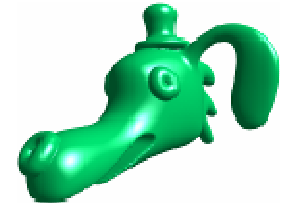

Sketch-Based Modeling with the BlobTree

Ryan Schmidt, Brian Wyvill, Mario Costa Sousa

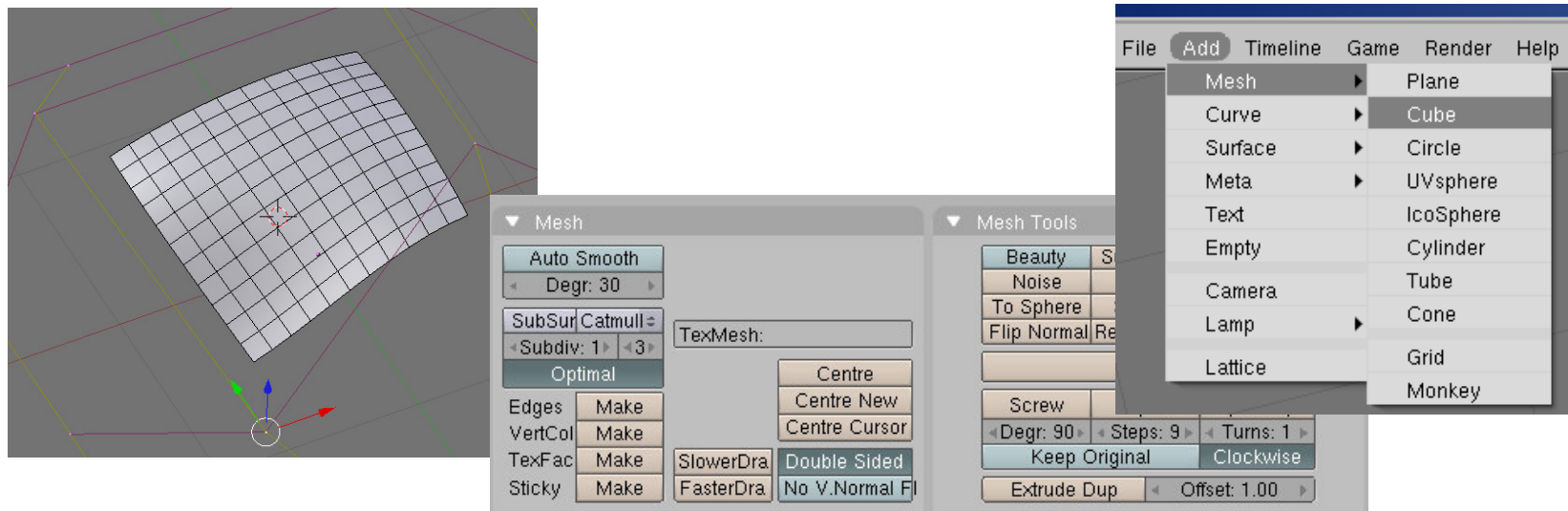
University of Calgary

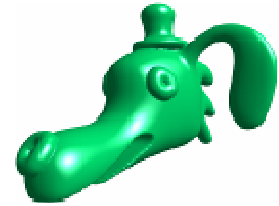
Canada

Motivation



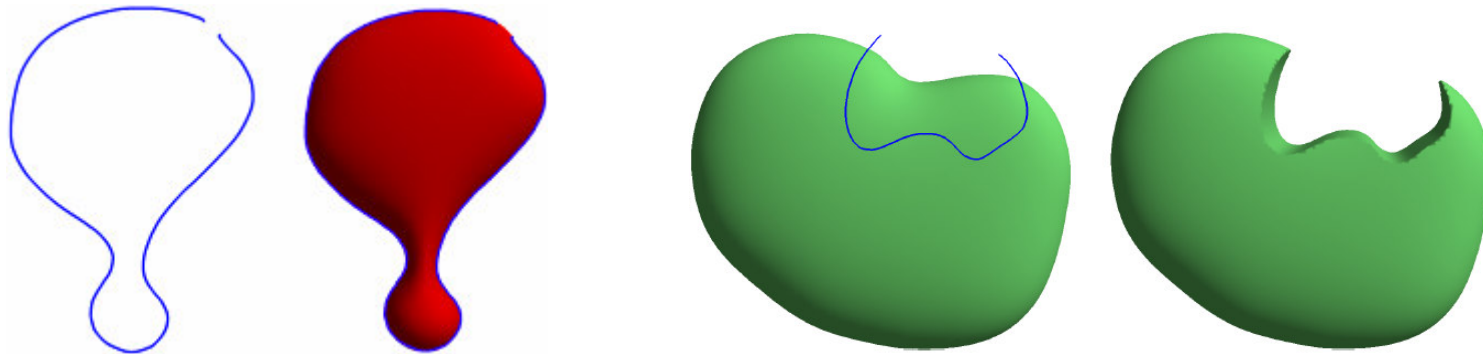
- Current 3D modeling interfaces are not suitable in early design stages
 - Very time-consuming compared to a pencil



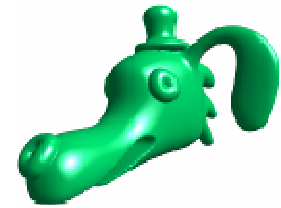


Motivation

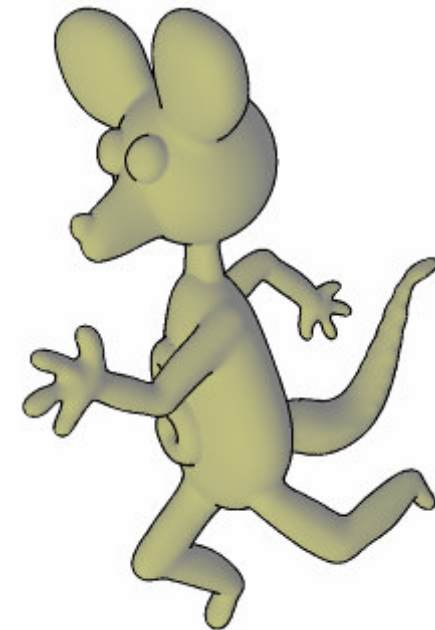
- Simplify modeling interface by leveraging designers existing drawing skills
 - Create 3D shapes using 2D sketches
 - Edit models using 2D sketches



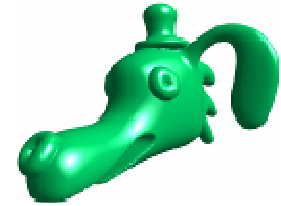
ShapeShop



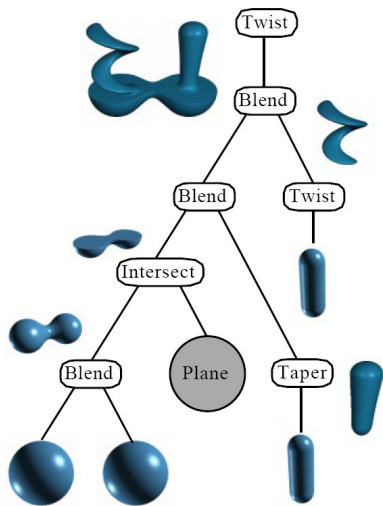
- Build on ideas from SKETCH [Zelevnik et al 96], Teddy [Igarashi et al 99], GiDES++ [Jorge et al 03]
- Use Hierarchical Implicit Volume Modeling (BlobTrees [Wyvill et al 99]) as underlying shape representation



