**Modeling Miscellany**
- Blobby Objects
- Constructive Solid Geometry
- Sweep Surfaces
- Fractals
- Particle Systems

**Blobby Objects**
Object: iso-surface of a distribution function

Example:
\[ F(r) = e^{-r^2} \]

**Multiple Blobby Objects**
- Add fields
- Blending of objects is automatic

**Rendering blobby objects**

1. Determine field value at voxel corners relative to iso-surface
Rendering blobby objects

Marching Cubes Algorithm

2. Compute intersection points on voxel edges to create iso-surface patch

Blobby Objects

Images by Michael Ward, WPI CS

Problem: Rendering can be expensive in terms of time and space

Constructive Solid Geometry

Images by Neil Dodgson
University of Cambridge

• Simple Objects: represented explicitly (sphere, cube, etc.)
• Complex Objects: represented as simple objects and operations (union, intersection, etc.)

CSG models are implicit models

• Intersection is easy
• Ray tracing is easy
• Everything else is hard!

Sweep Surfaces

Deborah Fowler, Hans Meinhardt, and Przemyslaw Prusinkiewicz
Modeling seashells, Siggraph '92

Sweep a shape (2D or 3D) in 3D space
Special Case Sweeps

- Surface of Revolution
- Extrusion

Rendering Sweeps

Approximate sweep with polygon mesh
- Where to sample curve?

Sample Parametric Curve $P(t)$

- Sample $P(t)$ at even intervals of $t$
- Sample $P(t)$ at even intervals along $P(t)$
- Sample $P(t)$ based on curvature

Results improve and complexity increases

Fractals

- Recursive approximation of curve based on self-similarity

Koch Snowflake

Mandelbrot Set

http://www.deepleaf.com/fractal/
Mandelbrot Explorer
http://kosmoi.com/Science/Mathematics/Fractals/Mandelbrot/

Fractals
- Used to model natural forms
  - Plants
  - Terrain
  - Clouds
- Render strategies have developed

Particle Systems
- A collection of particles that evolve over time
  - Fireworks
  - Cloth
  - Schooling fish

Ad hoc methods
- Water
- Fire
- Clouds
- Hair
- Skin
- Fur

Demo
- Fireworks
- Cloth
- Clouds
- Fractal clouds and mountains