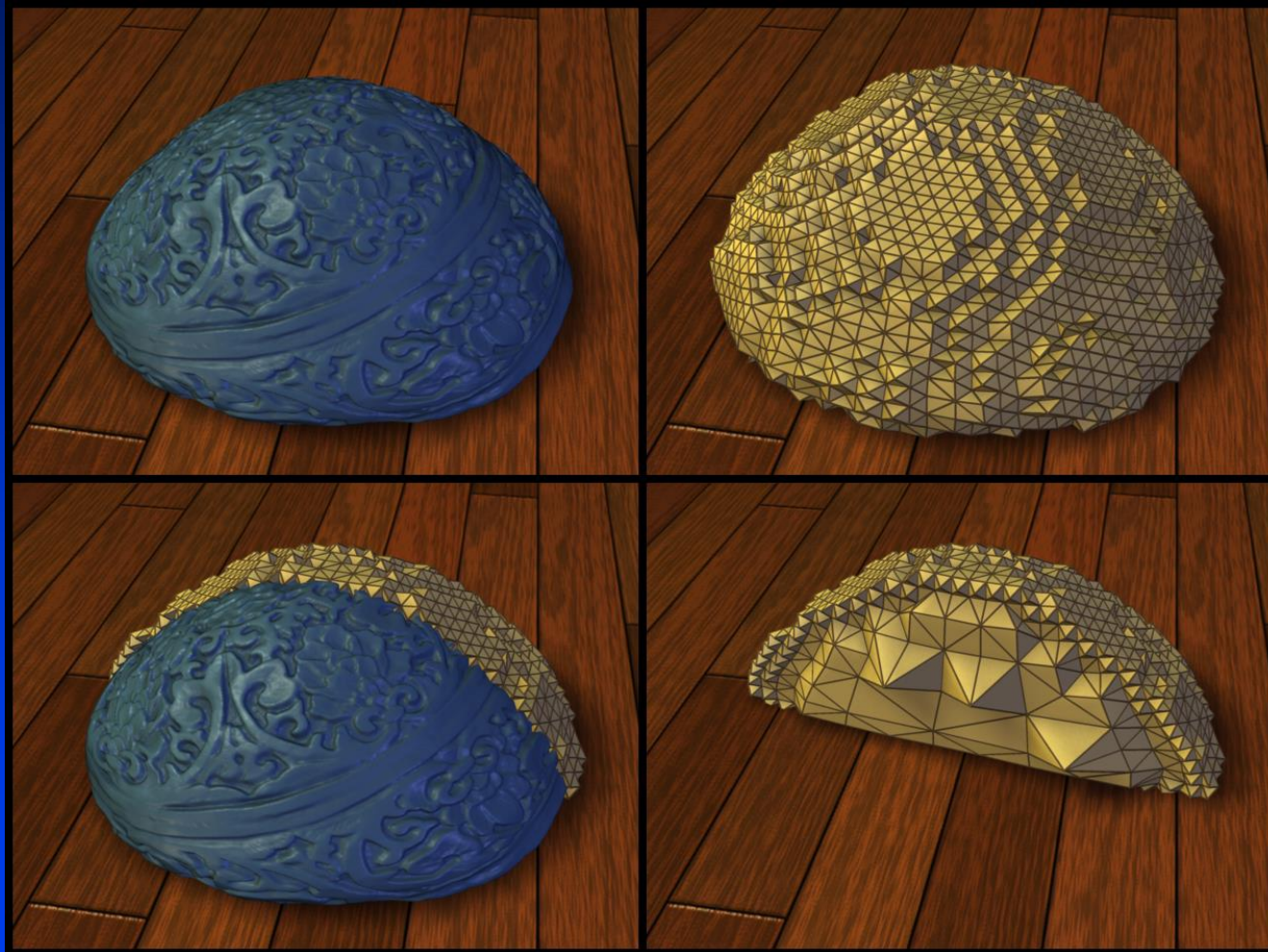
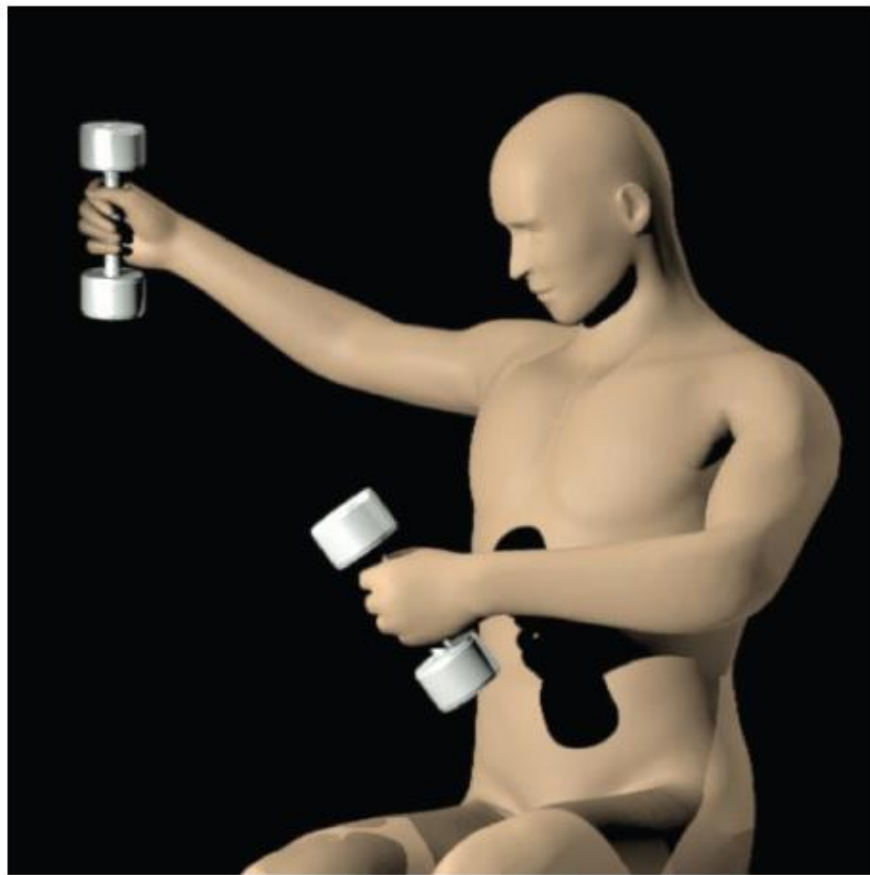