ShapeShop



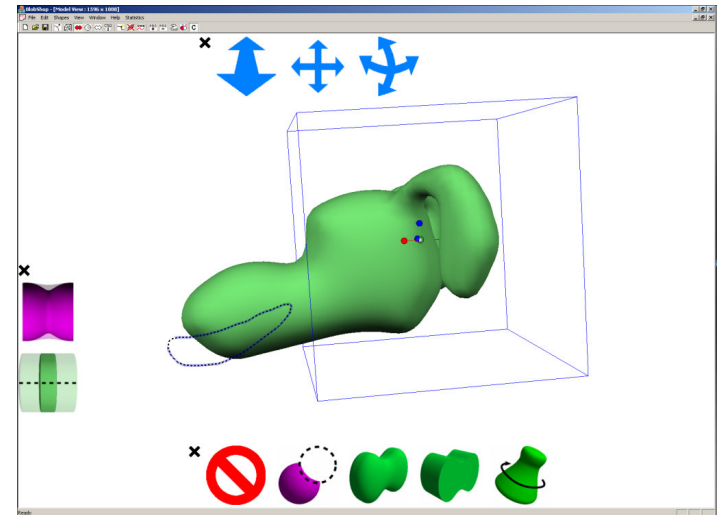
- ShapeShop is a tool for creating BlobTree models using sketches



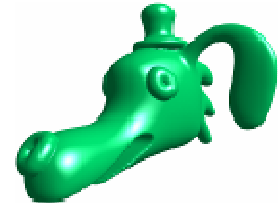
BlobTree



Sketching

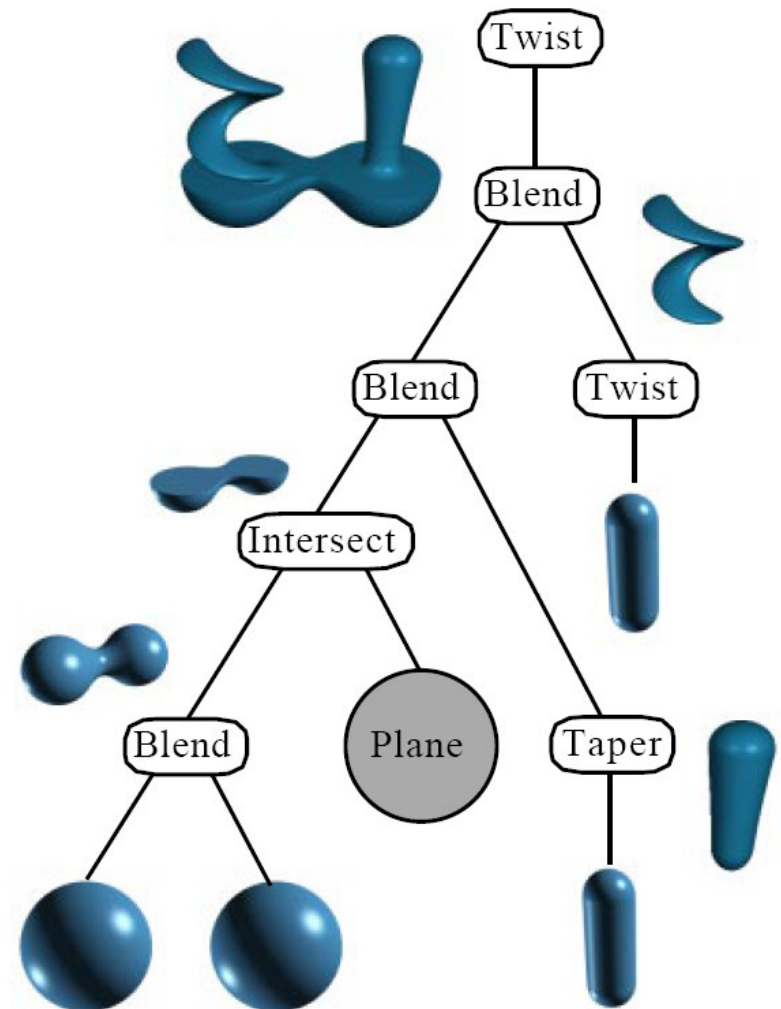


ShapeShop

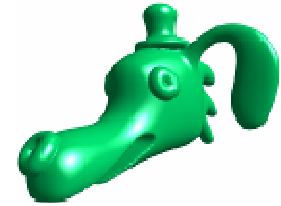


What is a BlobTree?

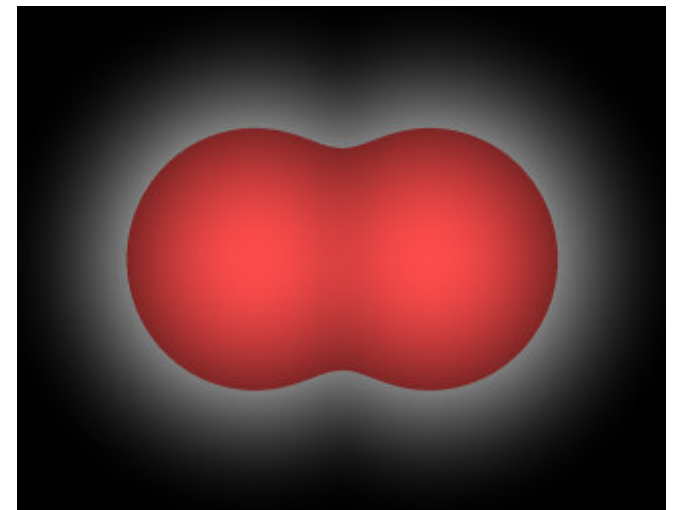
- 3D Implicit model
 - $F(\mathbf{p}) = V_{\text{iso}}$
- Like a CSG Tree with Blending, Warping, and many other operators
- Procedural definition
- Scene graph



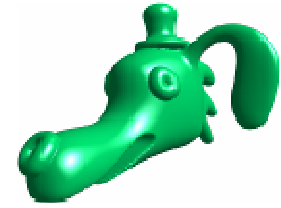
BlobTree Modeling



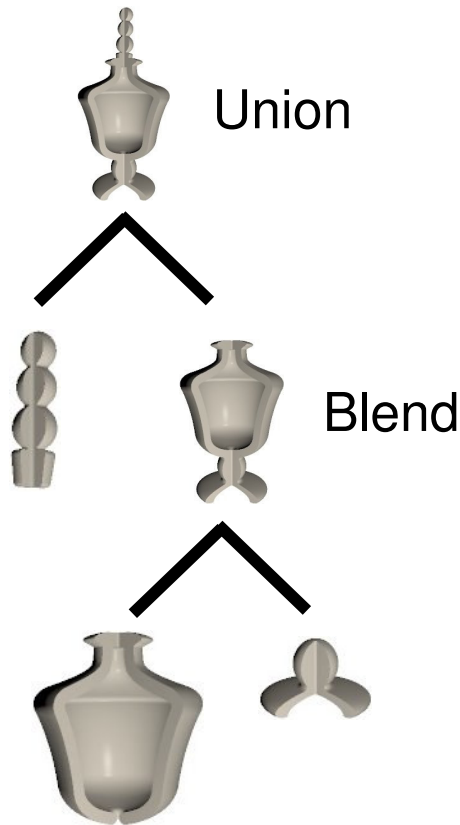
- Benefits Include:
 - Solid (Volume) Modeling
 - Shape composition is easy and robust
 - BlobTree is a **full construction history** and can be animated
- Underlying scalar fields $F(\mathbf{p})$ have *local influence*



