

Geometric Modeling

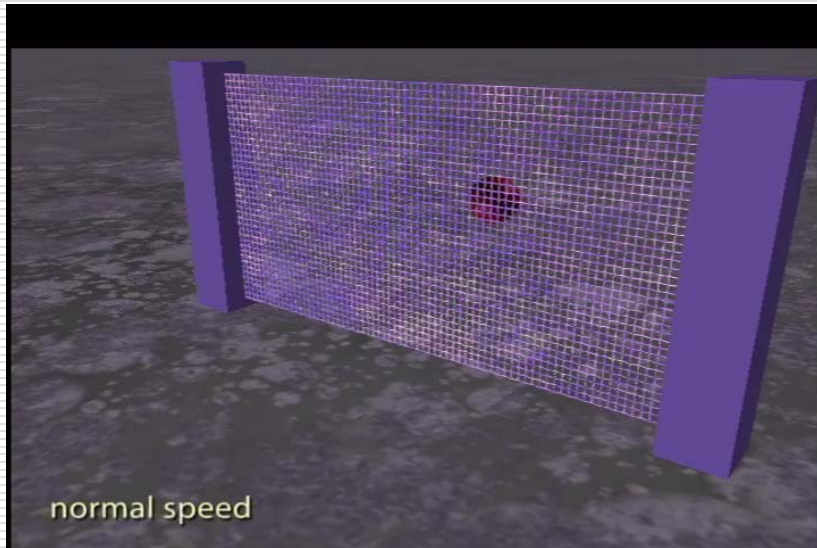
Bing-Yu Chen
National Taiwan University
The University of Tokyo

Self Introduction

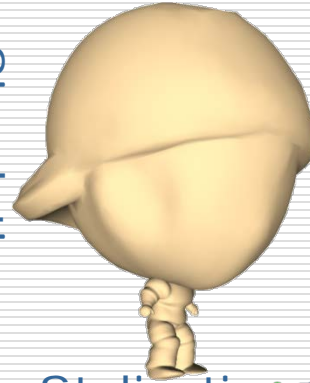
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 - E-mail: robin@ntu.edu.tw
 - Web: <http://graphics.csie.ntu.edu.tw/~robin/>

 - Professor, CSE, U-Tokyo, 2012-
 - Professor, IM & CSIE & GINM, NTU, 2011-
 - Visiting Researcher, CS, U-Tokyo, 2008-2011
 - Assoc. Professor, IM & CSIE & GINM, NTU, 2007-2011
 - Assist. Professor, IM & GINM, NTU, 2003-2007
 - Ph.D., IS, U-Tokyo, 2000-2003
 - M.S., CSIE, NTU, 1995-1997
 - B.S., CSIE, NTU, 1991-1995
-

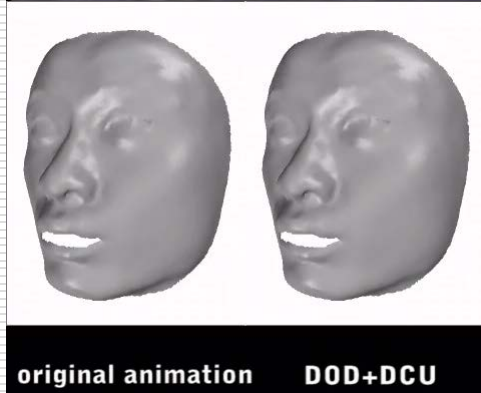
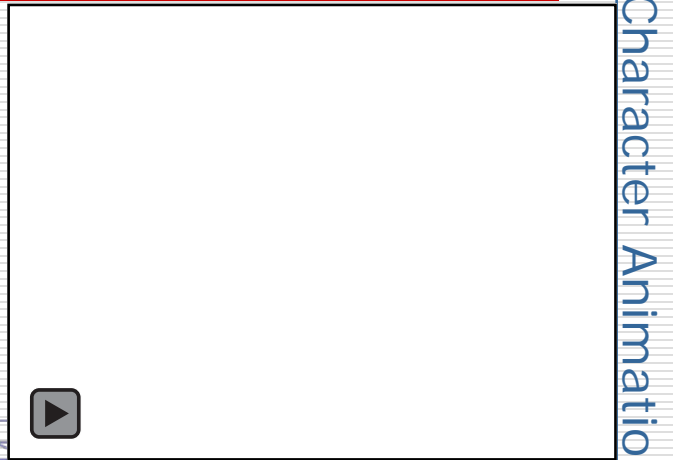
Modeling & Animation