Figure 1: Distributor Cap

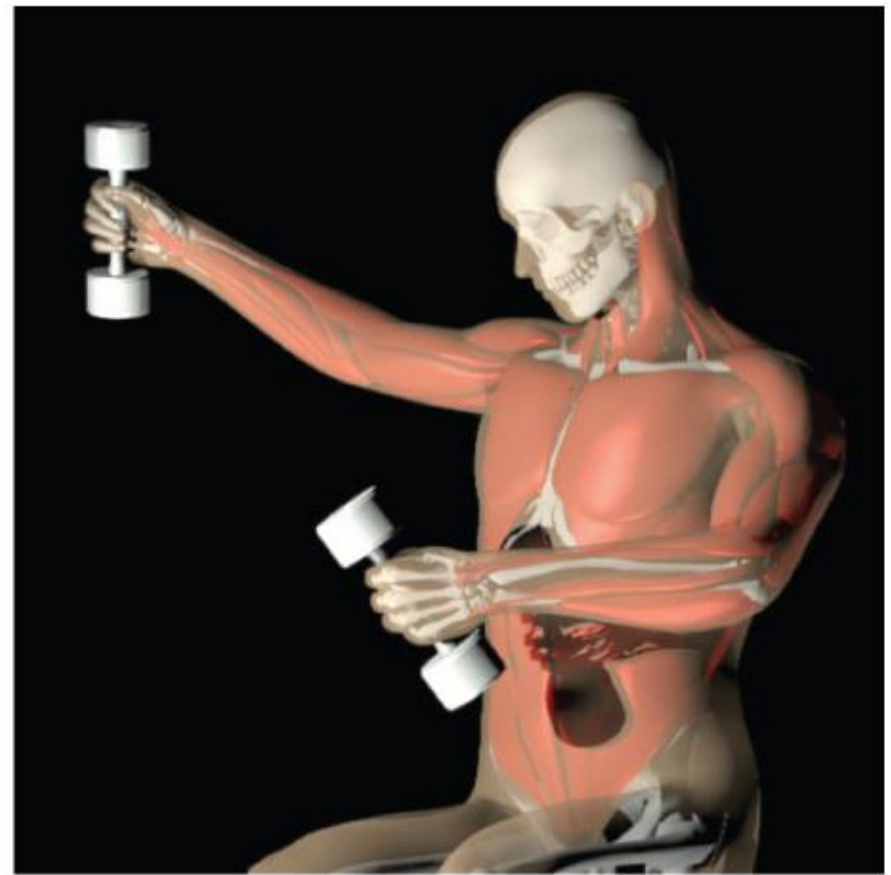
Finite Element Meshing



Biomechanical Modeling of Human



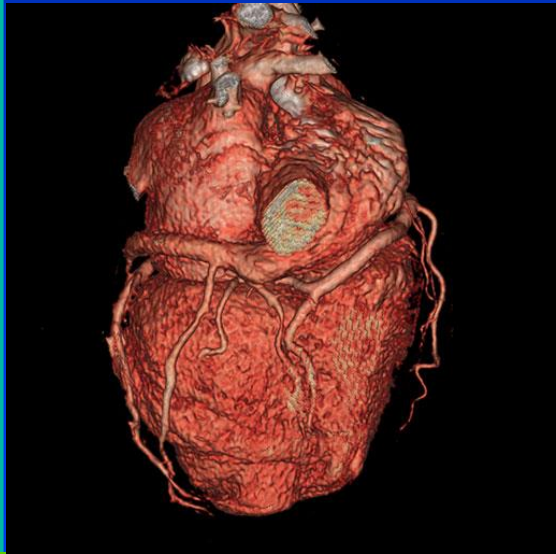
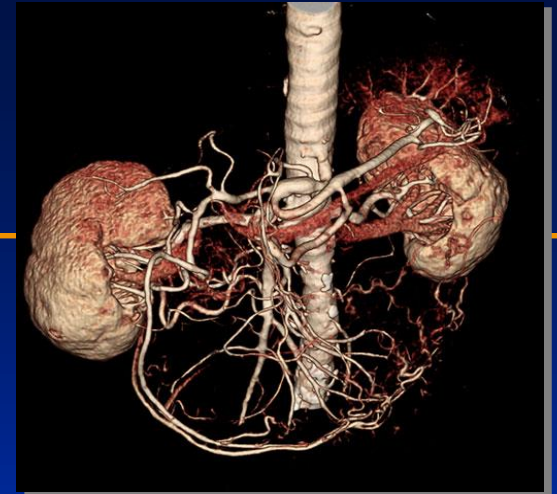
(a)



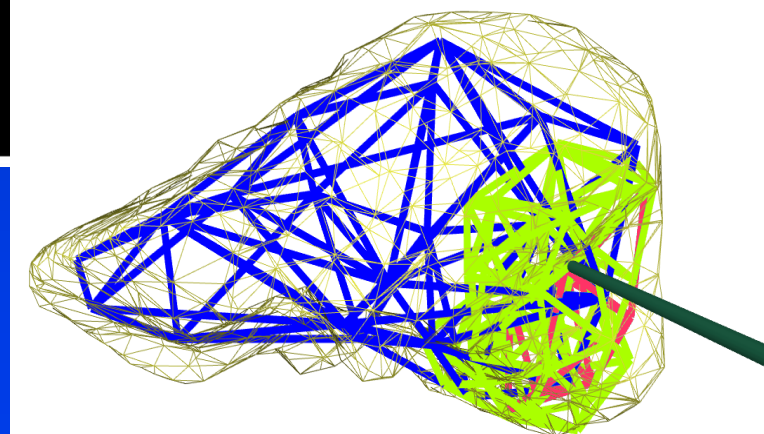
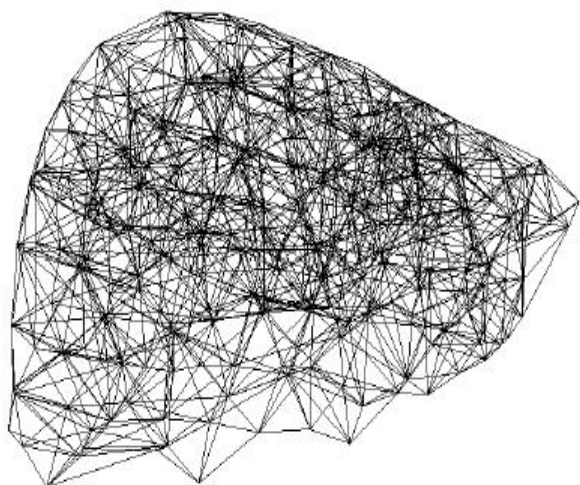
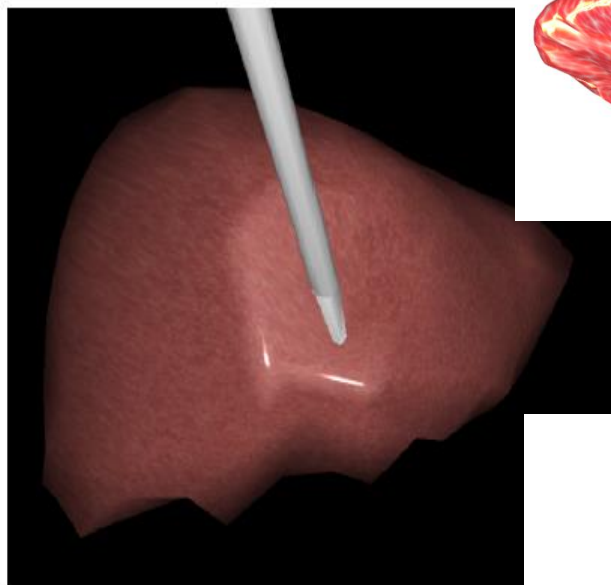
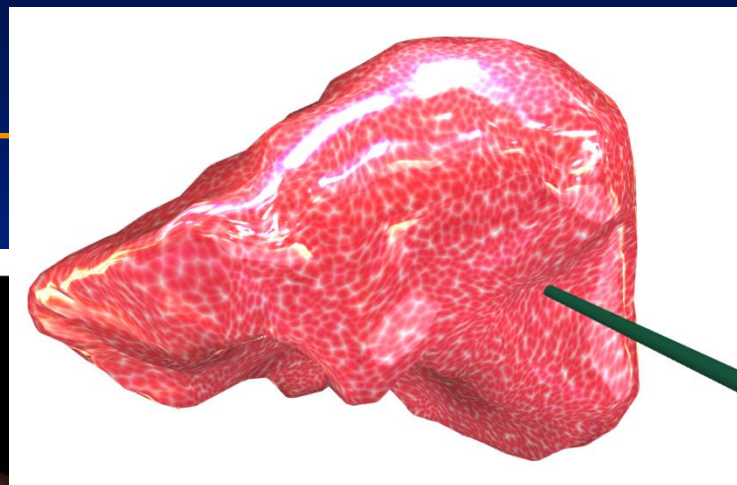
(b)

Fig. 13. The soft tissue simulator produces realistic deformations of (a) the visualization geometry, and (b) embedded volumetric muscles.