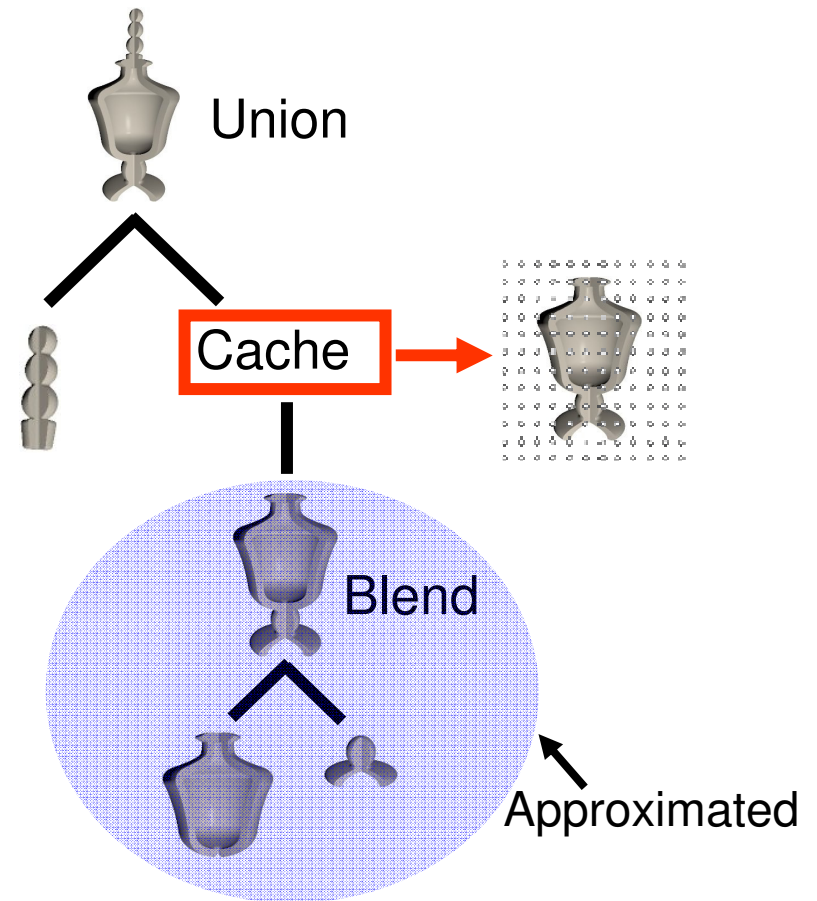
Hierarchical Spatial Caching



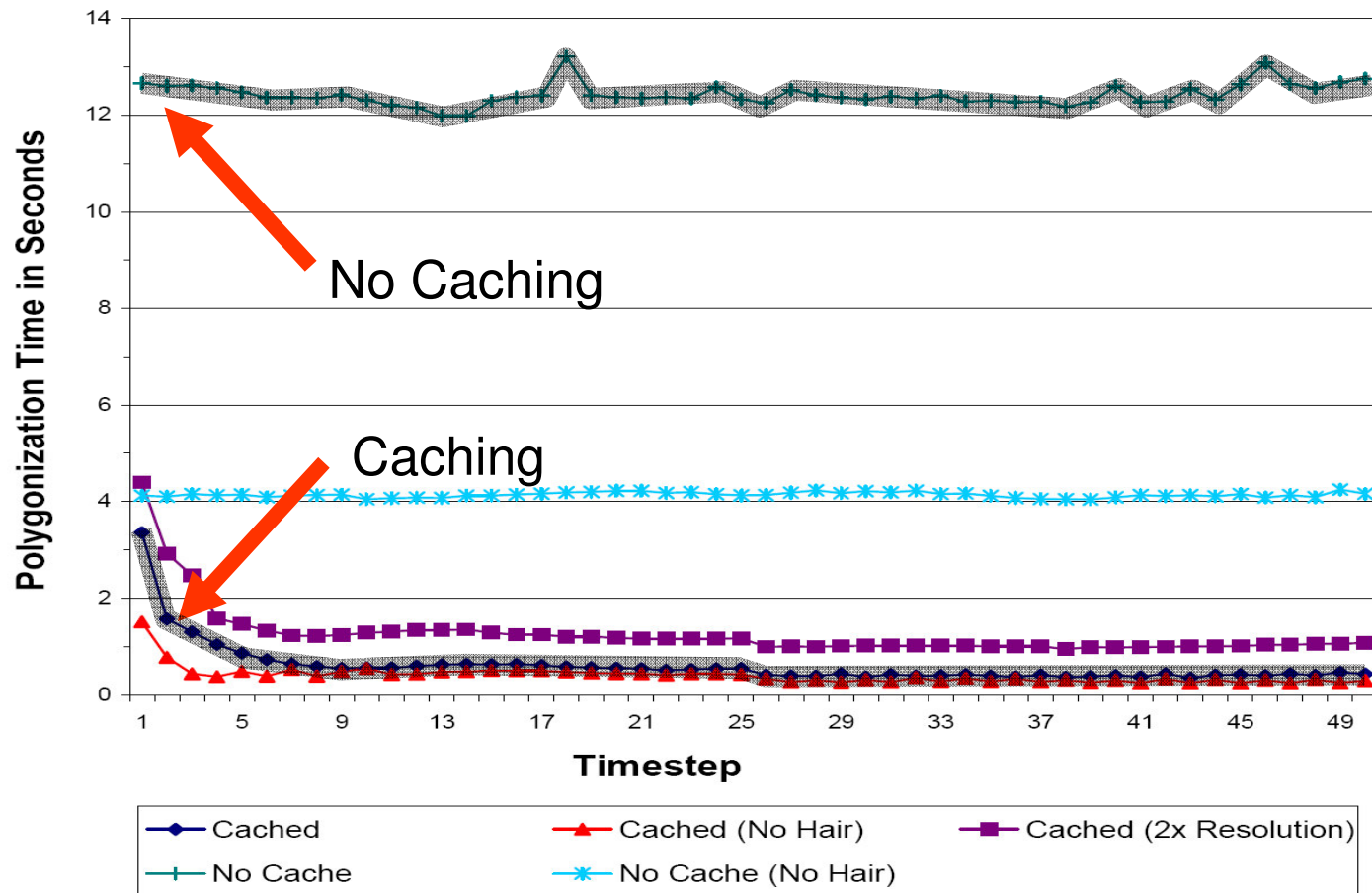
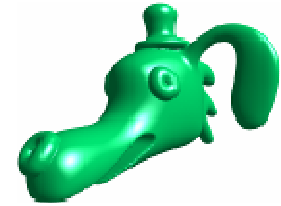
Standard BlobTree



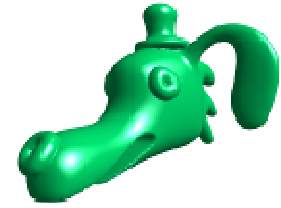
BlobTree with Cache



Caching Evaluation



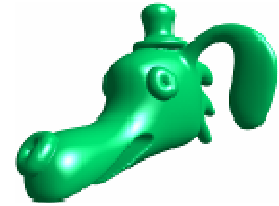
ShapeShop



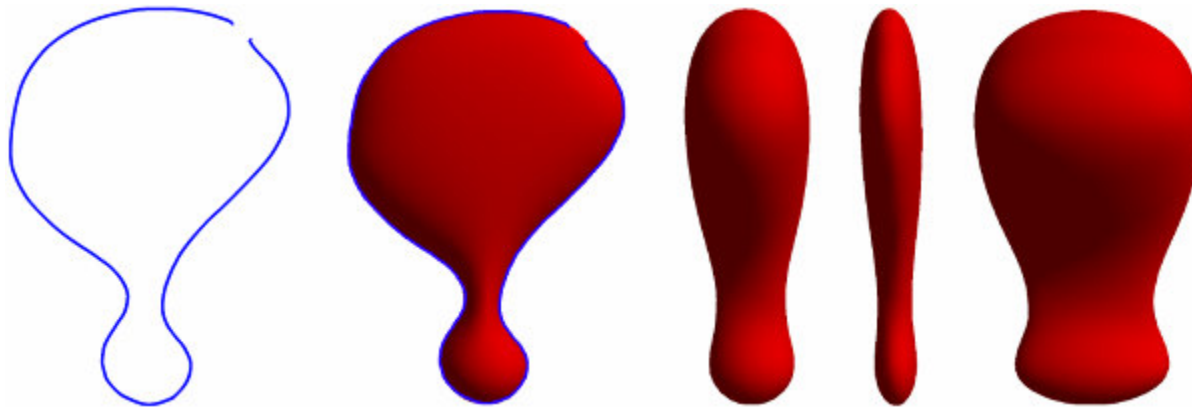
- “Free-Form” Sketch-Based Modeling
 - Largely in the style of Teddy
 - Integrated with CAD-style BlobTree modeler
- Non-modal sketching interface
 - No mouse buttons (“Clickless”)