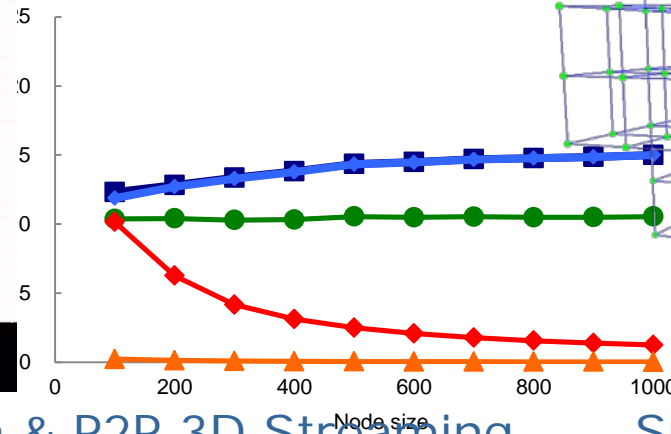
Simulation



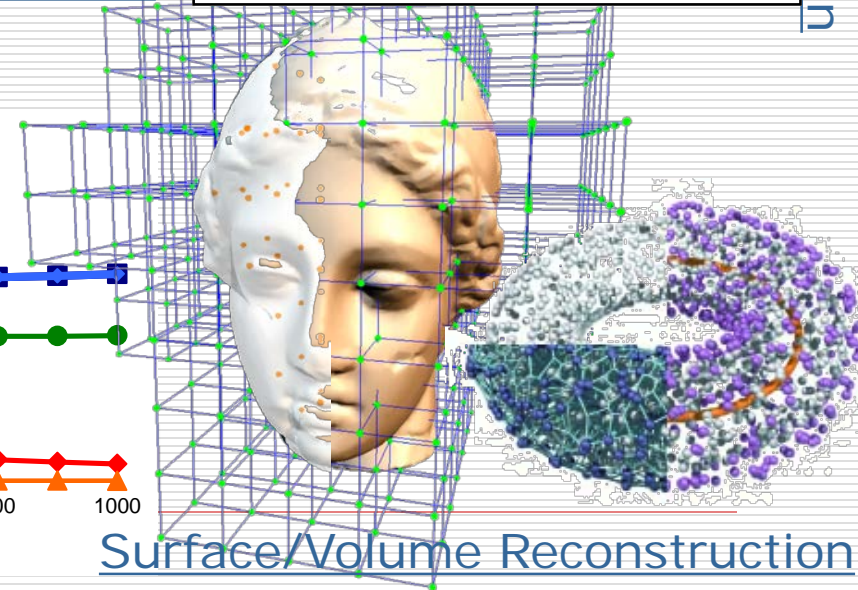
Stylization



original animation DOD+DCU

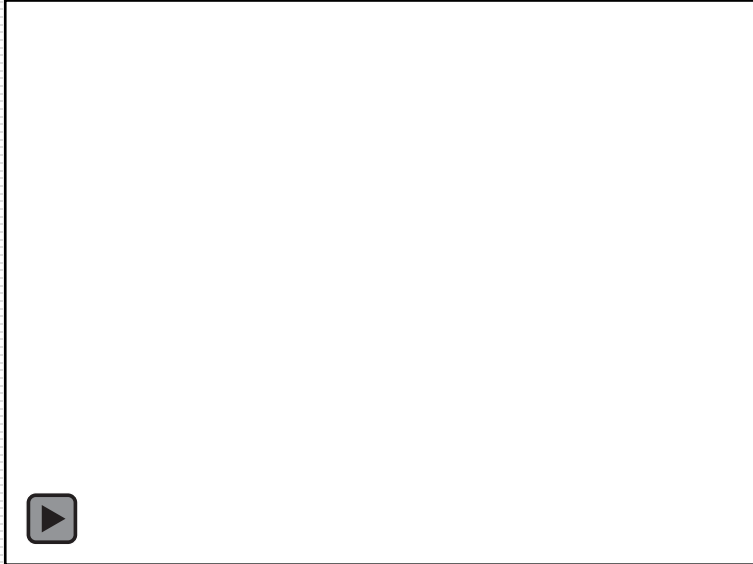
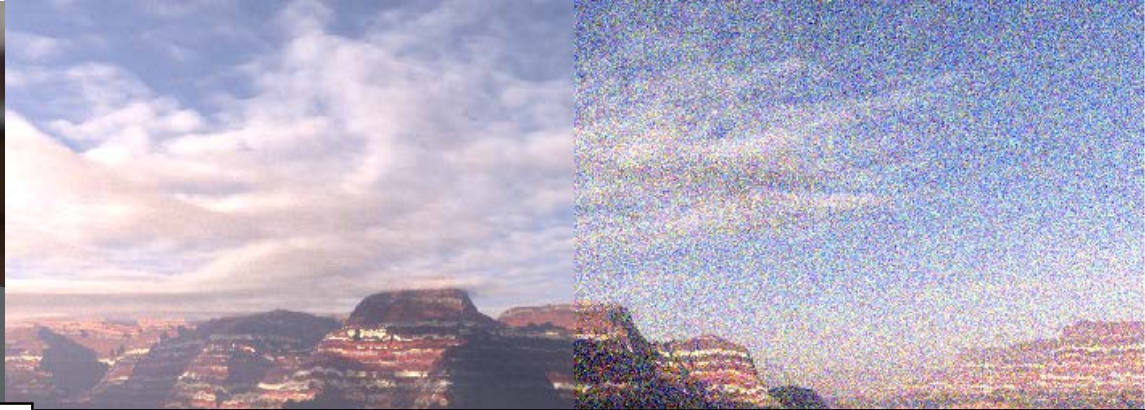


Mesh Simplification & P2P 3D Streaming



Surface/Volume Reconstruction

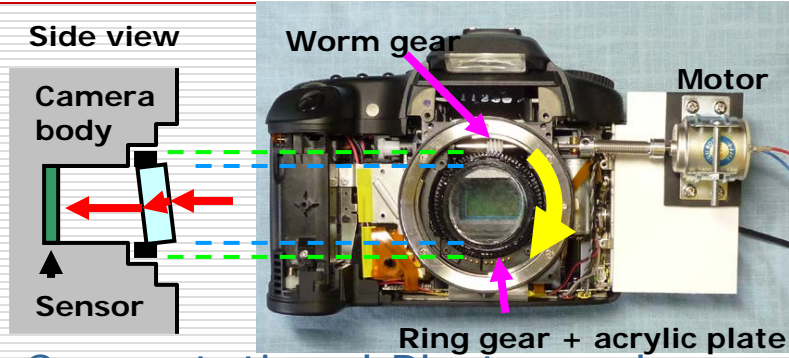
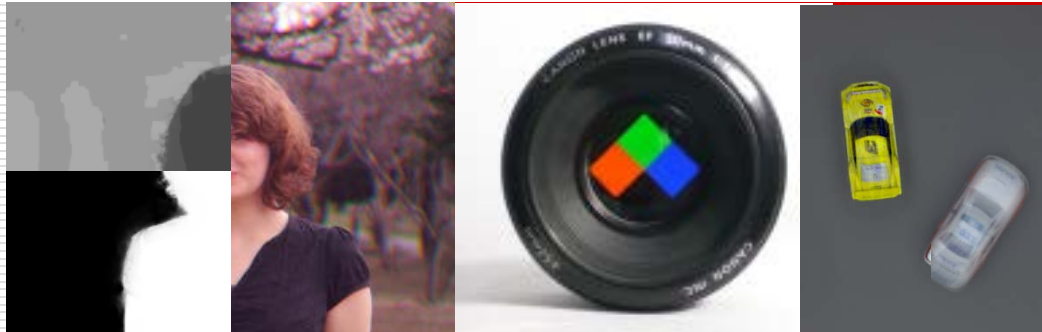
Realtime & Realistic Rendering



[Global Illumination](#)

[Participating Media Rendering](#)

Video & Image Processing



Computational Photography

Video Stabilization



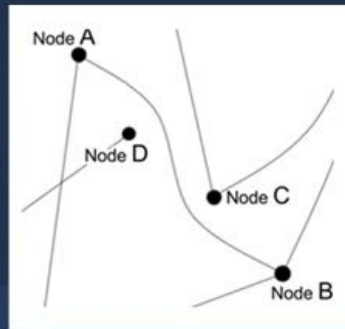
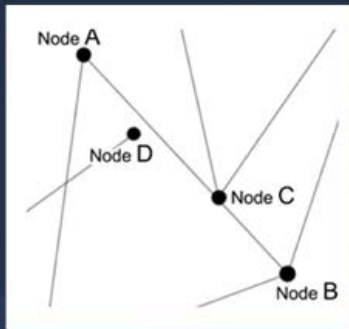
Local Color Transfer



Rephotography

Information Visualization

Routing and Curving the Edges.

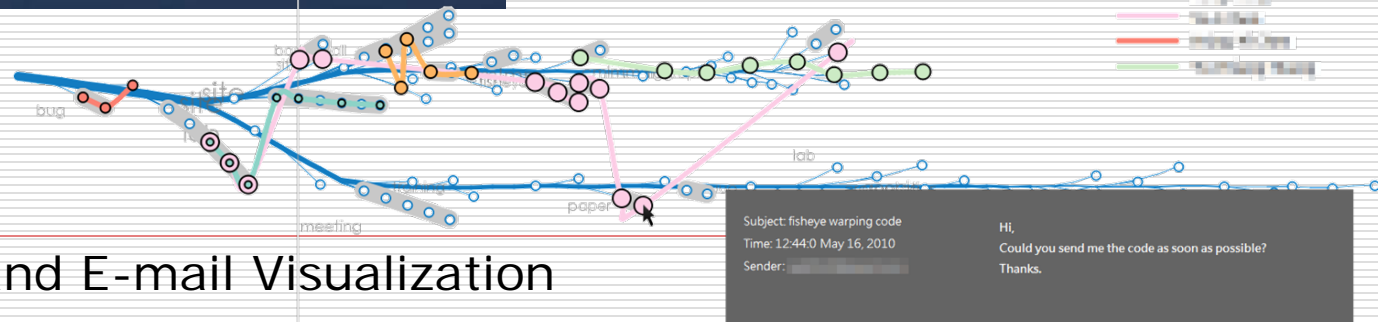
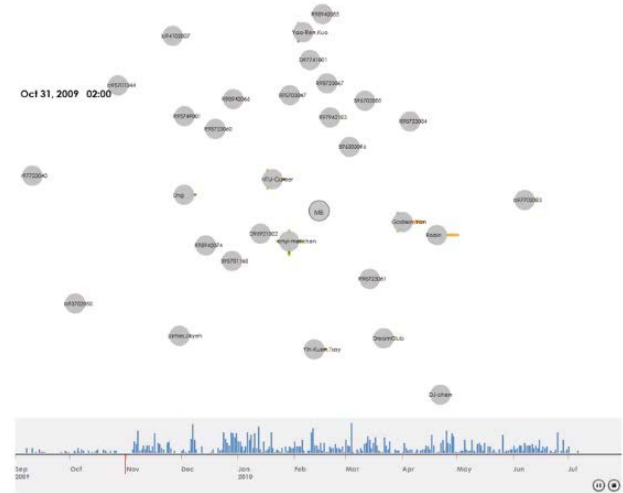


