

Level-of-Detail in Surface and Volume Modeling

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- ❑ **Introduction**
- ❑ **Surface Approximation with Triangle Meshes**
- ❑ **Simplification Algorithms**
- ❑ **LOD Models**
 - Part one: a comprehensive framework for multiresolution
 - Part two: overview of LOD models
- ❑ **Applications**

Motivations

- High complexity of 3D scenes
 - automatic acquisition of the surface of solid objects
 - ✦ range scanners -- 3D scanners
 - resolution supported: ~ 10 facets / mm^2
 - standard solid modeling tools (CAD)
 - complex 3D object defined by # faces $> 100\text{K}$
 - digital terrain models
 - millions of faces
 - tessellation of implicit surfaces

...Motivations...

- 3D graphics is a limited, valuable resource
 - **graphics throughput** of low level ws / pc : ~100K faces/sec
 - **interactivity** requires multiple frames per second
 - **web graphics** (VRML) needs transmission of data on low bandwidth networks
 - scientific users: 300-500KB/sec local, 10 - 100KB/sec remote
 - commercial/home users: 56Kb/sec *(in Italy)*
- graphics file size:
 - 24 byte/vertex (if binary, >> if ascii)

Reducing Graphics Costs

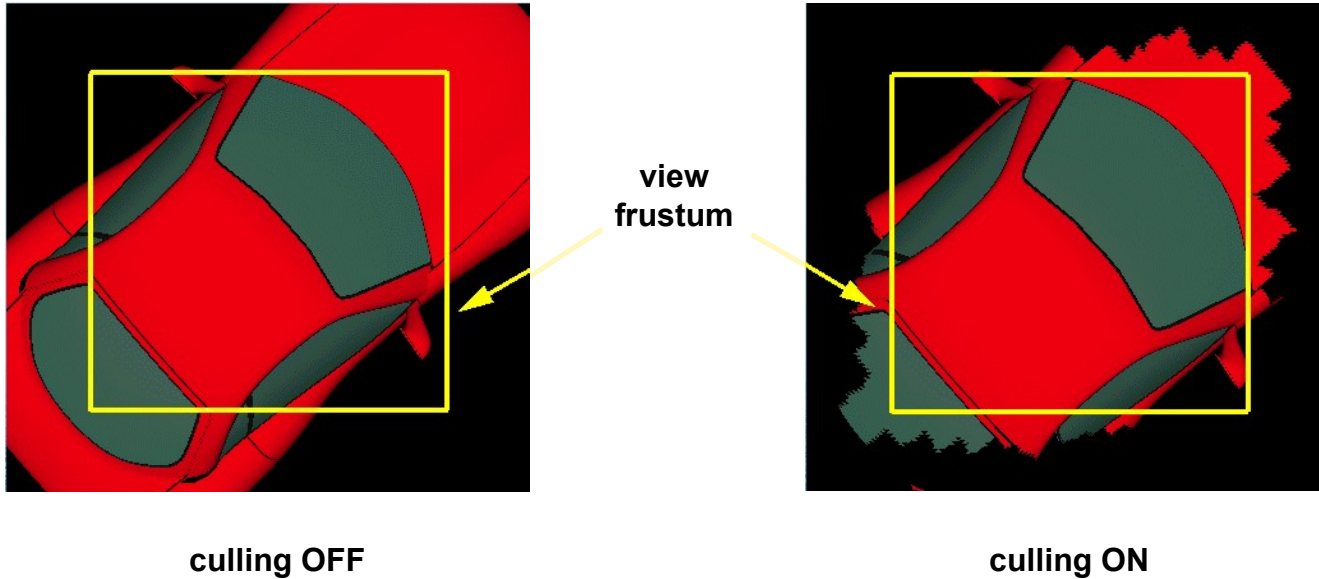
- **Visualization Stage:**
 - culling back faces
 - view frustum culling
 - visibility culling

- **Modeling Stage:**
 - tessellate surfaces with triangle meshes
 - simplify meshes
 - construct a LOD model

View Frustum Culling

- an example of **view frustum culling**
(images by SGI, OpenGL Optimizer)