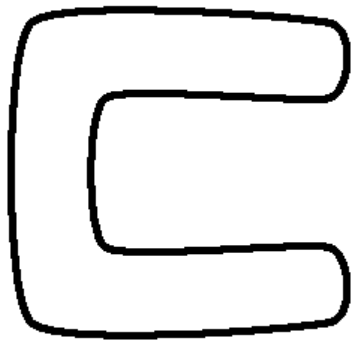
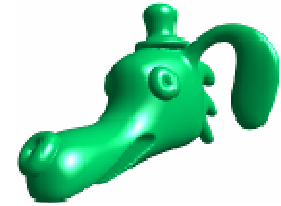
“Blobby” Inflation



- Mimic inflation technique of Teddy
 - Based on smooth distance field approximation
- Width variation generated by falloff function



Distance Field Approximation



Initial
Curve

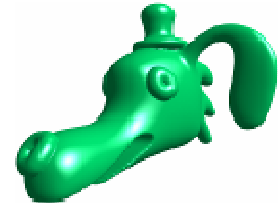


Exact Distance Field
(C^1 Discontinuities)



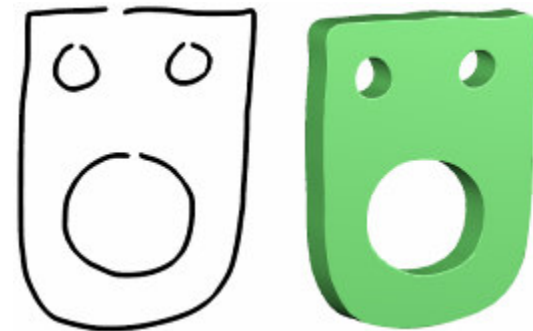
C^2 Smooth Distance
Field Approximation

Sweep Surfaces



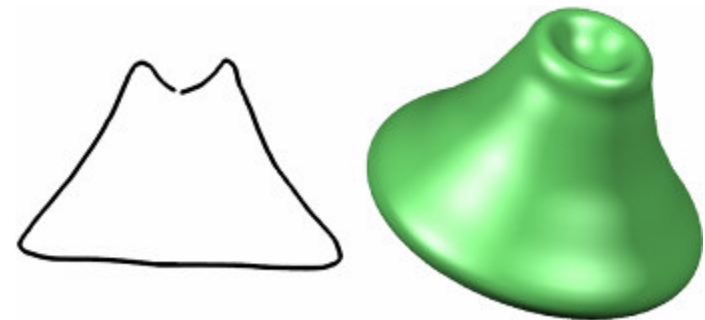
- Linear Sweeps

- Flat endcaps
- Rounded or sharp edge

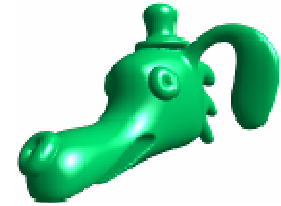


- Surfaces of Revolution

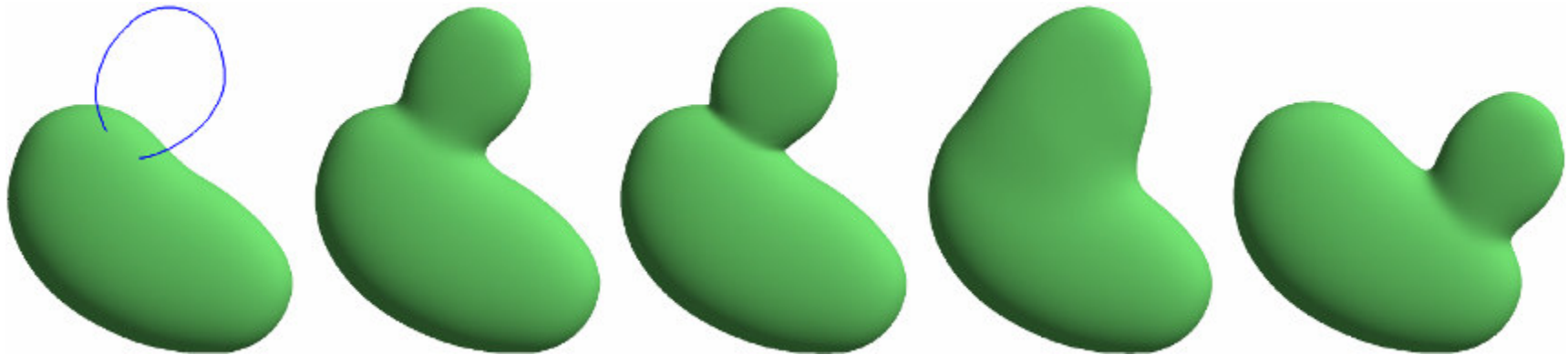
- Toroidal or Spherical
- Interior Holes

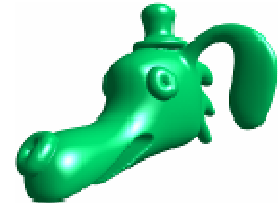


Blending



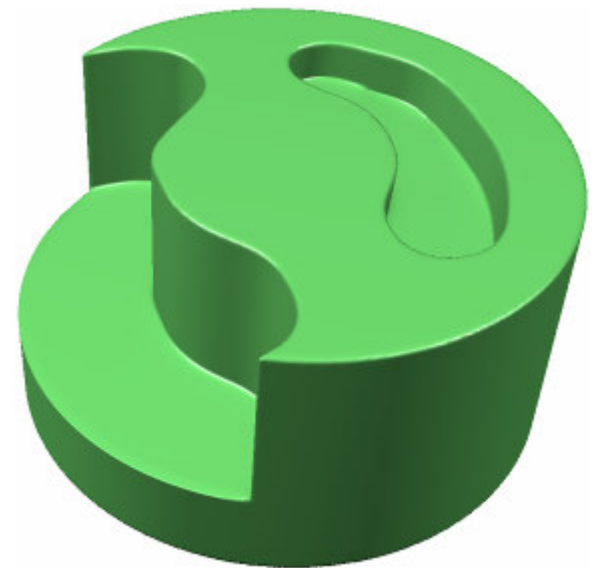
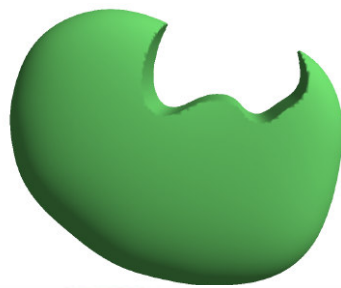
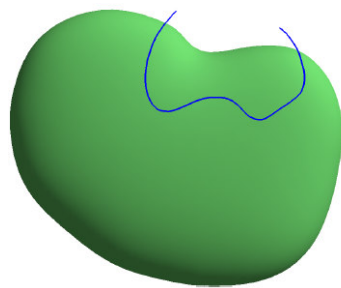
- Parameterized Blending Operator
- Blend surface is recomputed interactively

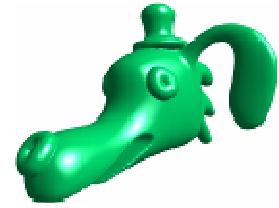




Cutting

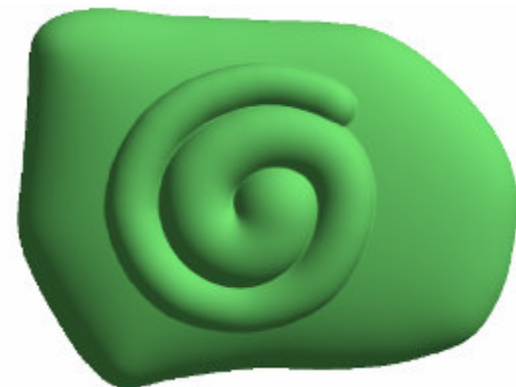
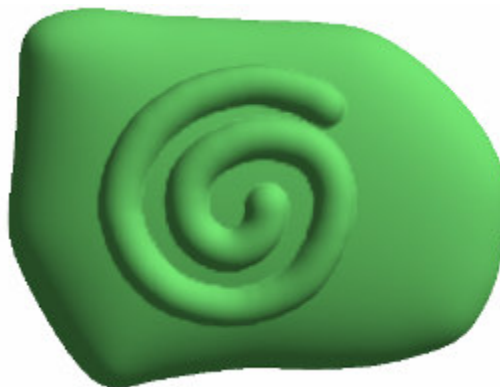
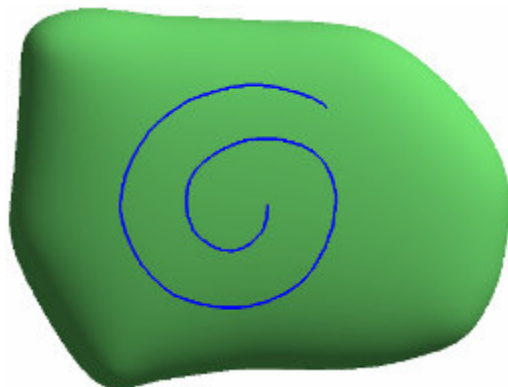
- CSG Subtraction with a linear sweep
- Interactively manipulate hole by manipulating sweep