Incorrect perception
on Node C

After routing the edge

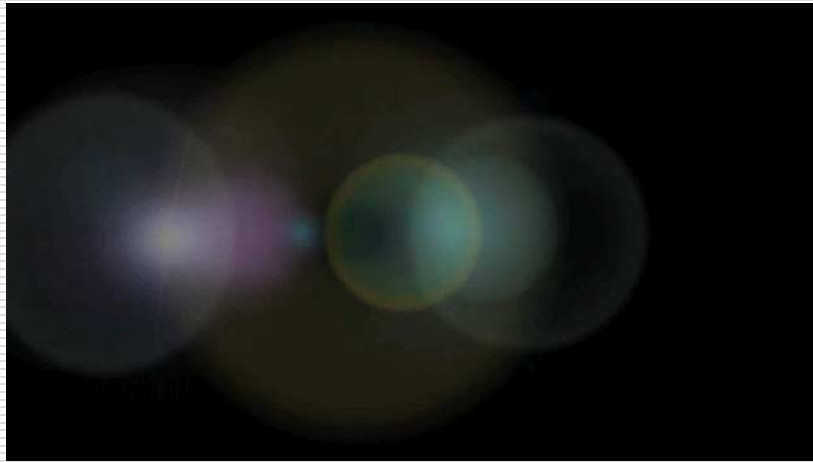
Graph Drawing

ContactVis

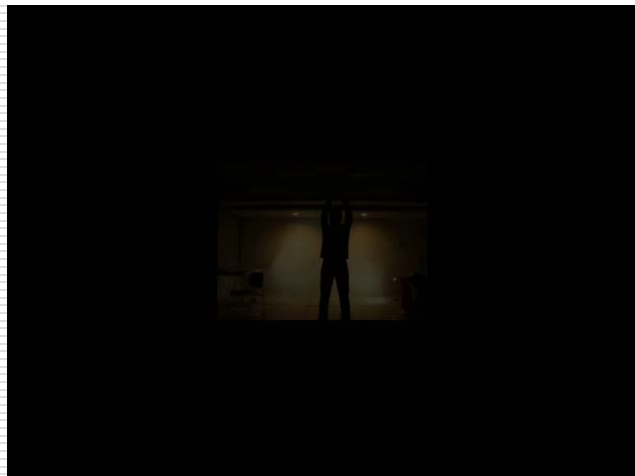


Social Network and E-mail Visualization

Interactive Technologies



User
Interface
&
Human
Factor



Installation Art

天地與我並生，而萬物與我為一 《莊子，齊物論》

"Heaven, earth and I are born of one, and I am at one with all exists,"
said Chuang-tzu.

Topics

- Computer Graphics – review
- Geometric Modeling
 - Object Representations
 - Data Structures of Meshes
 - Subdivision Surfaces
 - Parametric Curves and Surfaces
 - Mesh Simplification / Compression
 - (Consistent) Surface Parameterization

Pre-requirements

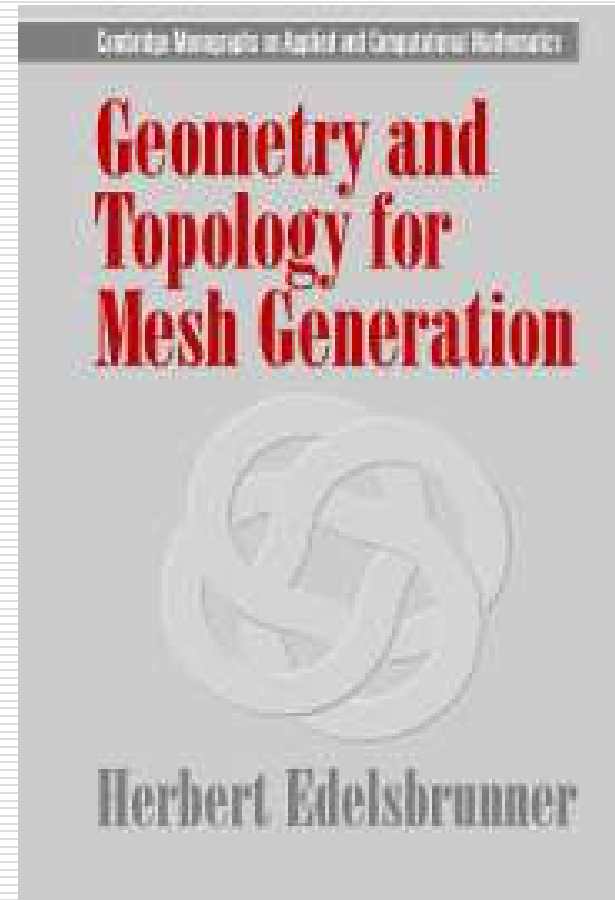
- Computer Graphics
 - Linear Algebra
 - Data Structures
 - Algorithms
 - Programming Skills
 - C/C++
 - Java
-

Computer Graphics - review

- [Color Model](#)
 - RGB / CMY / HSV models
- Transformations
 - [Affine Transformations](#)
 - [Homogeneous Coordinates](#)
- Projections
 - [Pinhole Camera Model](#)
 - [Parallel / Perspective Projections](#)
- [Hidden Surface Removal](#)
 - Z-Buffer / Ray Casting
- [Space Partitioning](#)
 - Uniform Grid / KD-Tree / Octree / BSP
- [Bounding Volumes](#)
 - AABB / OBB
- Illumination and Shading
 - [Phone Model](#) / [Shading](#)
- [Texture Mapping](#)
 - Texture Mapping / MIPmaps
 - Environment / Bump / Displacement Mappings

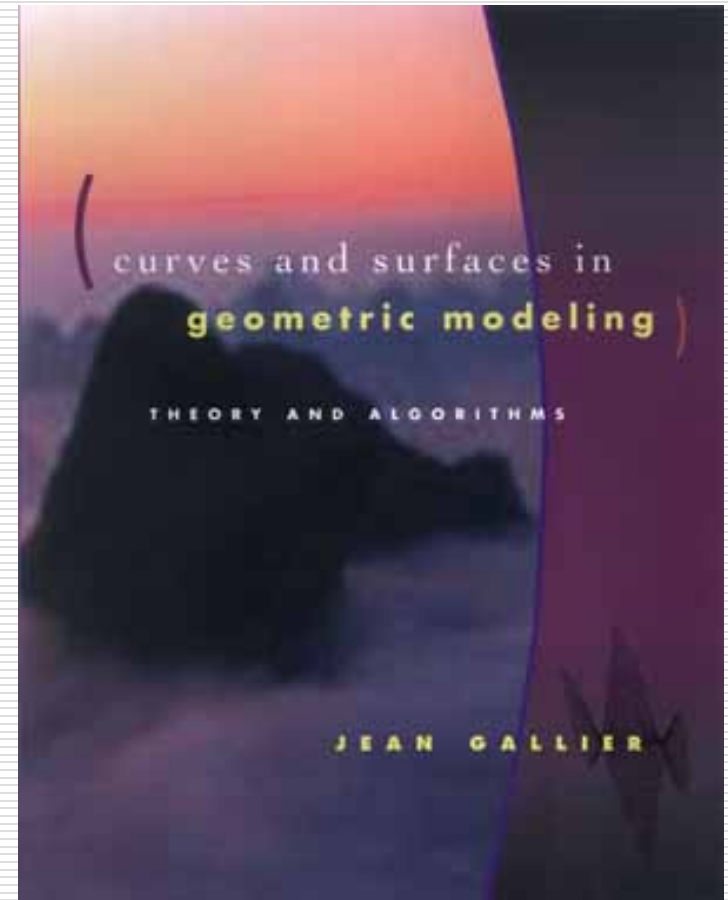
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- H. Edelsbrunner.
*Geometry and Topology
for Mesh Generation*,
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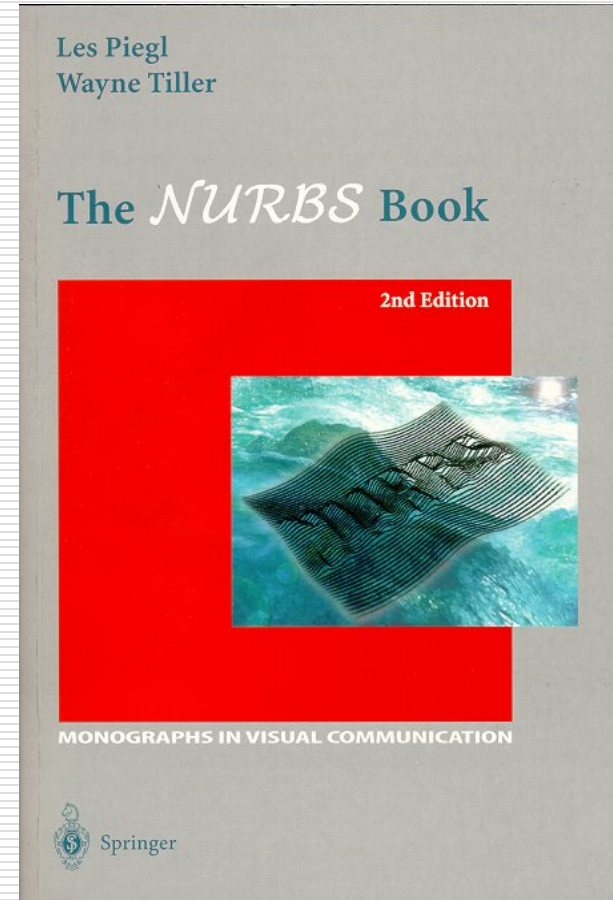
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- J. Gallier.
Curves and Surfaces in Geometric Modeling: Theory and Algorithms, Morgan-Kaufmann, 1999.