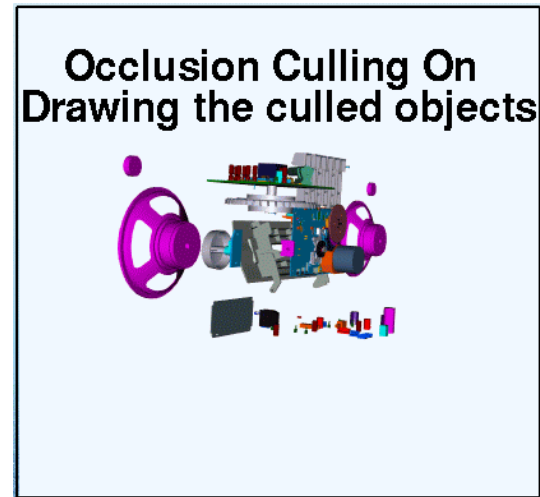
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Visibility Culling

- an example of **occlusion/visibility culling**

(images by SGI, OpenGL Optimizer)

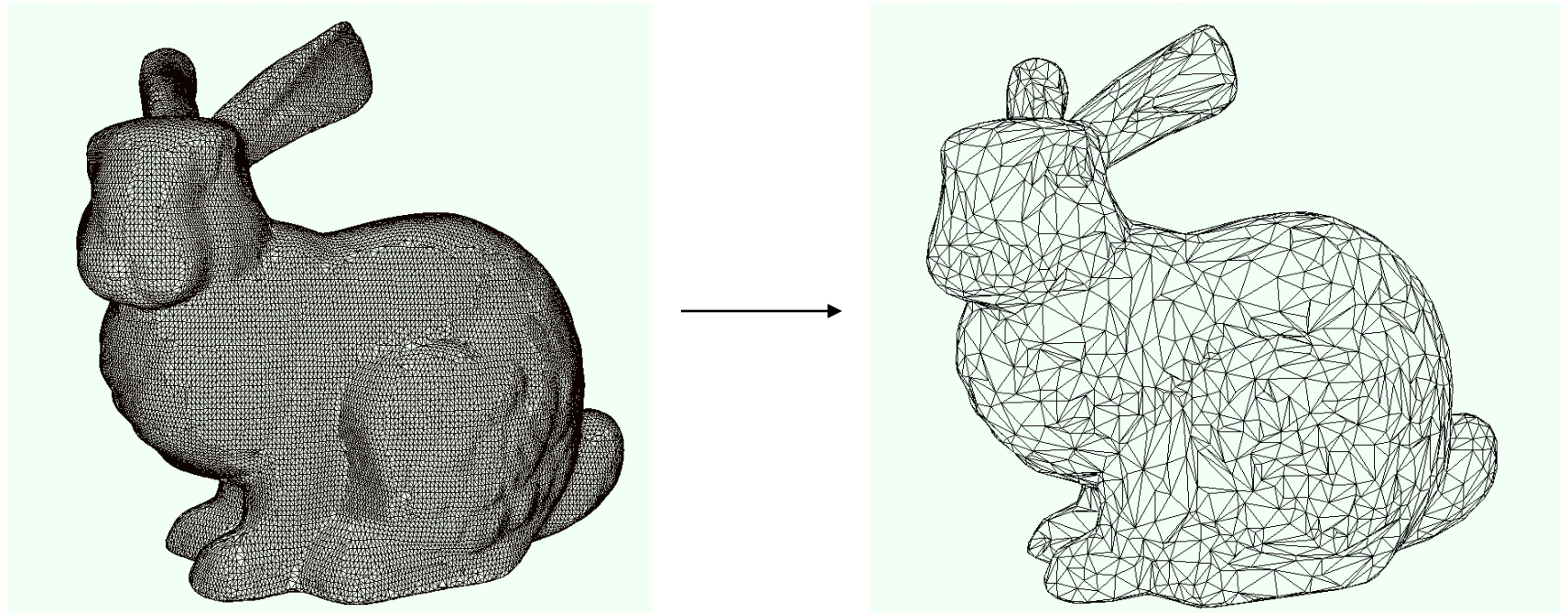


Level of Detail: Approximating surfaces with triangle meshes

- **Assumption:**
 - accuracy of the approximation is proportional to the number of triangles
- **Objective:**
 - always produce the simplest mesh that satisfies the accuracy required by the application

...Approximating Surfaces...

- **On-the-fly simplification:** extract from raw data a mesh of minimal size whose accuracy is sufficient for application needs
 - only raw data and the simplified mesh are stored
 - simplification is usually an expensive task



...Approximating Surfaces...

- **LOD / multiresolution model:** build a model off-line that encompasses many different representations and that can be queried efficiently
 - more expensive in terms of space
 - more efficient: support to real-time operations