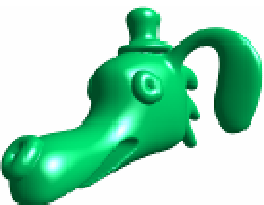


Surface Drawing

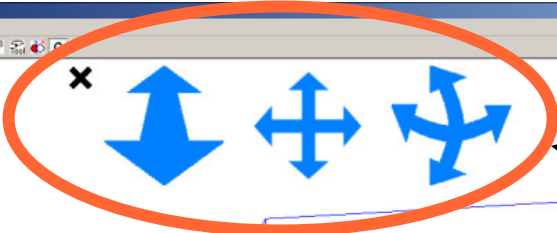
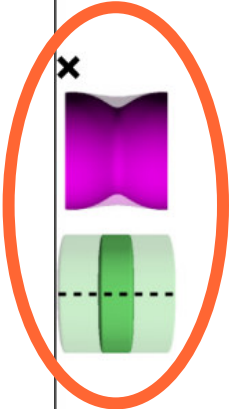
- Find polyline on surface with ray intersection
- Add new primitives
- Entire stroke can be removed at any time



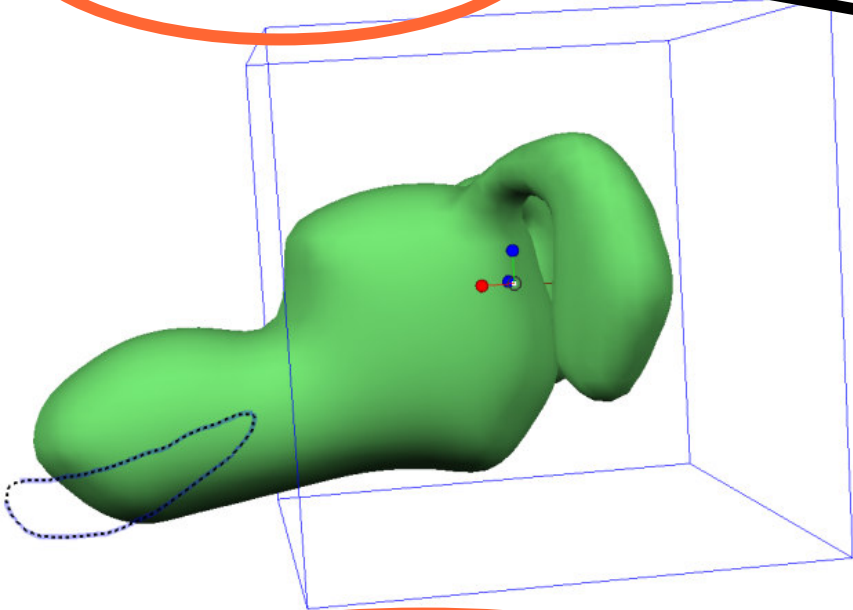
Sketching Interface



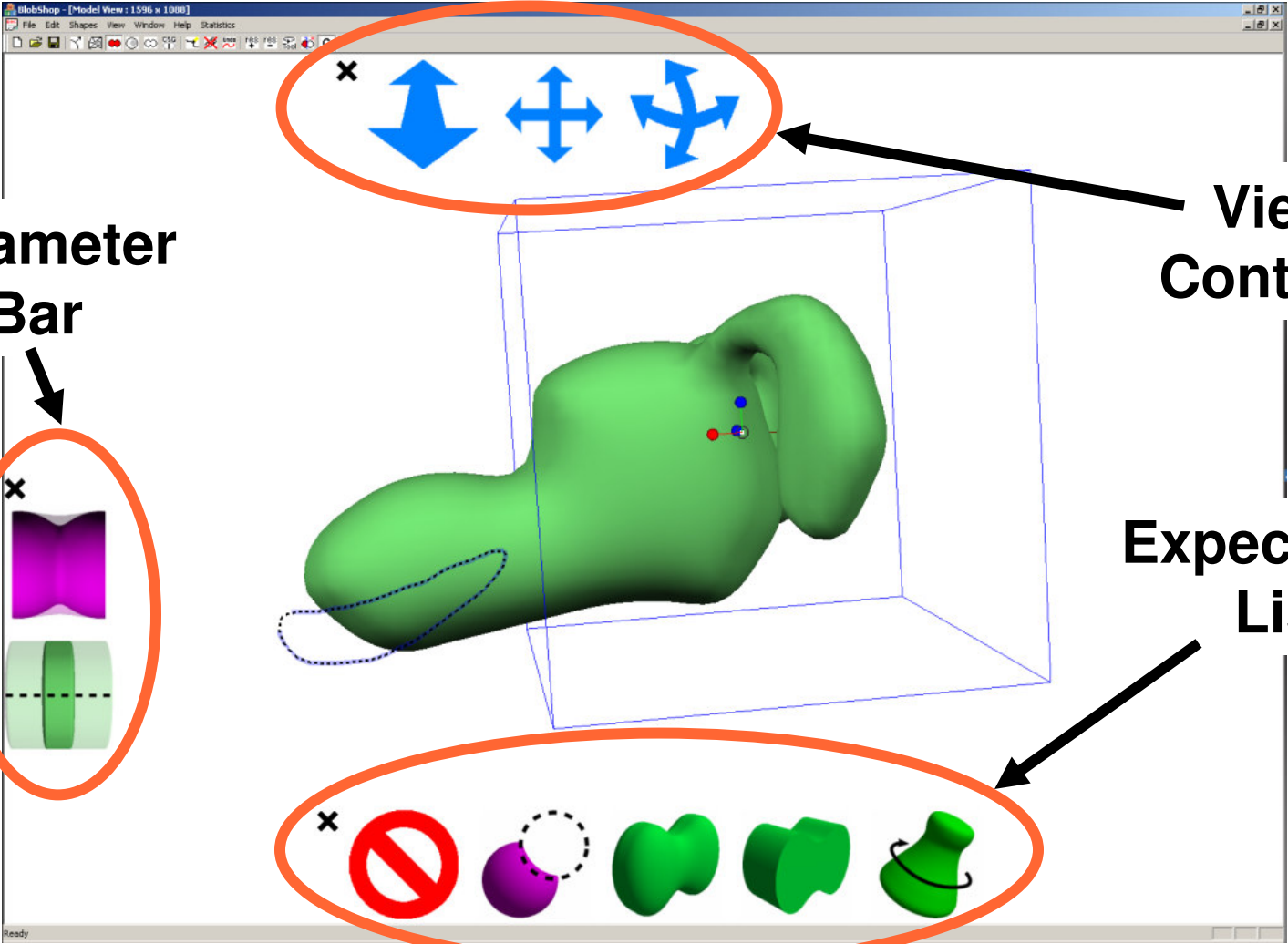
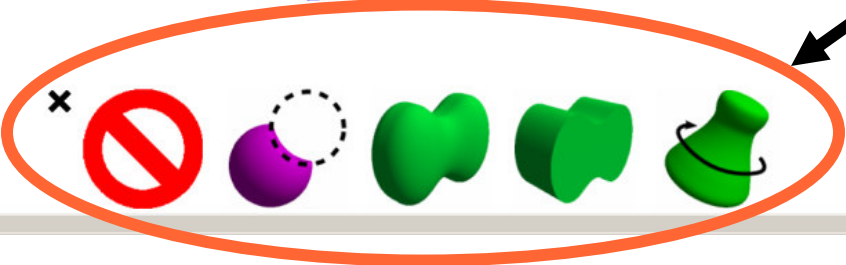
Parameter Bar