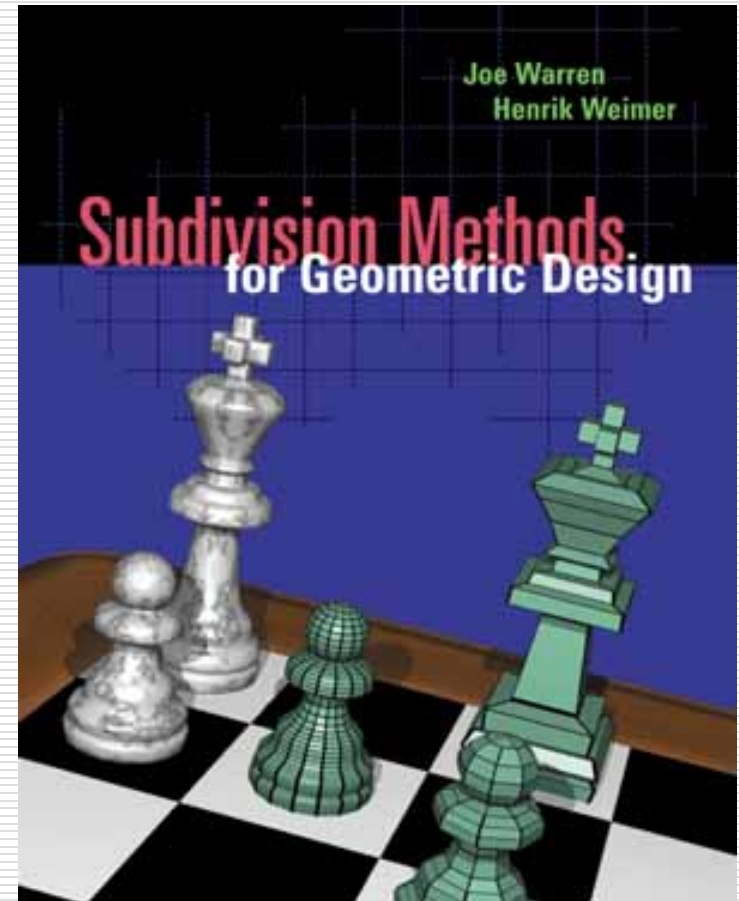
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- L. Piegl,
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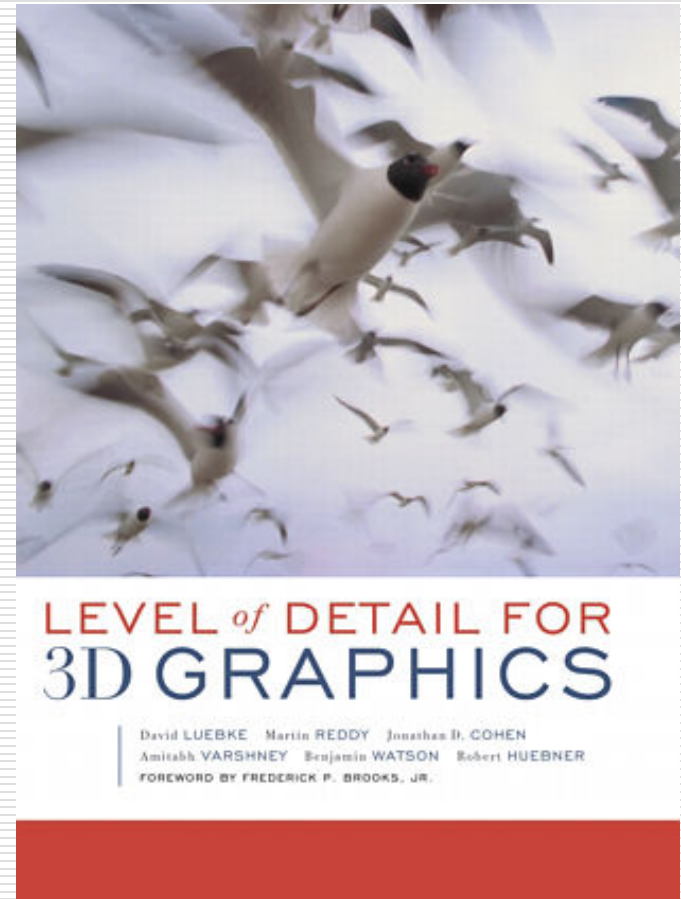
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H. Weimer.
*Subdivision Methods
for Geometric Design:
A Constructive Approach*,
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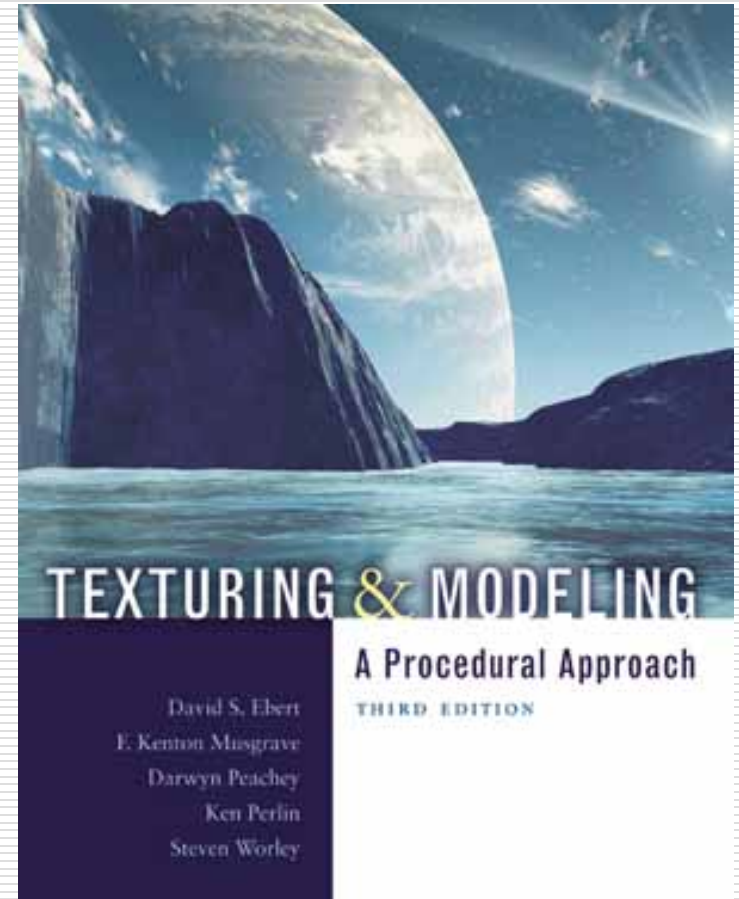