Biomedical Applications

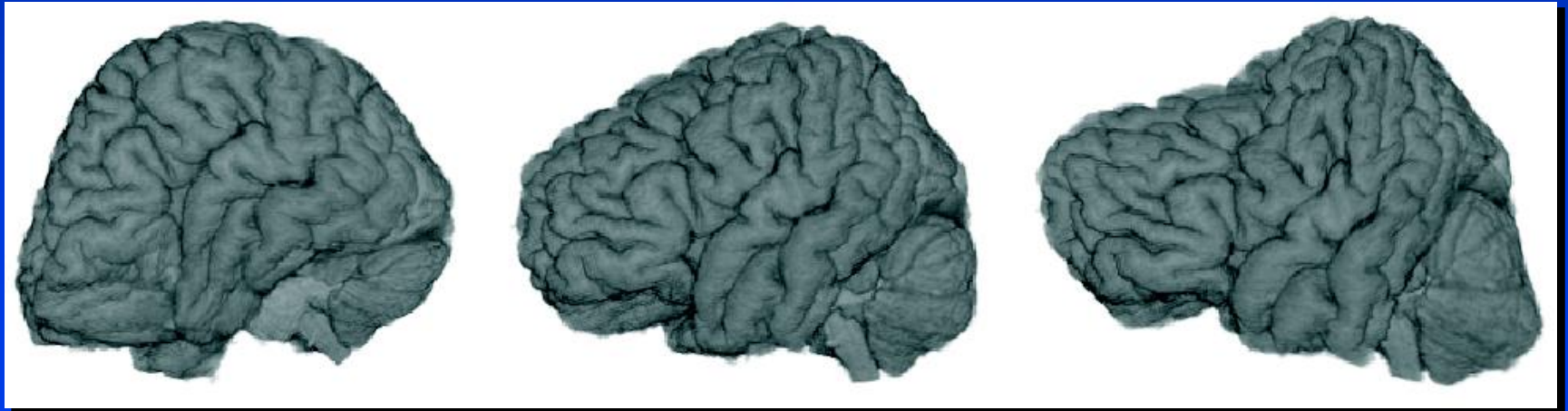


Organ Deformation

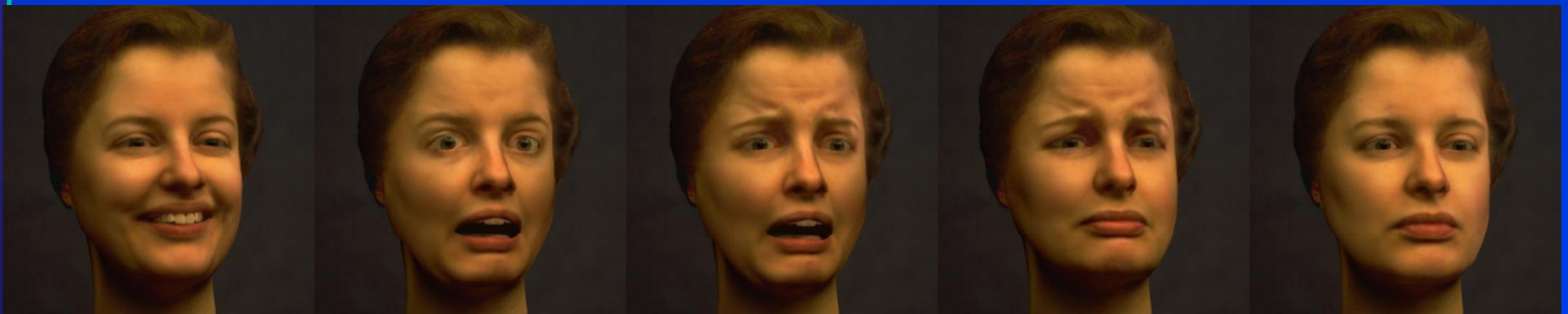
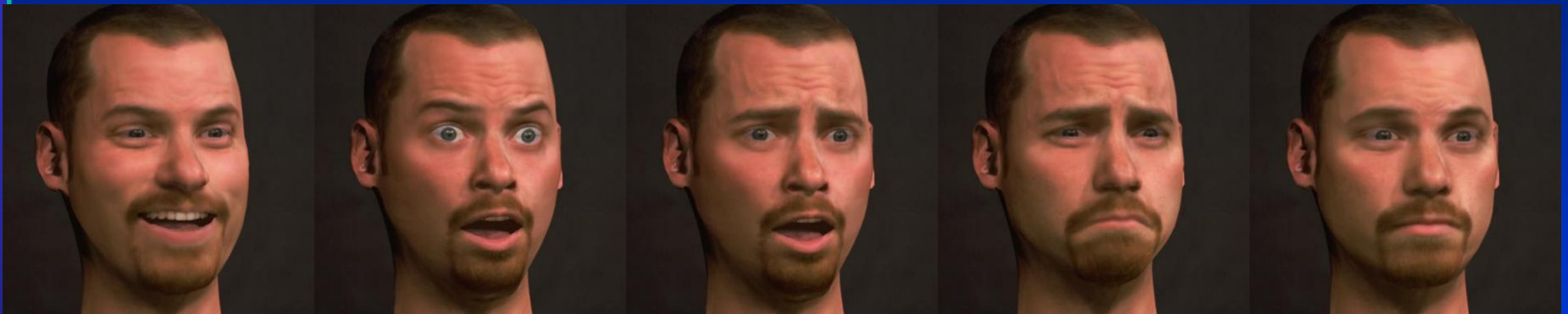


Brain Deformation

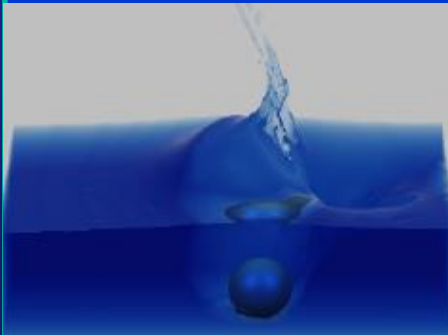
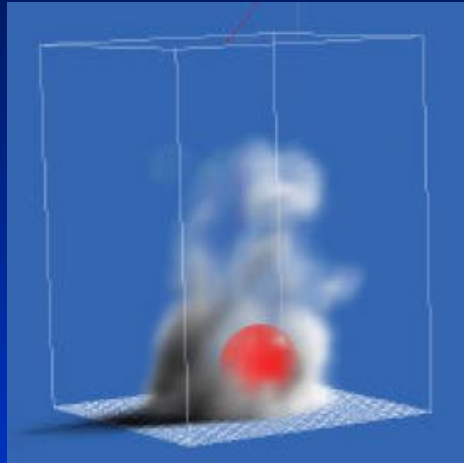
- Medicine
- Simulation
- Modeling
- Entertainment



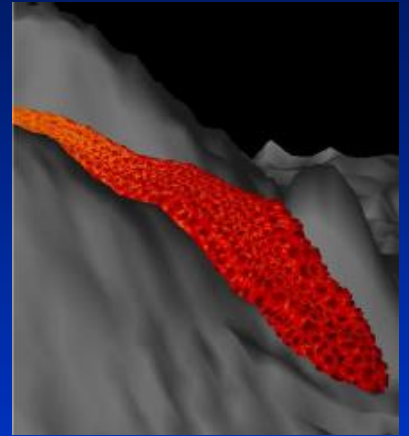
Facial Animation



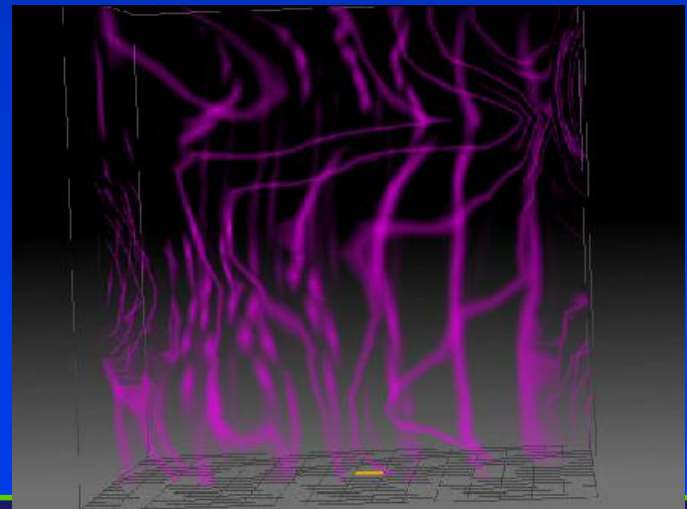
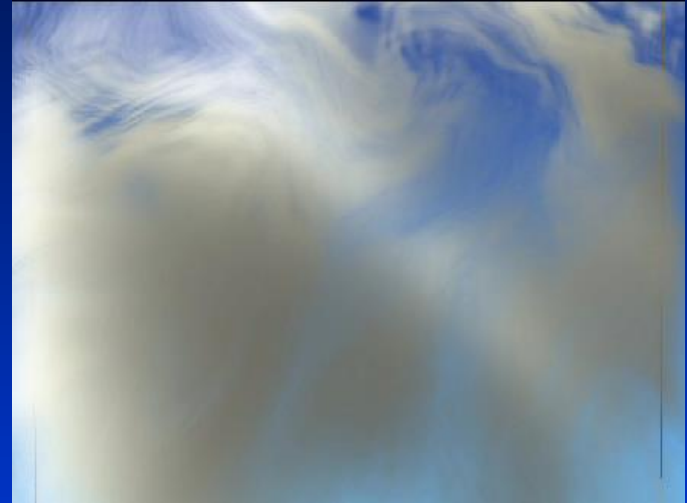
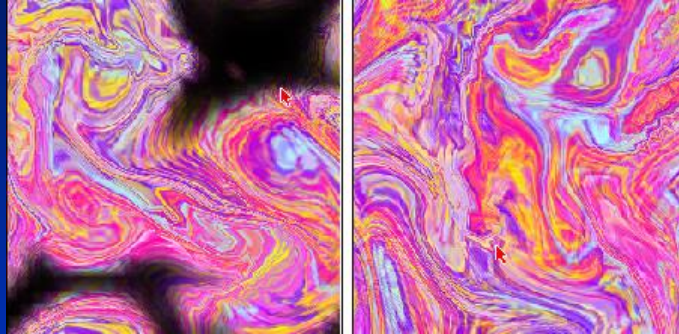
Fluid Simulation