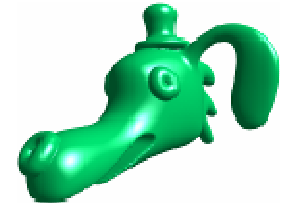
View Controls



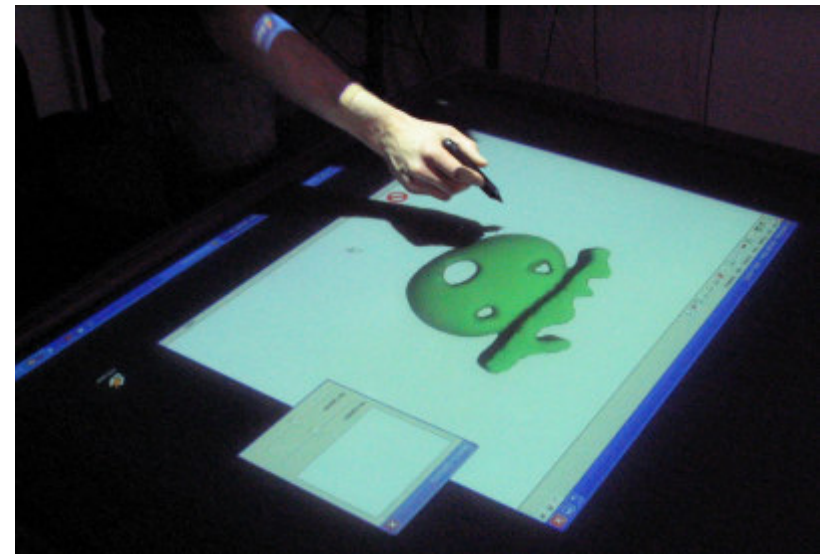
Expectation List

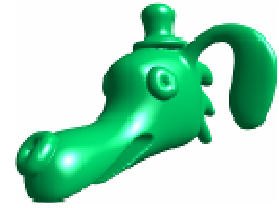


Interaction Design



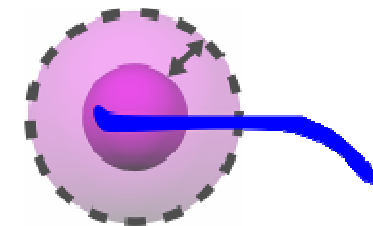
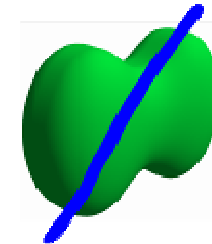
- Sketching interface is Non-Modal
 - No Mouse Buttons or Keyboards
- Pencils have no buttons
- Large display input systems are often non-modal (SmartBoard, etc)



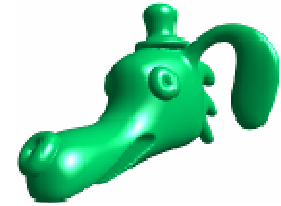


Non-Modal Widgets

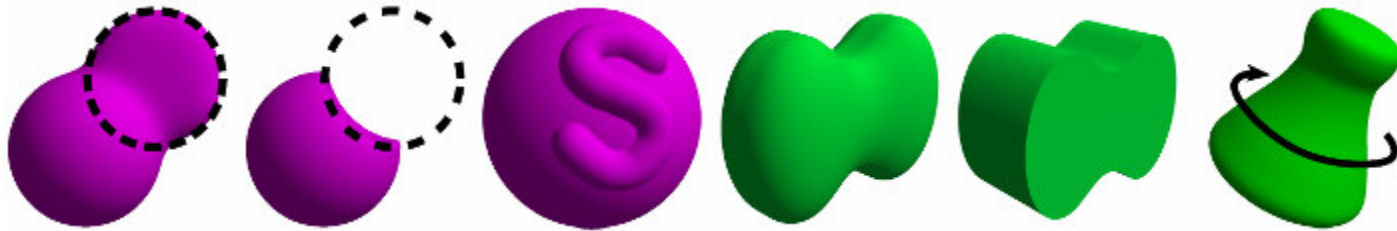
- Pure gesture interface is challenging
 - Complex gestures, sketch/gesture collision
- Adapt ideas from CrossY [Apitz et al, UIST 04]
- Crossing for button selection
- Capture-Drag for changing continuous values