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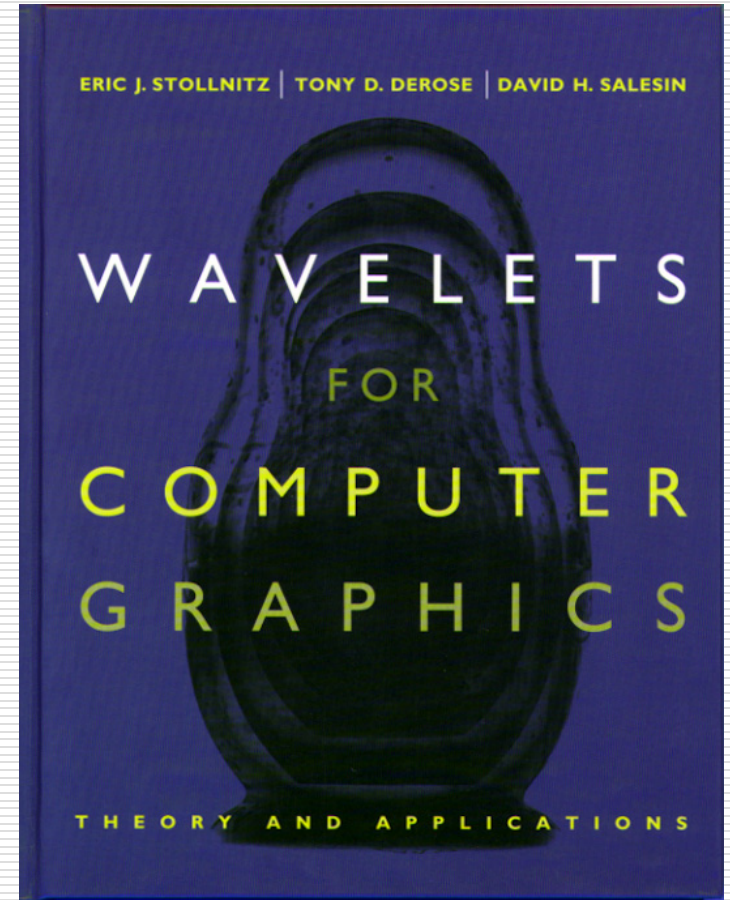
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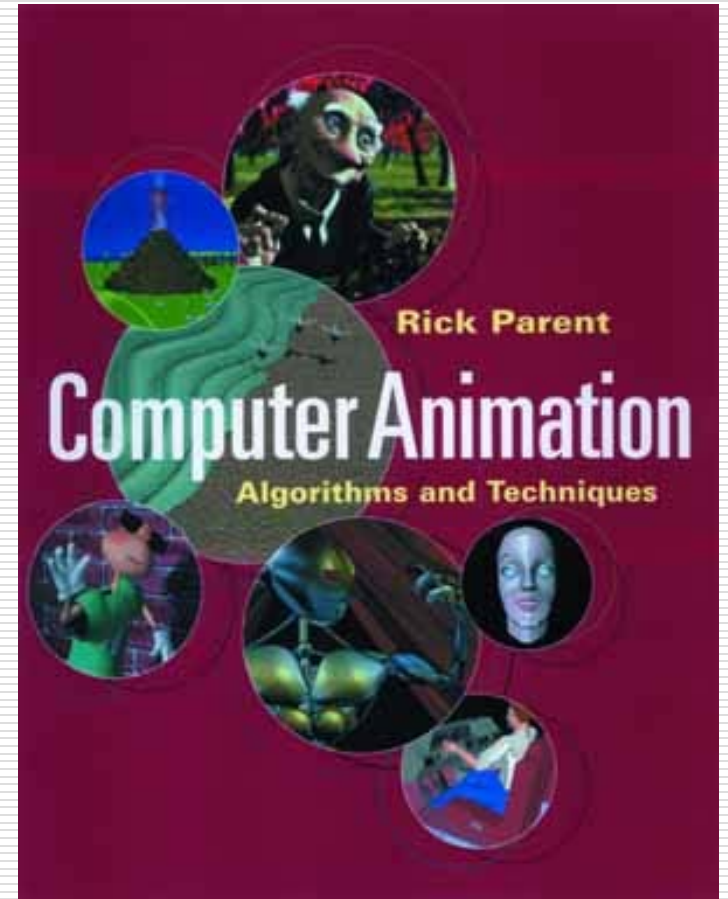
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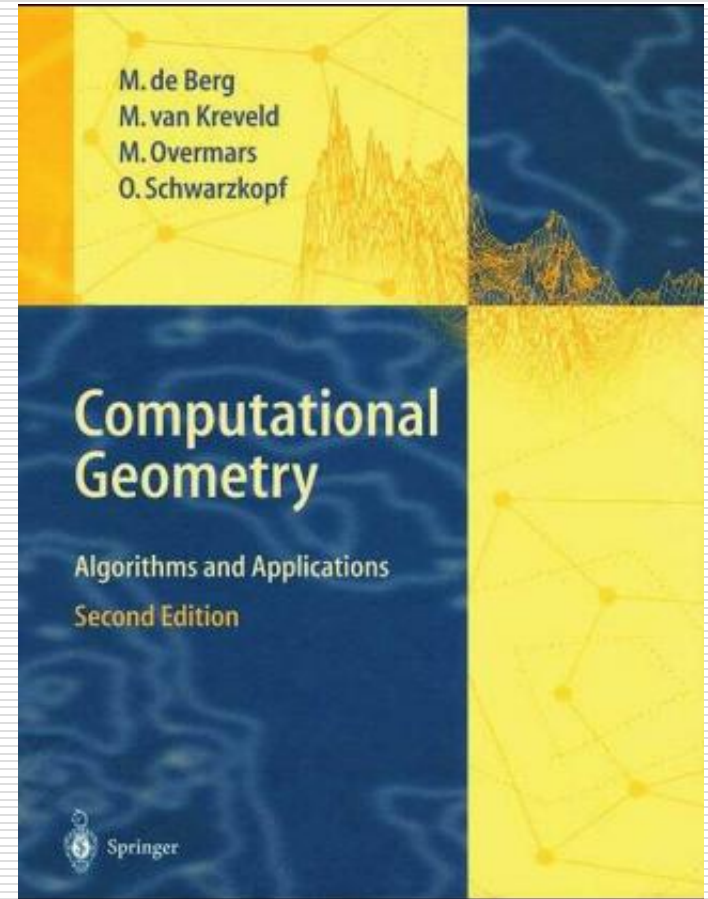
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*Computer Animation:
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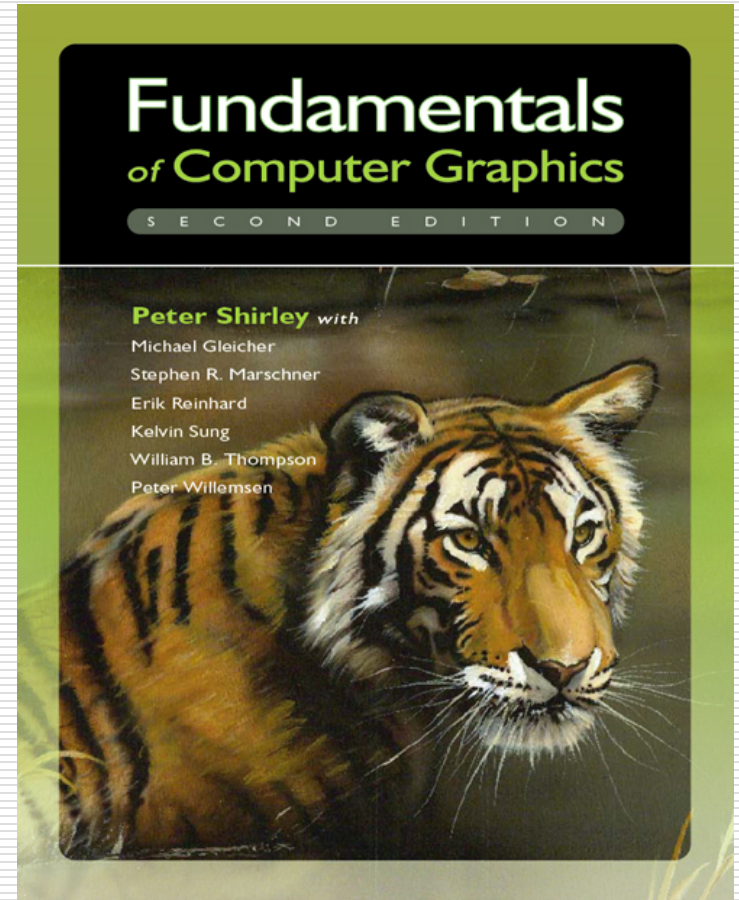
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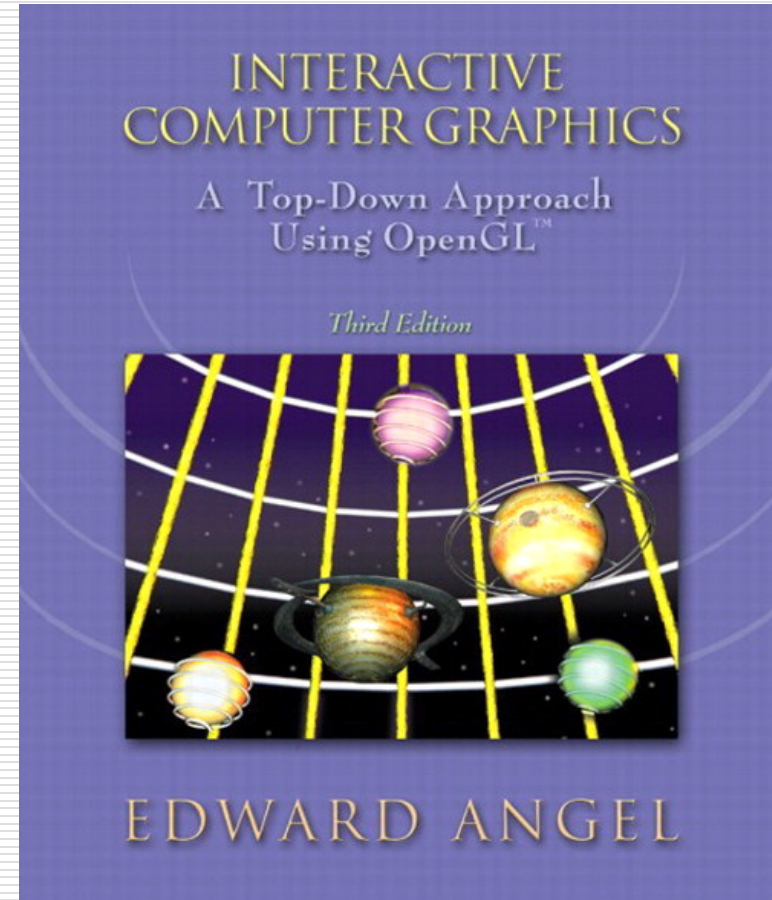
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*Interactive Computer Graphics:
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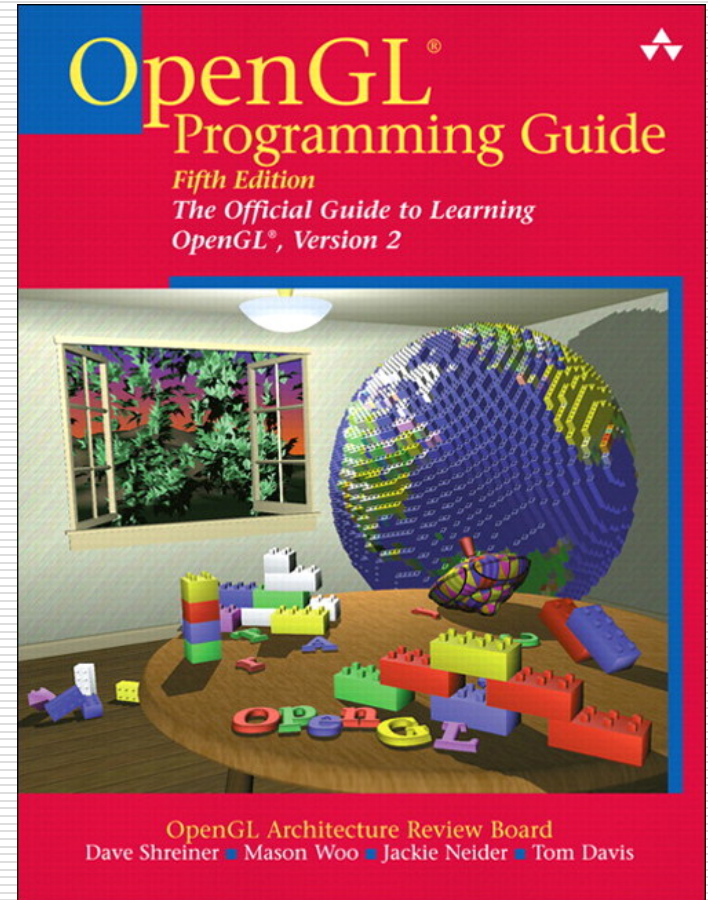