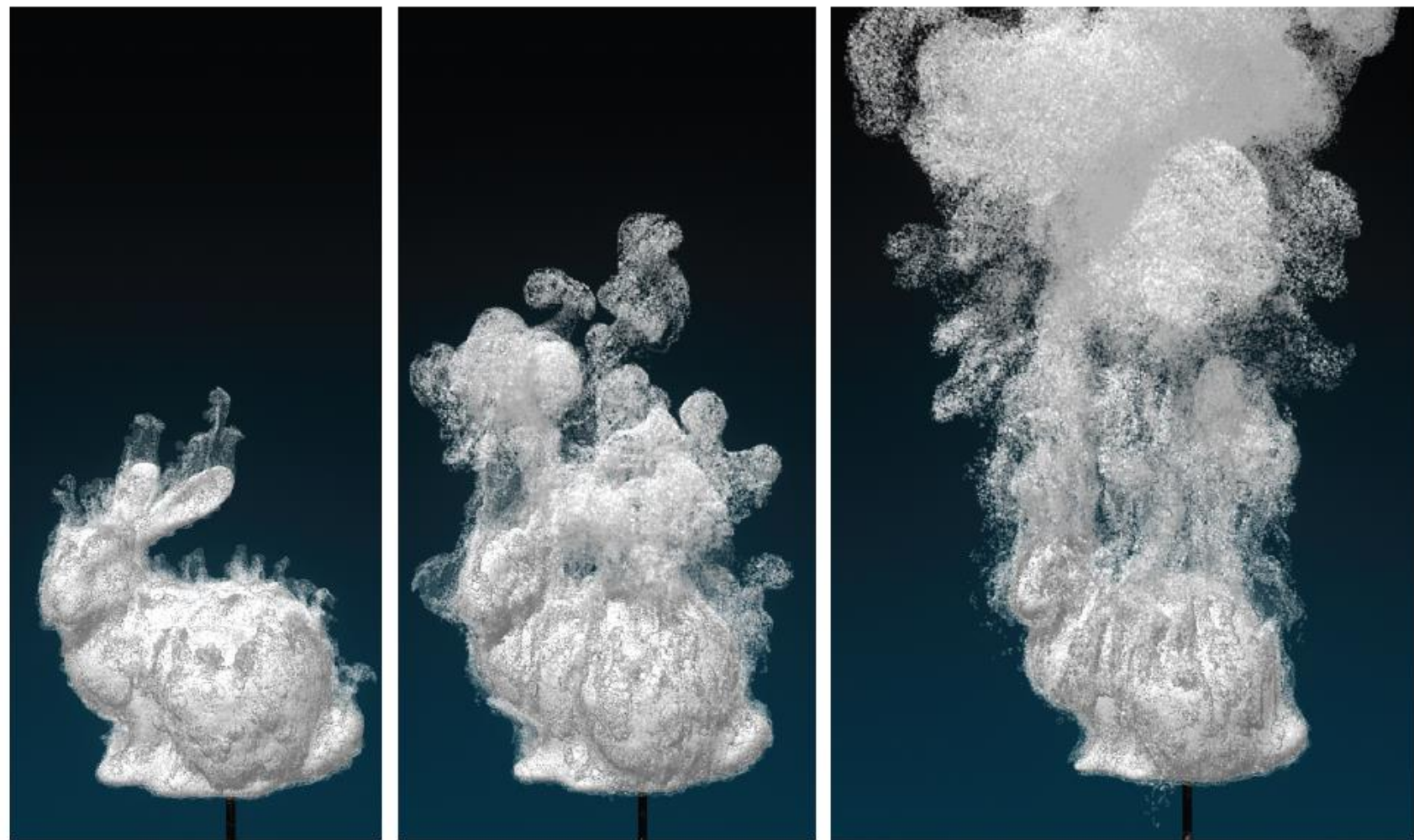
Natural Phenomena



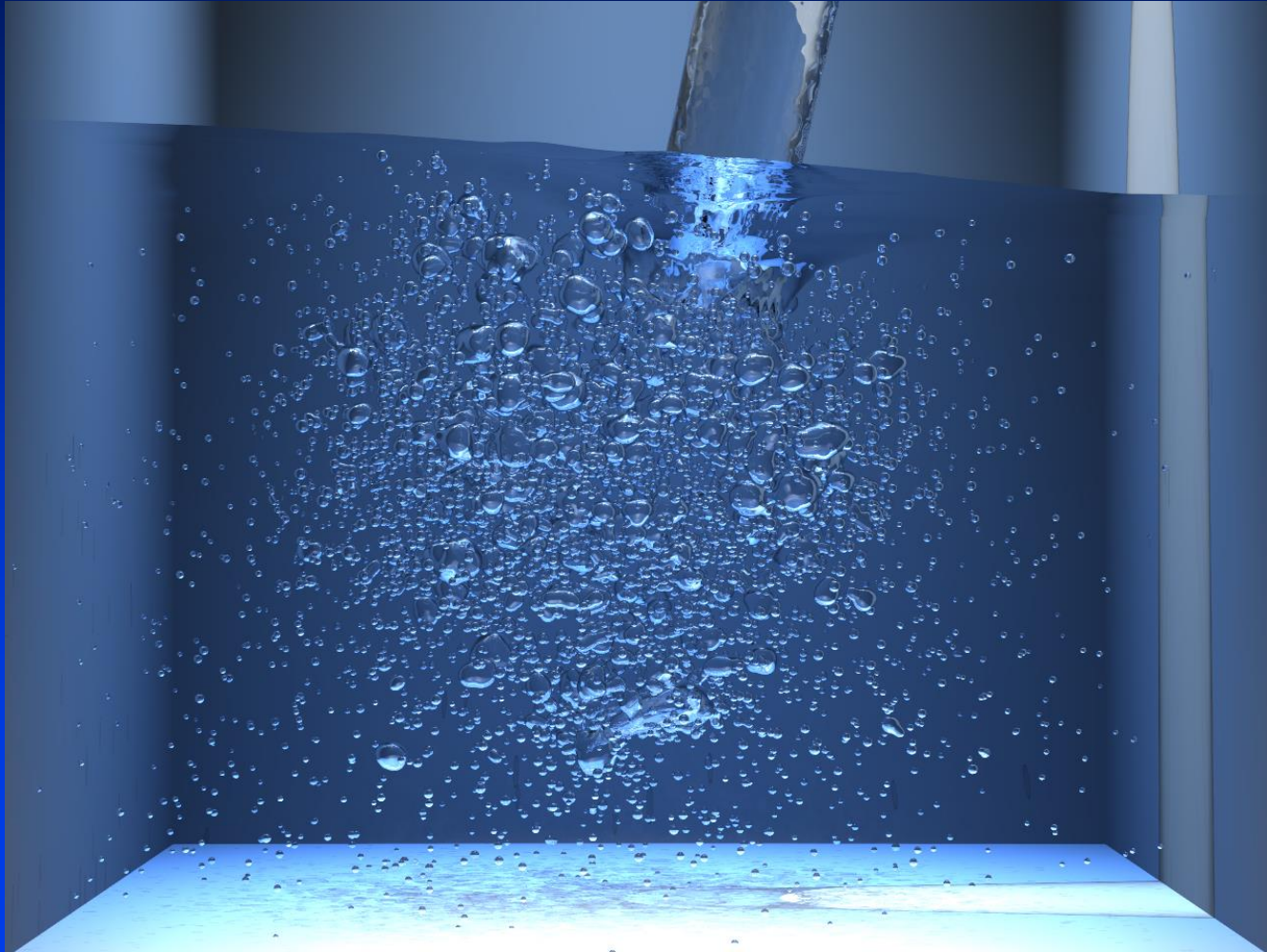
Flow Simulation (Navier-Stokes Equation)



Simulation of Bubble Flow

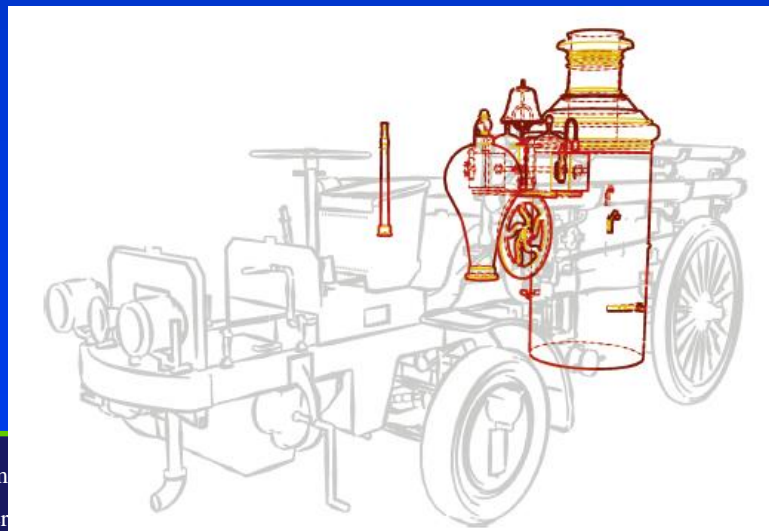
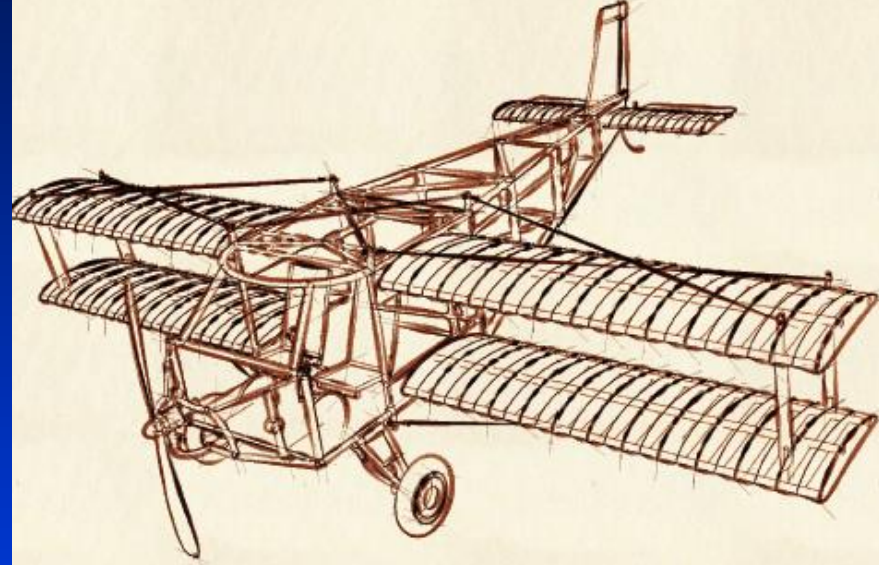