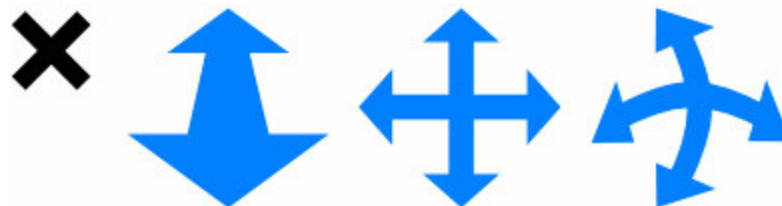
Model Interaction

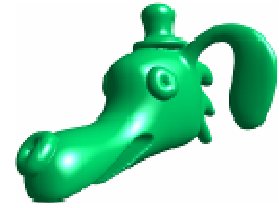


- Expectation List



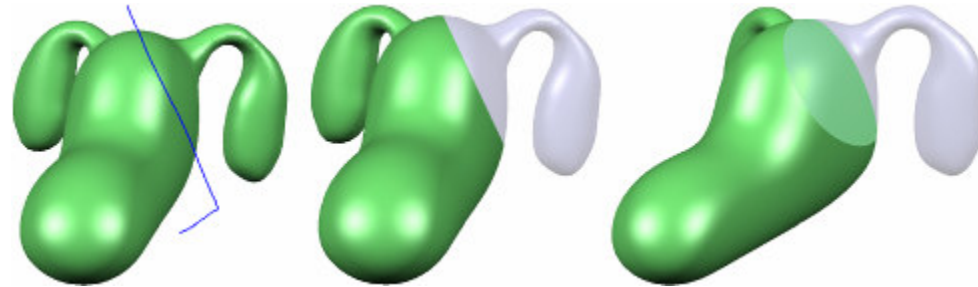
- View Control Toolbar



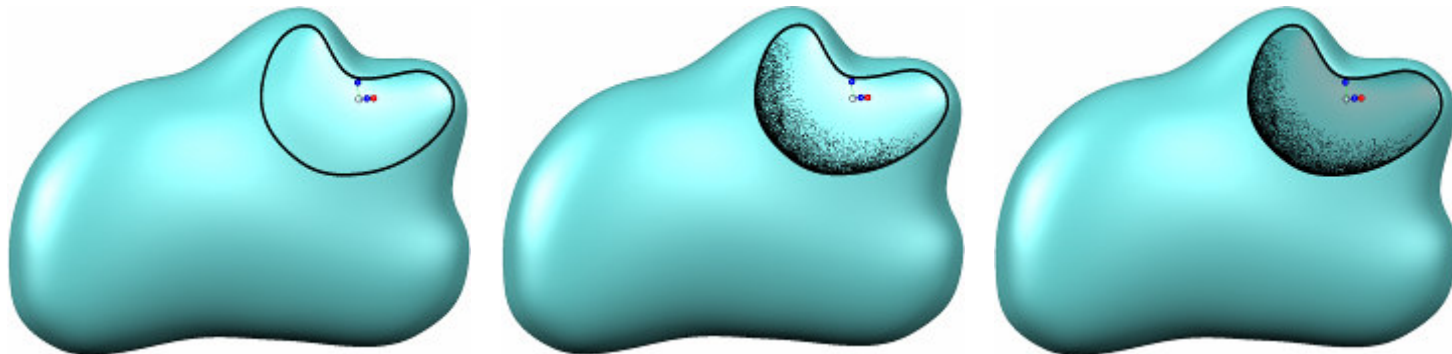


Visualization Assistance

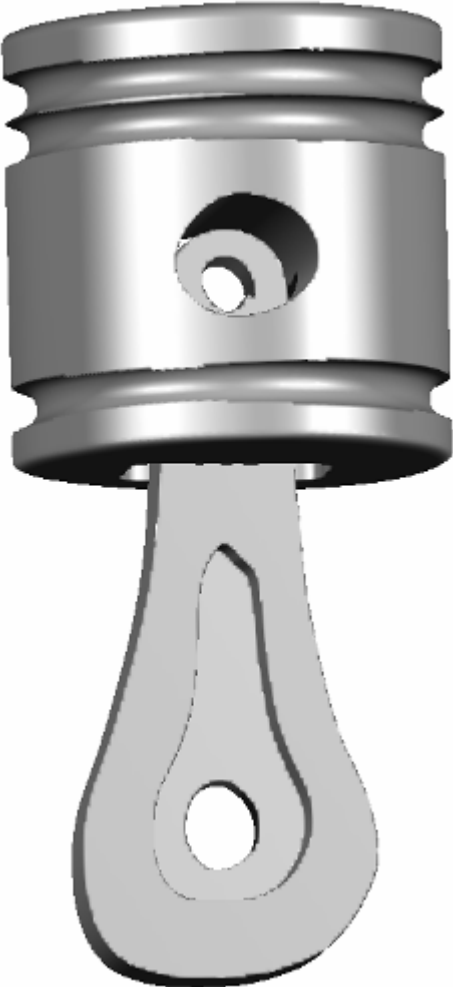
- Dynamic Clipping



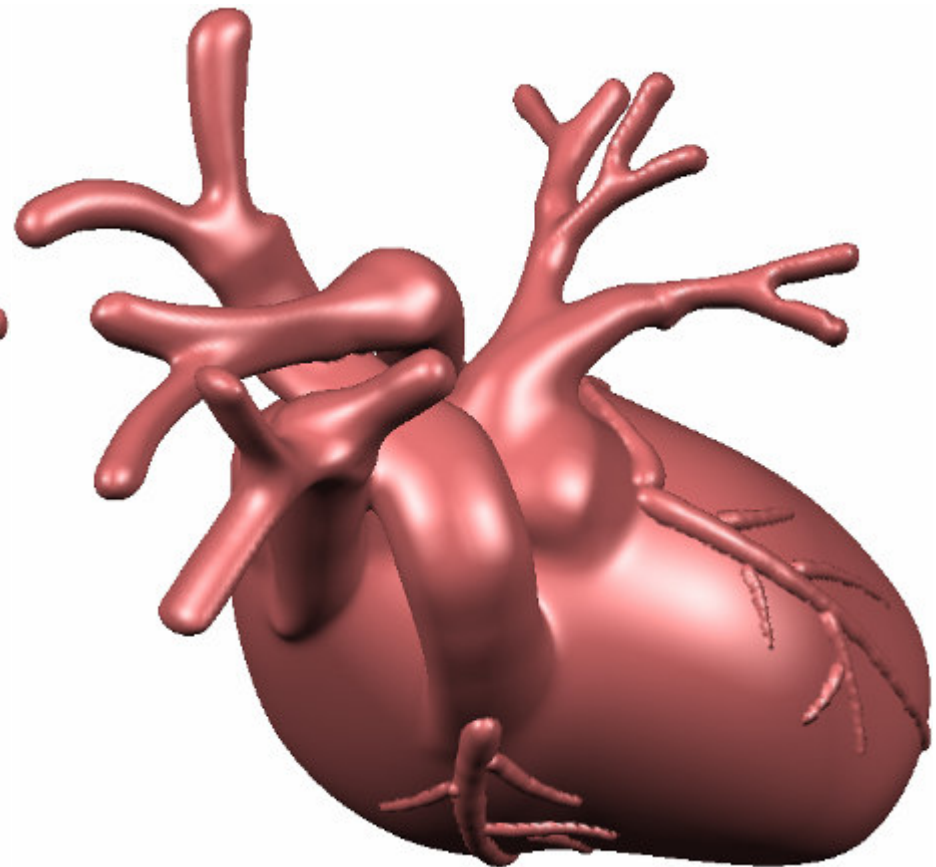
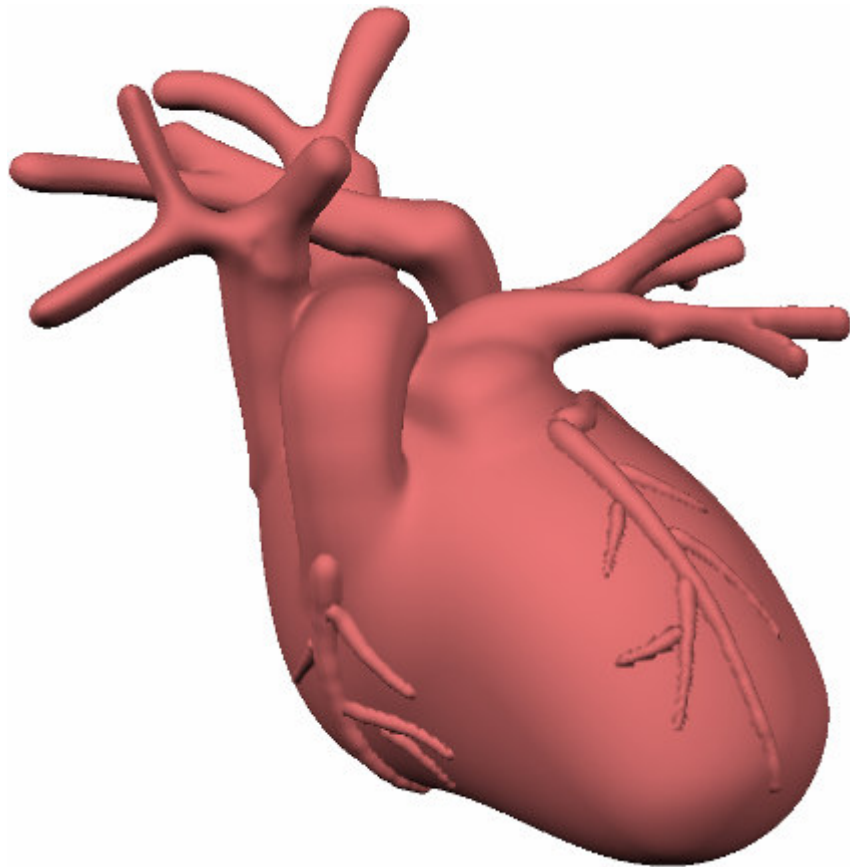
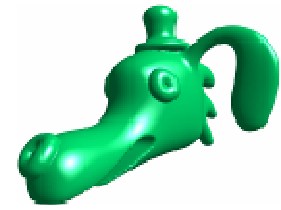
- Internal Volume Visualization