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- D. Shreiner,
M. Woo,
J. Neider,
T. Davis.

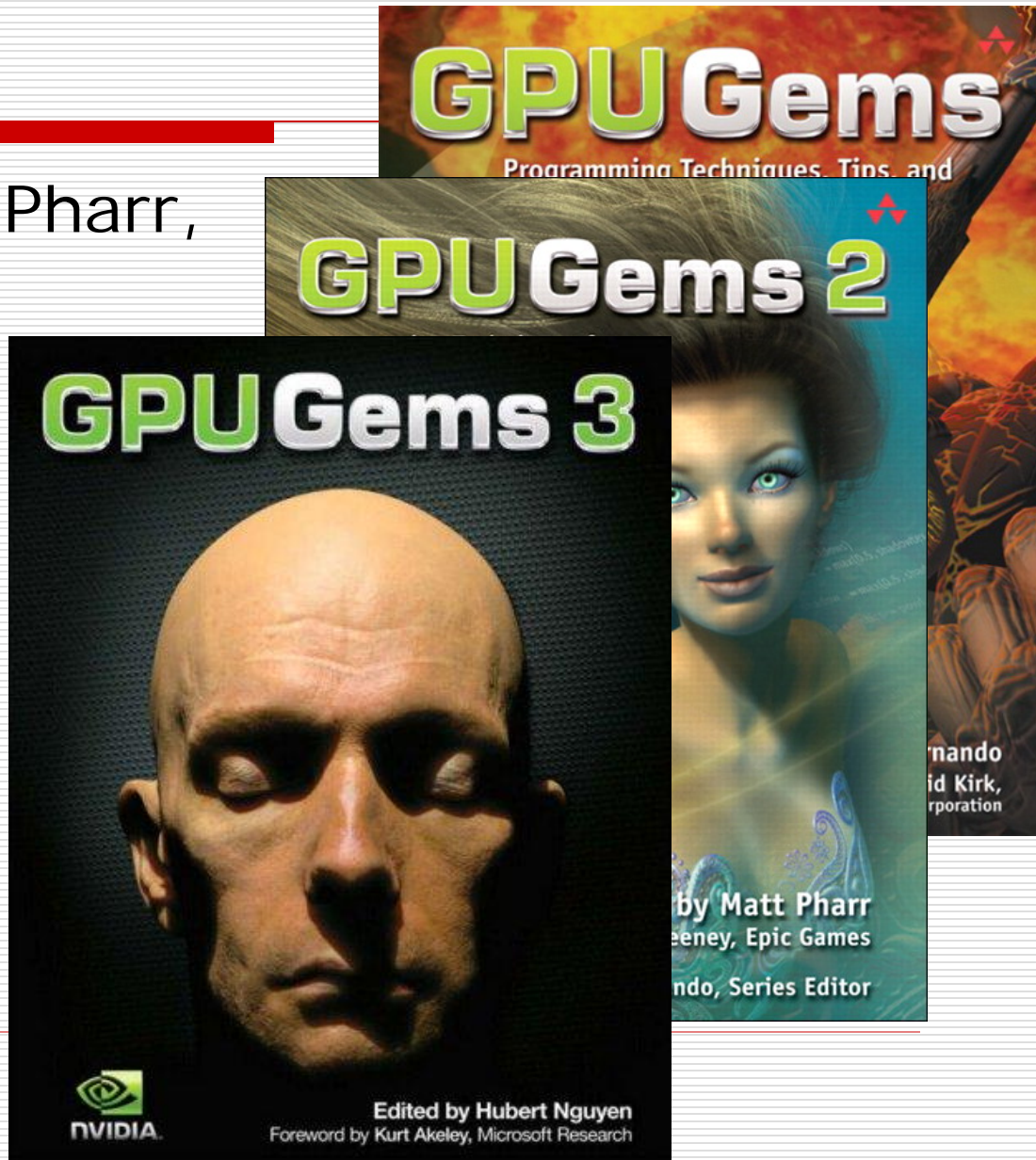
OpenGL®

*Programming Guide:
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Reference

- R. Fernando, M. Pharr, H. Nguyen.
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 - ❑ ACM SIGGRAPH Conference Course Notes
 - ❑ ACM SIGGRAPH Asia Conference Proceedings
 - ❑ ACM SIGGRAPH Asia Conference Course Notes
 - ❑ Eurographics Conference Proceedings
 - ❑ Eurographics State-of-the-Art Reports
 - ❑ Pacific Graphics Conference Proceedings
 - ❑ Proceedings of Symposium on Computer Animation
 - ❑ Proceedings of Symposium on Geometry Processing
 - ❑ ACM Transactions on Graphics
 - ❑ IEEE Transactions on Visualization and Computer Graphics
 - ❑ Computer Graphics Forum
-

Why Modeling?

- To describe any real-life object on computer – must start with shape(3D)



Geris Game

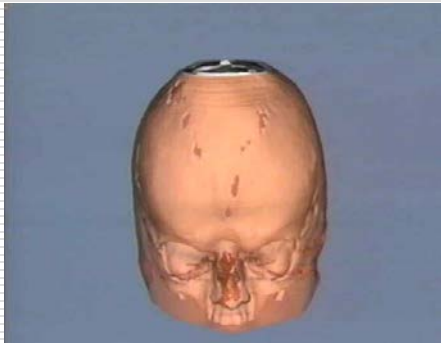


Utah Teapot

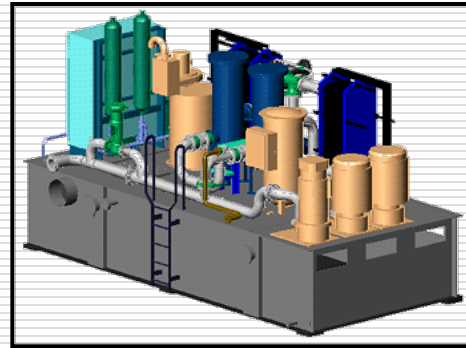


Stanford Bunny

What are the applications?



medical



engineering



e-commerce



art



game



movie

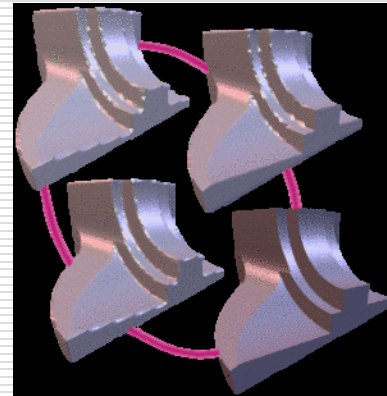
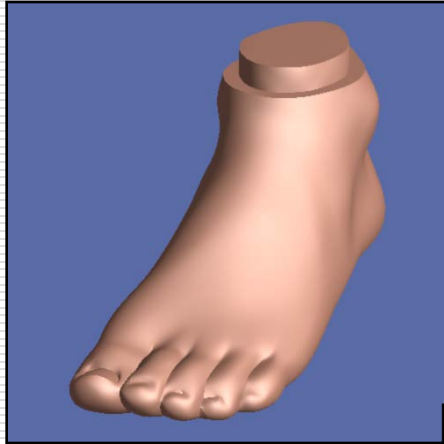


simulation

What we will face?

- Discrete (polygonal mesh) models
 - typically triangular
 - Why discrete?
 - simplicity – ease of description & transfer
 - base data for rendering
 - input to most simulation/analysis tools
 - output of most acquisition tools
 - CT, MRI, laser, etc.
-

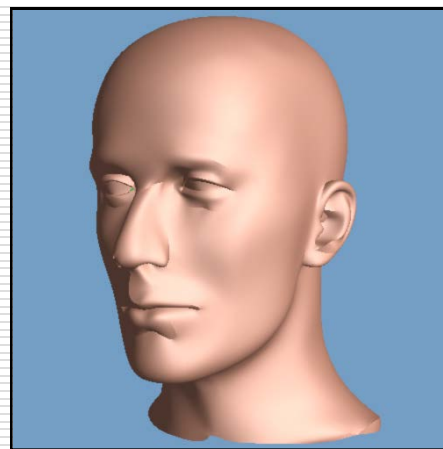
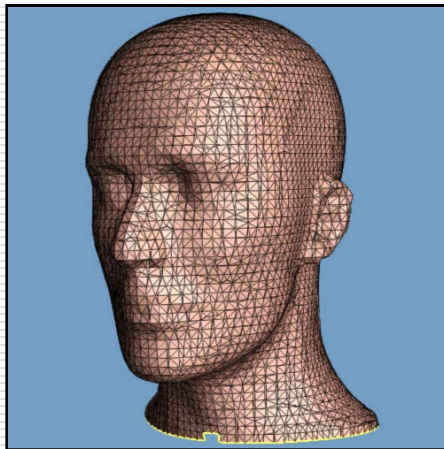
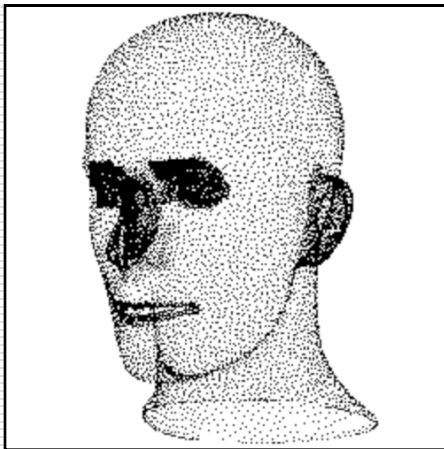
Generation/Reconstruction



[Kobbelt et al. 01']