Simulating Water Bubbles

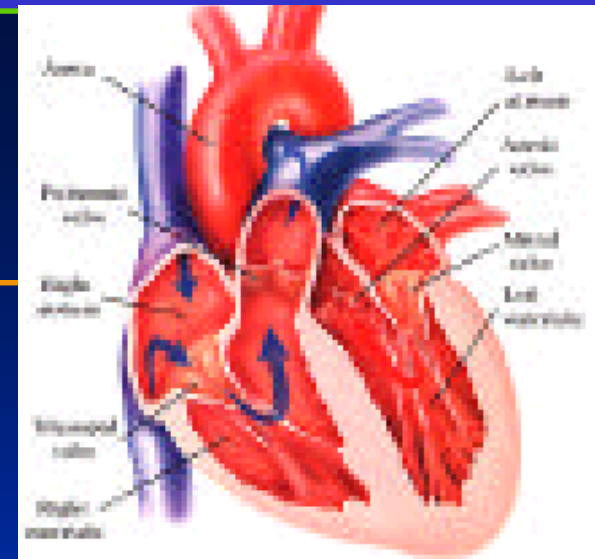


Other Topics

Non-Photorealistic Rendering



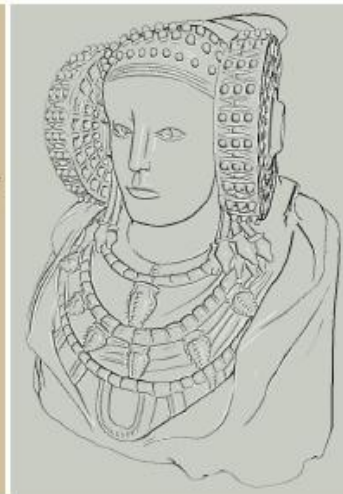
NPR



Computer Art



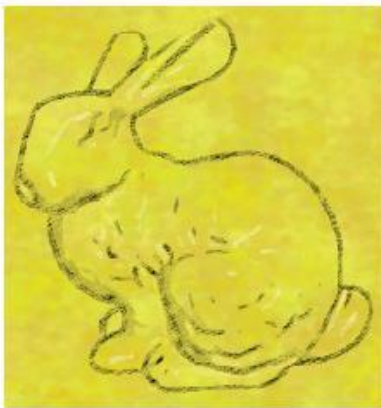
(a) Hebe, David, and Athena



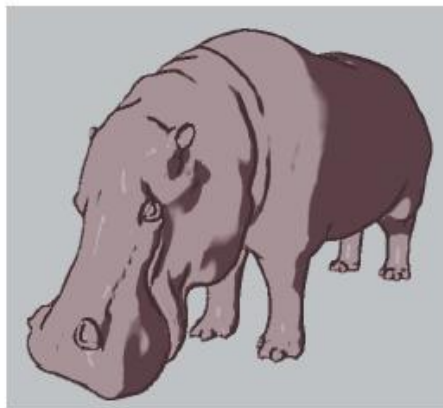
(b) Dama



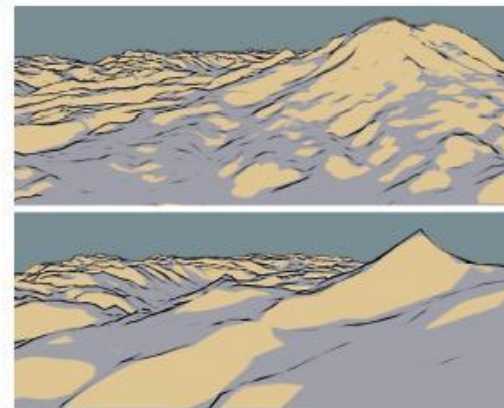
(c) Horse



(d) Bunny

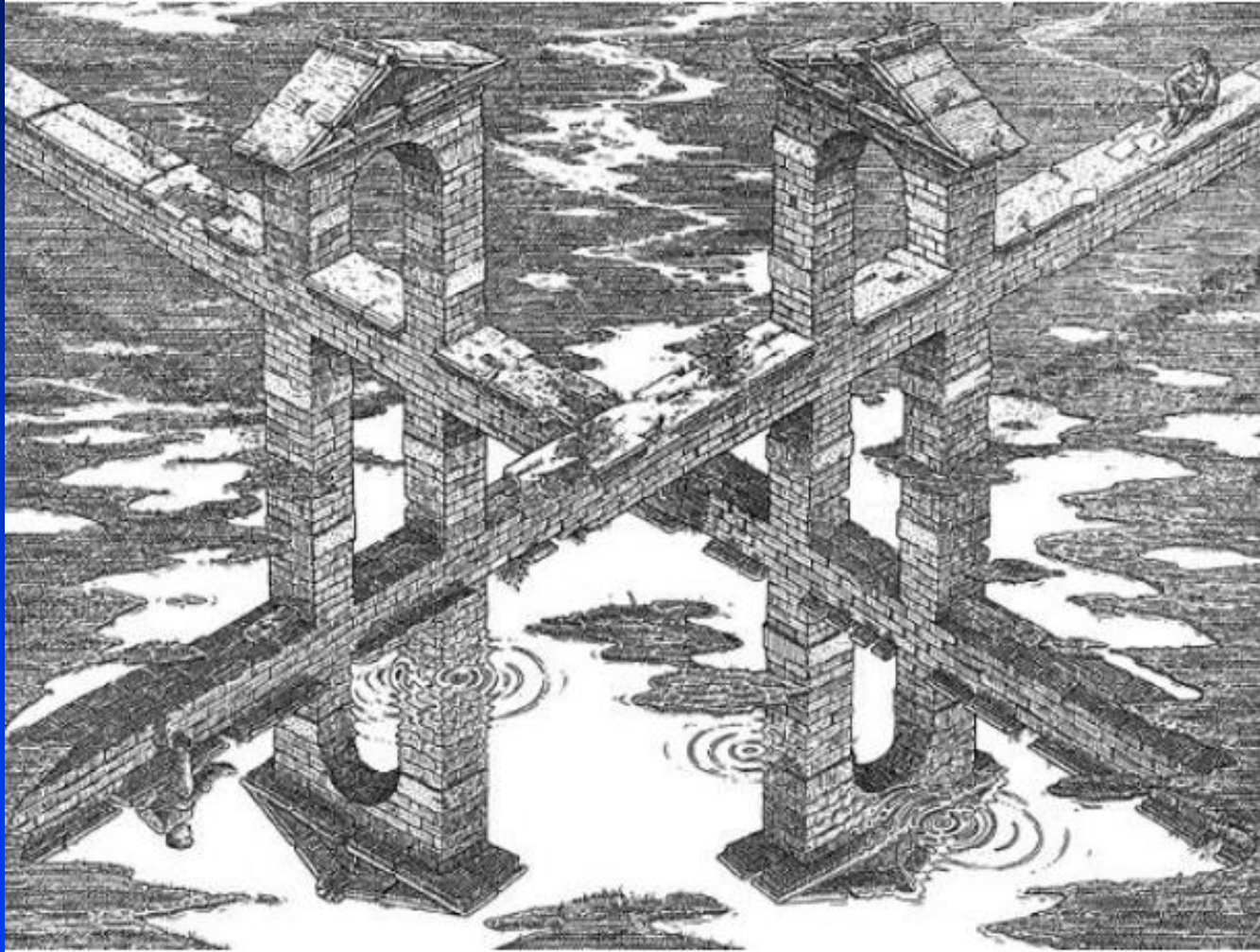


(e) Hippo

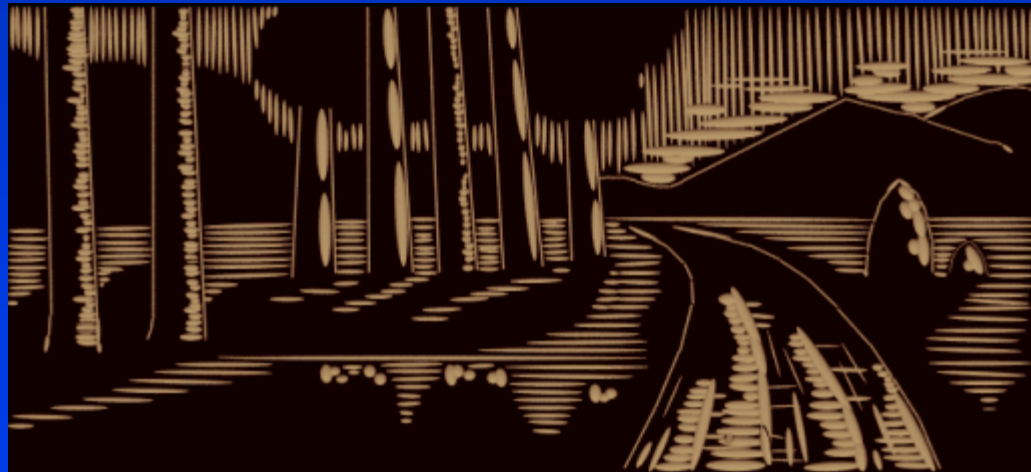
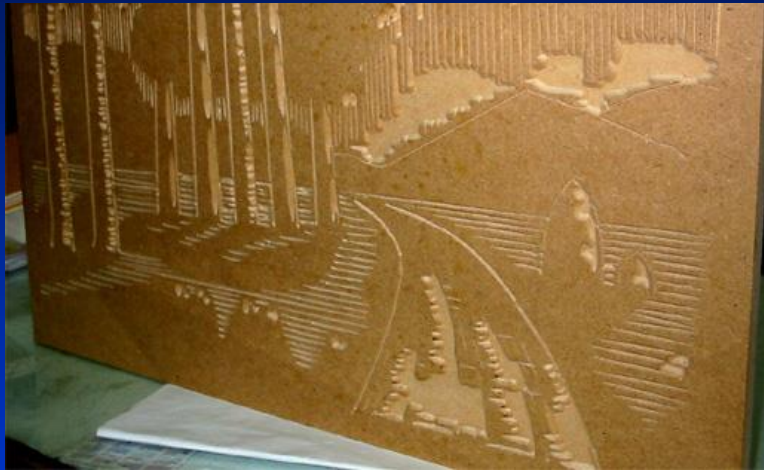


