Johns Hopkins
Engineering for Professionals

605.767 Applied Computer Graphics

Brian Russin

Module 7A
Procedural Modeling

Procedural Modeling Methods

- Procedural modeling
  - Introduction
- Curved surfaces
  - Blobby objects
  - Subdivision curves and surfaces
- Particle systems
- Fractal geometry
- Fractal terrain
- View dependent terrain

Advanced Modeling Techniques

- Geometric models often can not generally efficiently model natural phenomena
  - Require advanced modeling techniques
  - Sometimes these techniques require special rendering methods
  - Many techniques are suitable for representing dynamic objects
    - Useful for both modeling and animating objects
- Some techniques are useful for modeling many different types of objects
  - Fractals, particle systems
- Others are very specific (special purpose)
  - Ocean wave models
- Provide a sample of some of the techniques

Procedural Modeling

- **Procedural** or **functional modeling** techniques are well established in computer graphics
  - Fractal terrain generation is common technique
  - 'Special' effects often use procedural models
    - Animation sequences and movie special effects
- Motivations for procedural modeling:
  - Objects modeled using a procedure and a parameter can be changed as a function of time
    - Useful for animation sequences
  - Low cost method of generating visually complex objects
    - Terrain - generate thousands of polygons cheaply using procedural method
    - Many objects in nature are modeled procedurally
  - Save space – **database amplification**
- Drawback - procedures tend to be specific
  - Different techniques have evolved to satisfy a narrow set of applications
  - Due to complexities found in nature we might expect diversity of models

Examples of Procedural Modeling

- Molecular interaction using blobby objects
- Subdivision surfaces
- Particle techniques for fireworks and waterfalls
- Fractal subdivision for terrain
- Fourier synthesis for water waves, clouds
- Procedures for generating textures
  - 3D textures, turbulence
- Shape grammars for plants and trees
- Vertex perturbation
- Many examples of 'special' techniques!
  - New techniques every year at Siggraph
    - Association for Computing Machinery (ACM) Special Interest Group Graphics