

Sketch-Based Modeling with the BlobTree (sketches_0292)

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1 Background

Sketch-based modeling provides an intuitive and expressive interface for 3D model creation. With the Teddy [Igarashi et al. 1999] system, complex free-form 3D models could be quickly produced using a gesture interface. However, the topological modeling operations implemented in Teddy were limited by the underlying shape representation (triangle meshes). Related systems based on variational implicit surfaces [Araújo and Jorge. 2003] produce smoother results but cannot support complex models.

We are exploring the use of hierarchical implicit models (BlobTrees [Wyvill et al. 1999]) for free-form sketch modeling. A key property of BlobTrees is that the scalar fields defining the underlying primitives have finite support, and hence local influence on the model. This local influence preserves a “principle of least surprise” that is critical for interactive modeling. We have developed a spatial caching technique [Schmidt et al. 2005] that supports interactive construction of complex BlobTree models, allowing us to experiment with a sketch modeling tool that uses a BlobTree as the underlying shape representation.

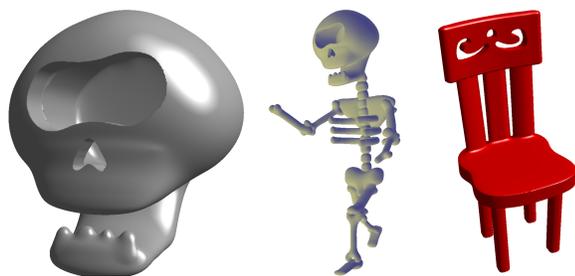


Figure 1: Complex models with arbitrary topology can be created quickly with our sketch-based BlobTree modeling system.

2 BlobTree Sketching

A BlobTree is defined procedurally by a hierarchy of individual shapes (primitives) and composition operators. We have recently developed a variable-width BlobTree sweep primitive that supports direct specification of the sweep profile, mimicking the inflation techniques used in existing sketch systems (Figure 2a). Few topological limitations are placed on the input sketch, in particular “holes” are faithfully reproduced in the 3D surface (Figure 2b).

BlobTree models are both a surface and a volumetric representation. This is beneficial for sketch modeling as many intuitive 3D model construction tasks can be mapped directly to the volumetric blending (Figure 2c) and CSG operators (Figure 2d) supported by BlobTrees. Existing BlobTree primitives can be used to create surface detail, for example by placing point primitives on the surface along sketch lines (Figure 2e). The resulting volume models are

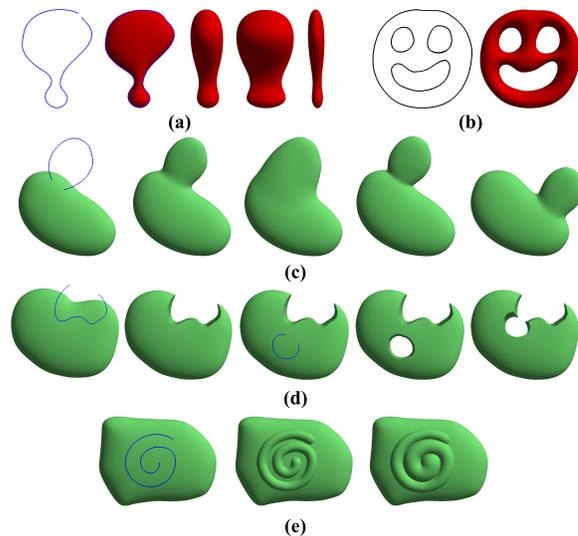


Figure 2: Sketch-based modeling interactions.

guaranteed to define topologically valid surfaces that can be visualized at any resolution.

Another benefit of BlobTrees is that the underlying hierarchy is both a CSG/blending tree and a scene graph for the current model, suitable for animation. The BlobTree hierarchy also represents a construction history, permitting non-linear modification of the model. Our system allows the user to interactively tweak a blend surface or move a hole by manipulating the underlying primitives (Figure 2c and d). Topological changes are handled transparently.

References

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