(f) Zoom-in/out of landscape

Impossible Figures



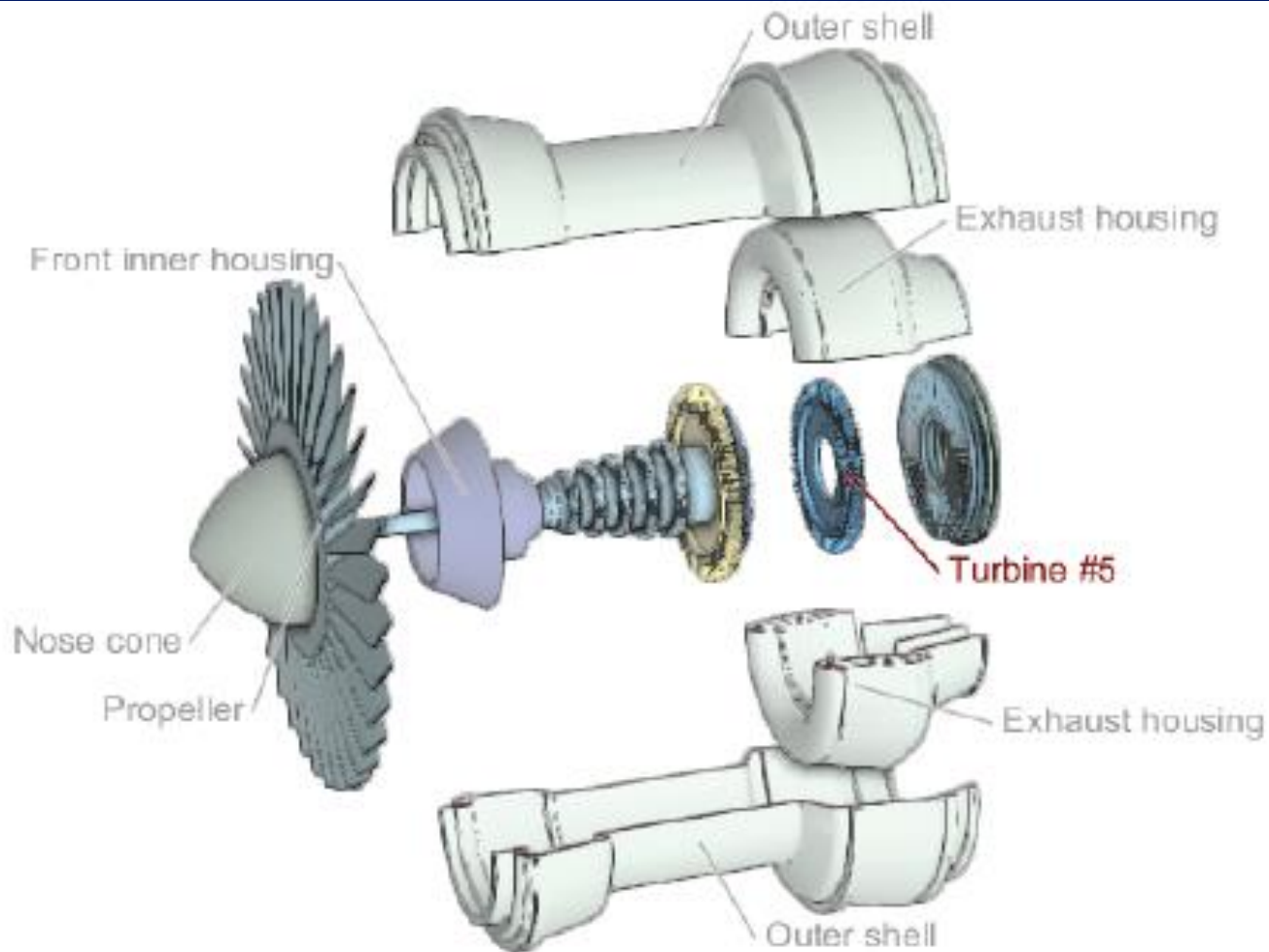
Computer Art with Physical Interface



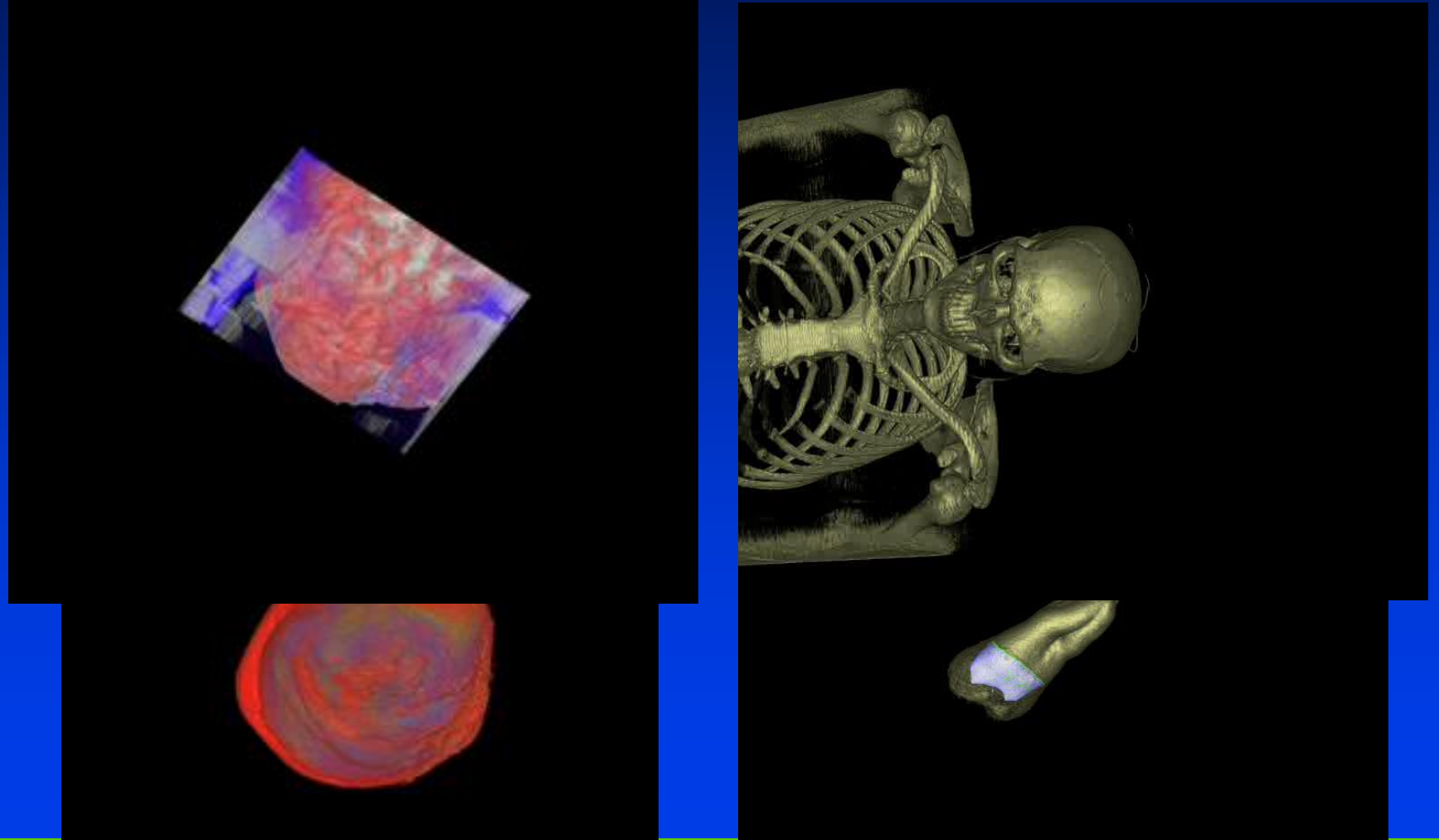
Generating New Models from Examples