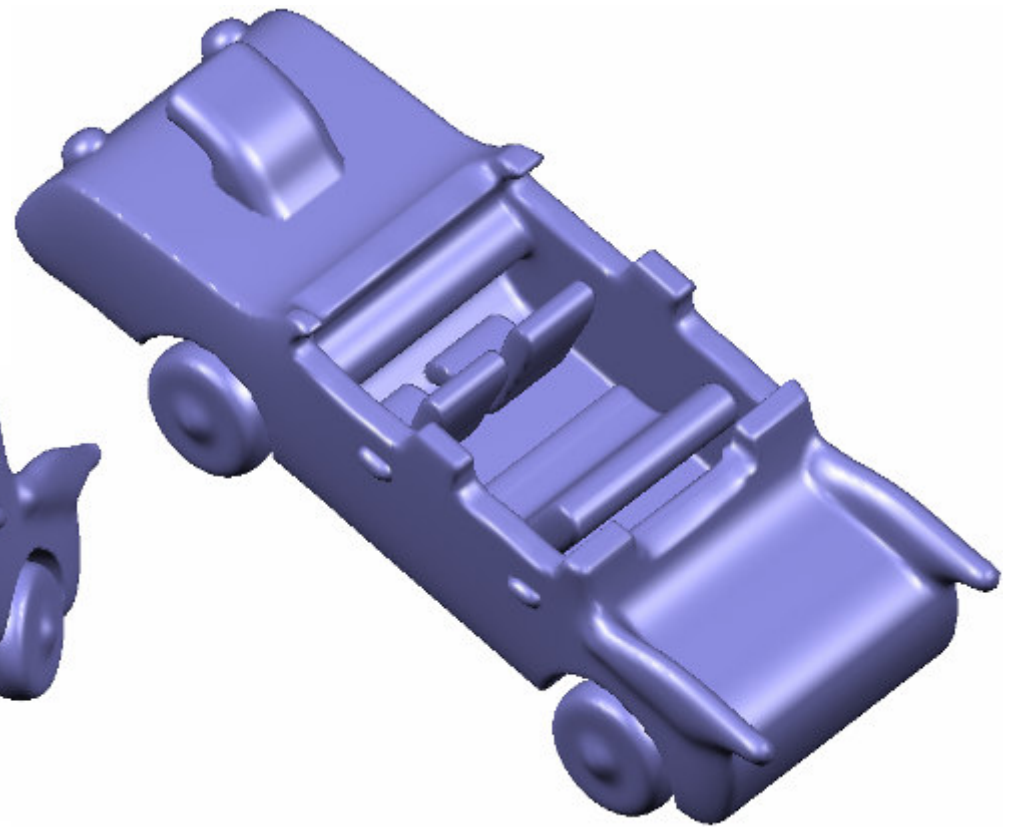
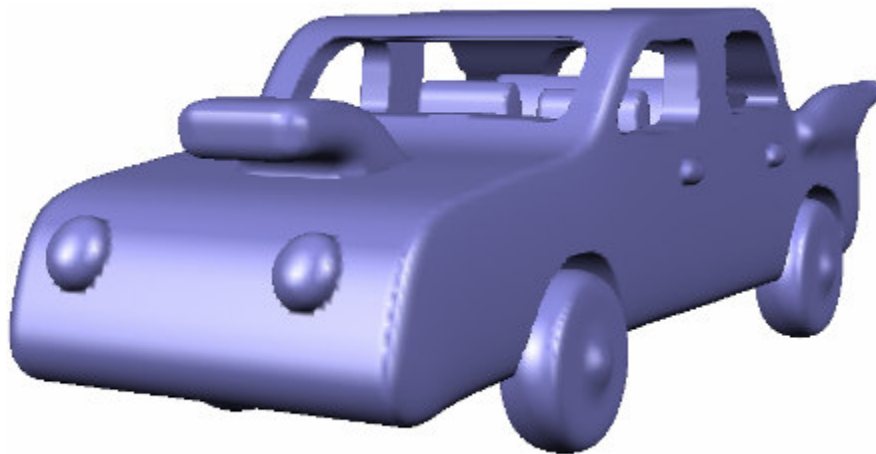
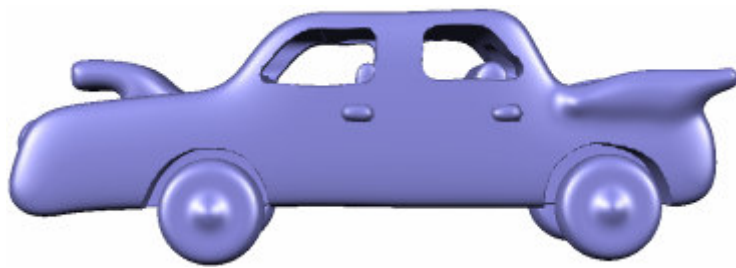
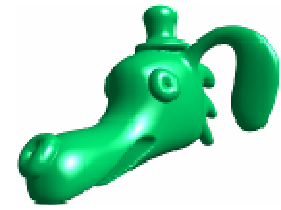
Piston Model



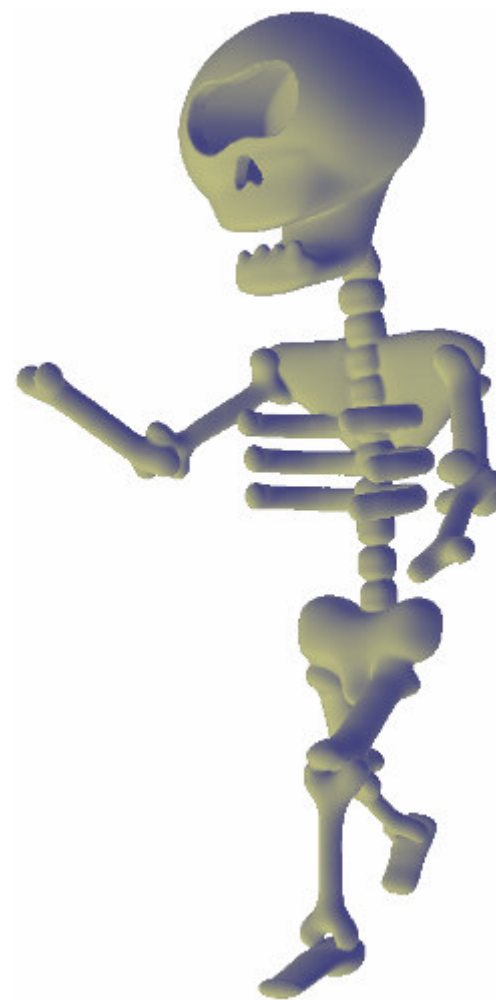
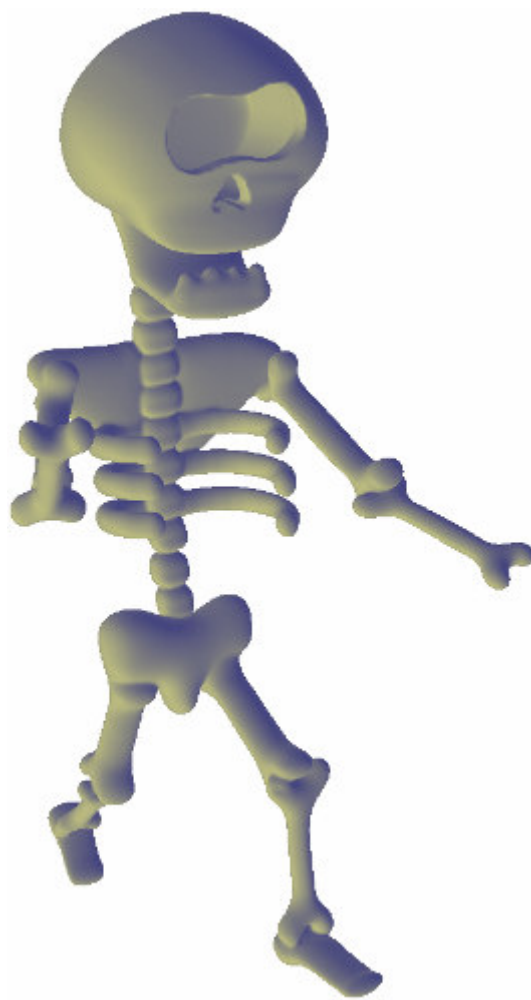
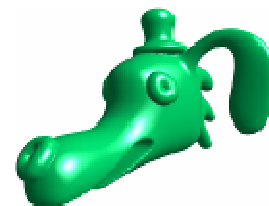
Heart Model



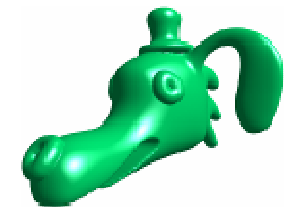
Car Model



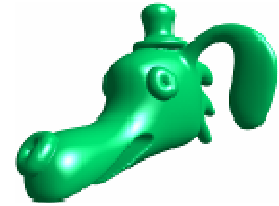
Skeleton Model



3D Doodle



Thank You



- Details:
Full Paper in Sketch-Based
Interaction and Modeling
Workshop @ Eurographics
- Questions?