Exploded View Diagram

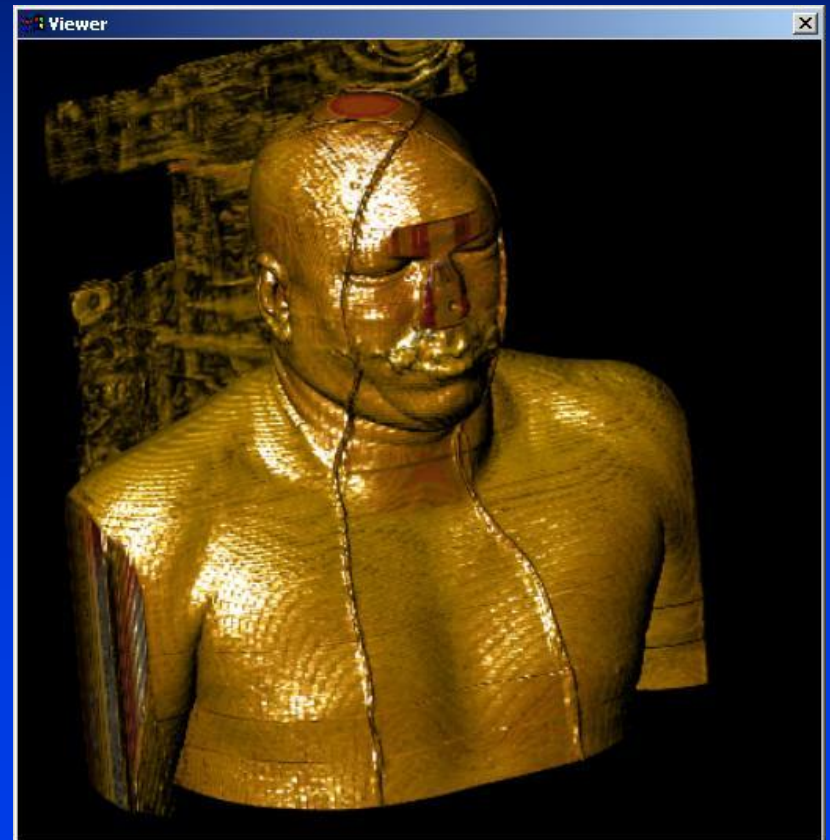
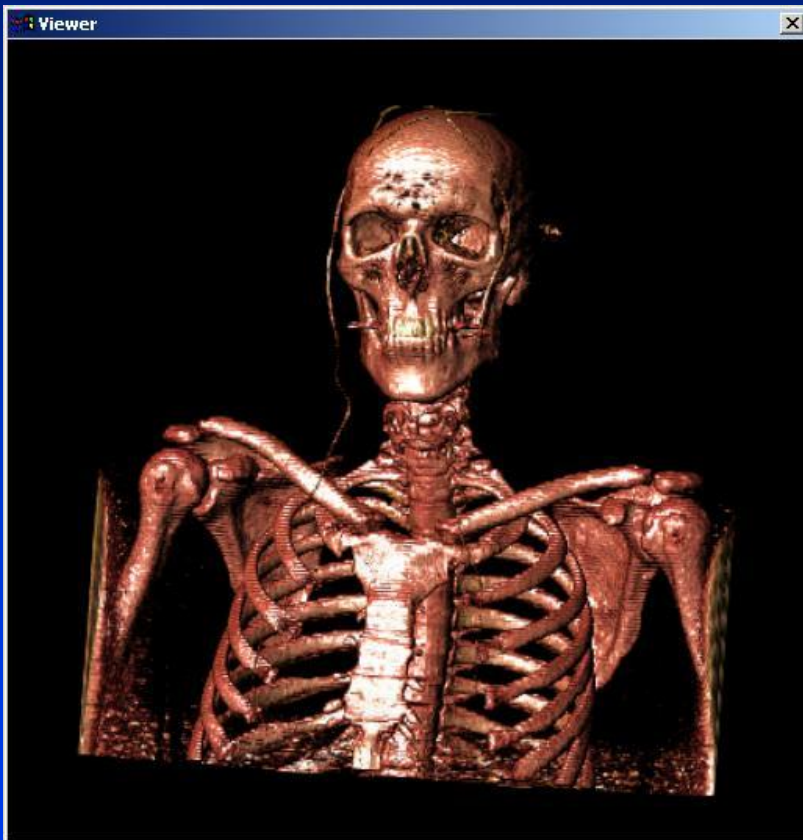


Volume Rendering

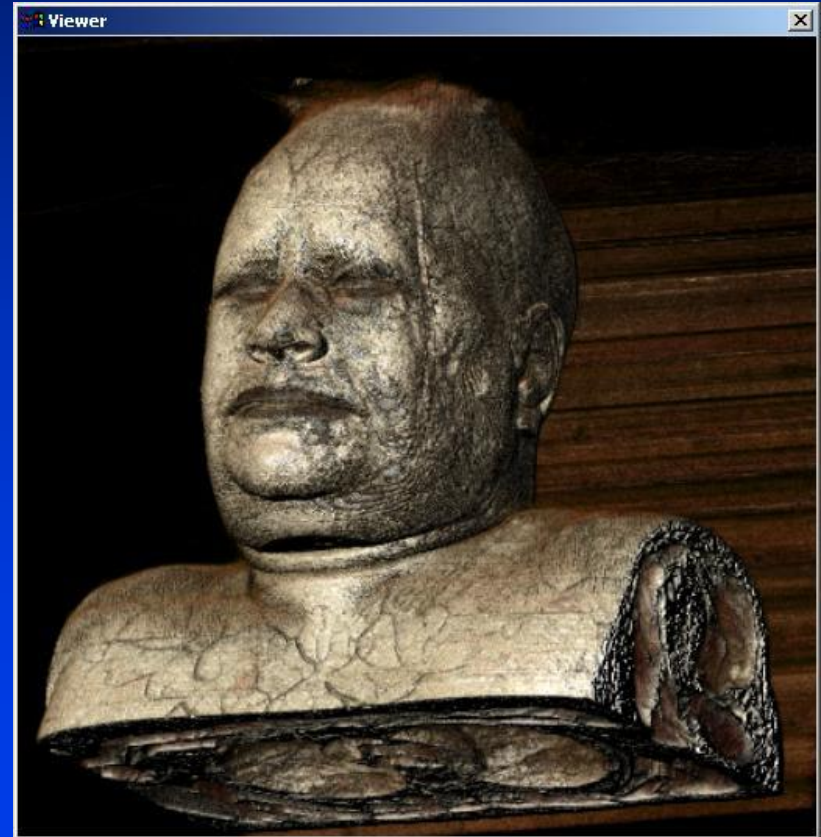
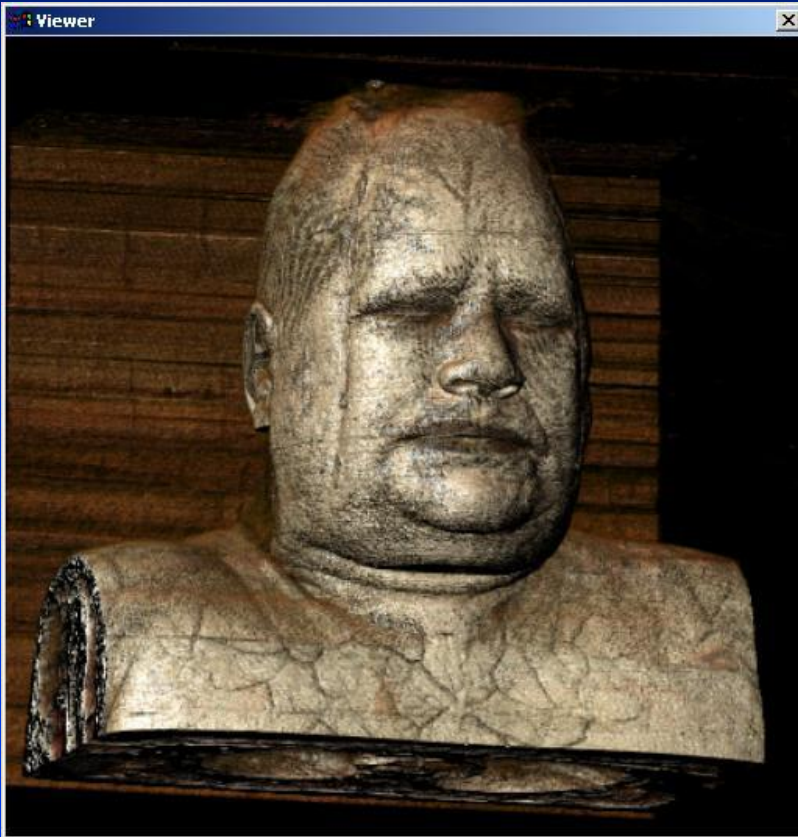




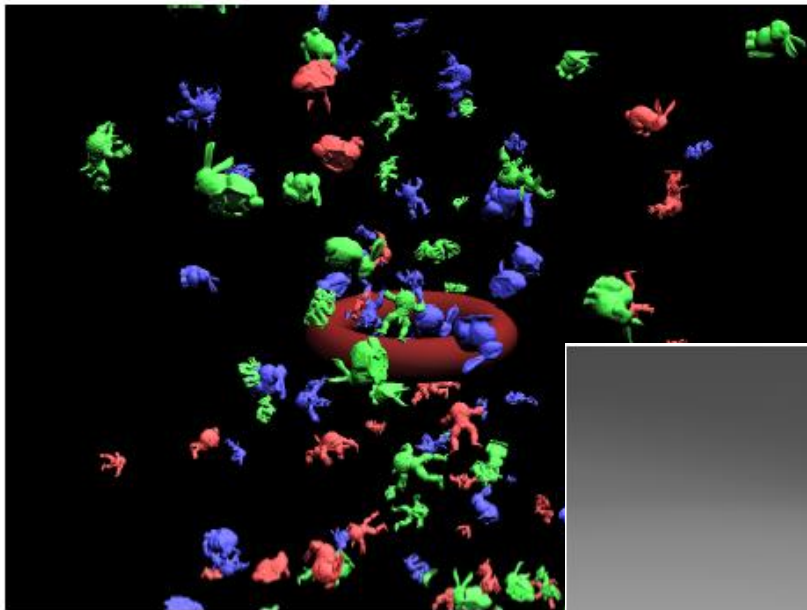
Visible Human Dataset (Male)



Visible Human Dataset (Female)

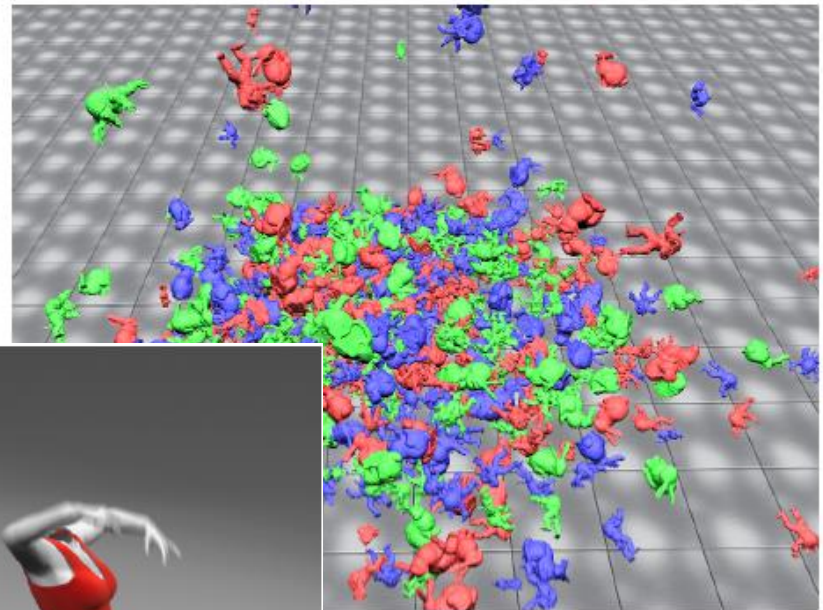


Collision Handling



(a)

Figure 5: Screenshots of



(b)

) Plane Simulation.



Urban Modeling



Flow Simulation

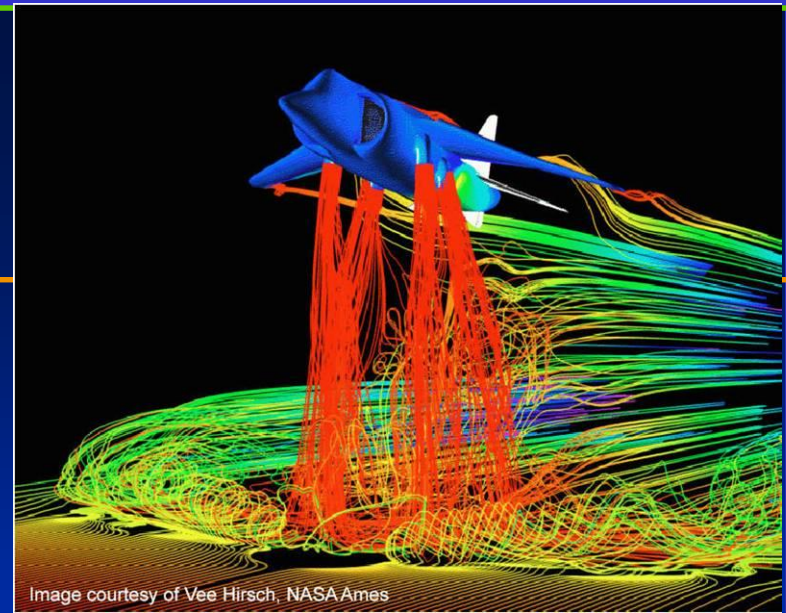
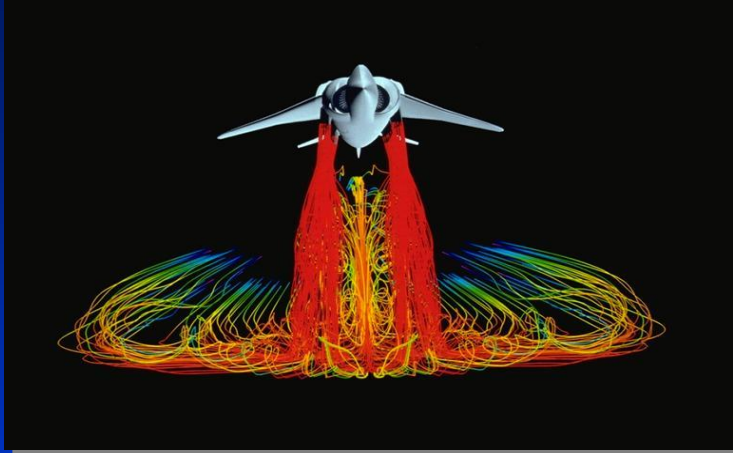
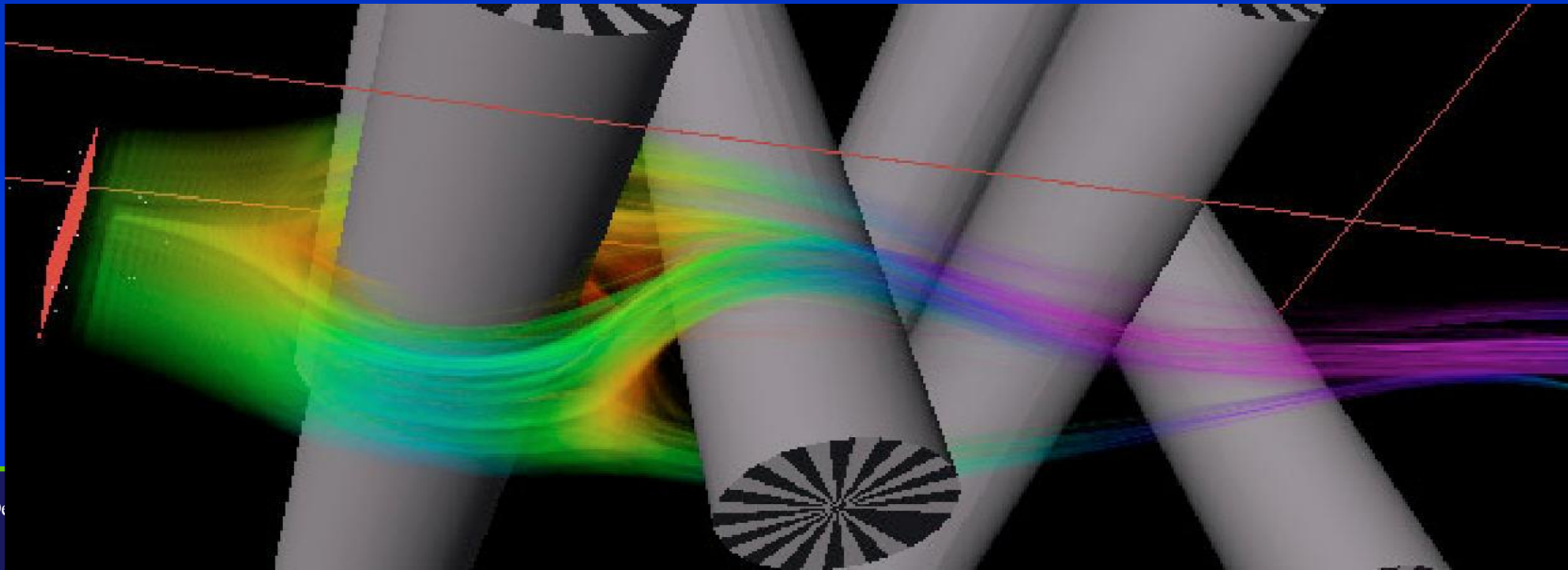


Image courtesy of Vee Hirsch, NASA Ames



Light Transport



Augmented Reality in Neurosurgery