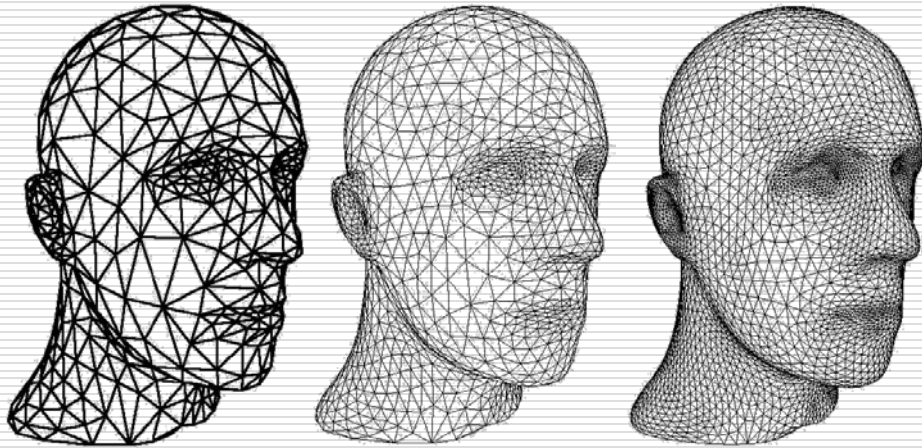
[Curless and Levoy 96']



[Hoppe et al. 92'] [Hoppe et al. 93'] [Hoppe et al. 94']



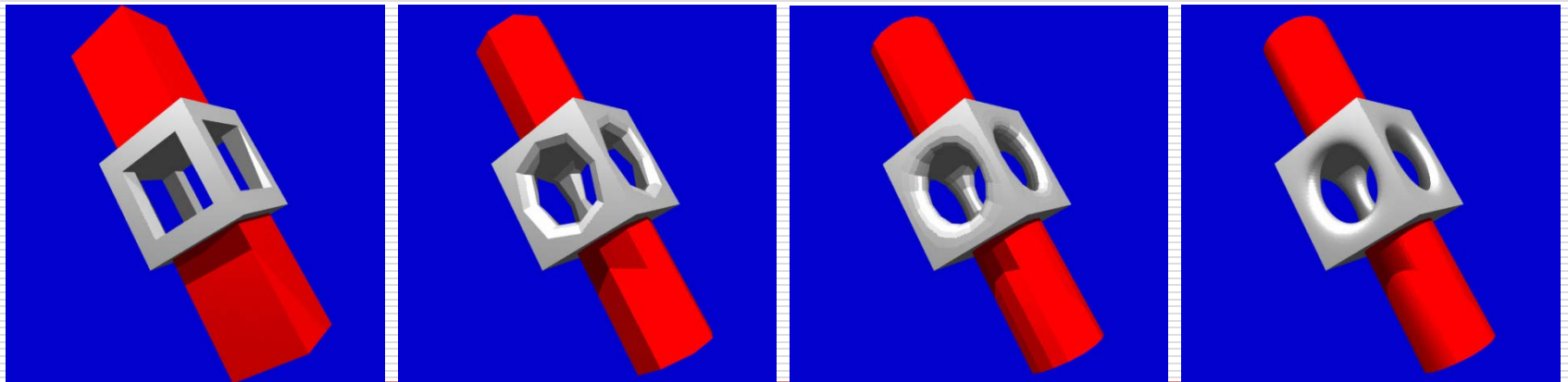
Subdivision/Remeshing



[Kobbelt 00']

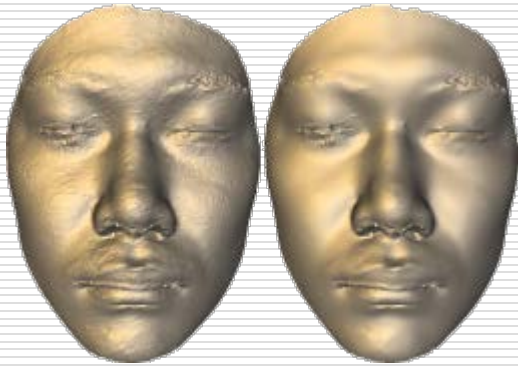


Geri's Game

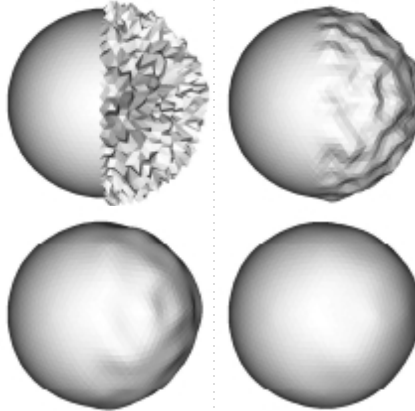


[Warren and Weimer 02']

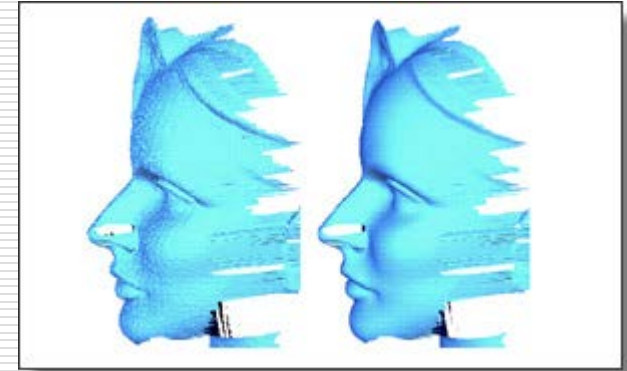
Smoothing



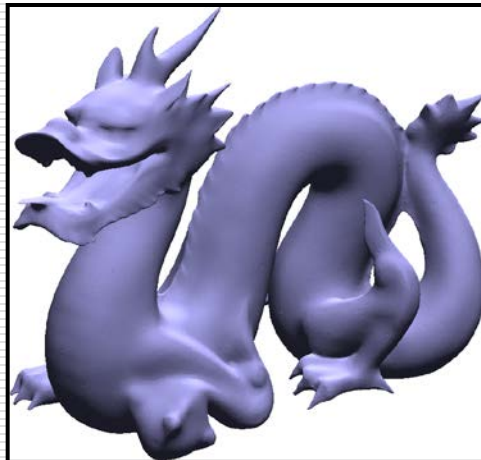
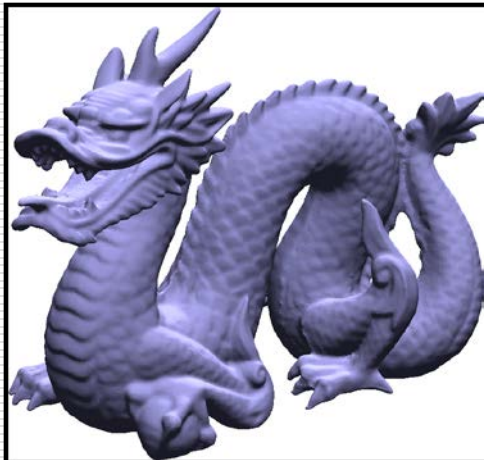
[Fleishman *et al.* 03']



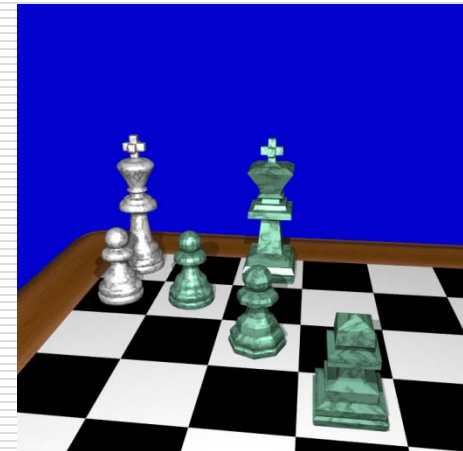
[Taubin 95']



[Desbrun *et al.* 99']

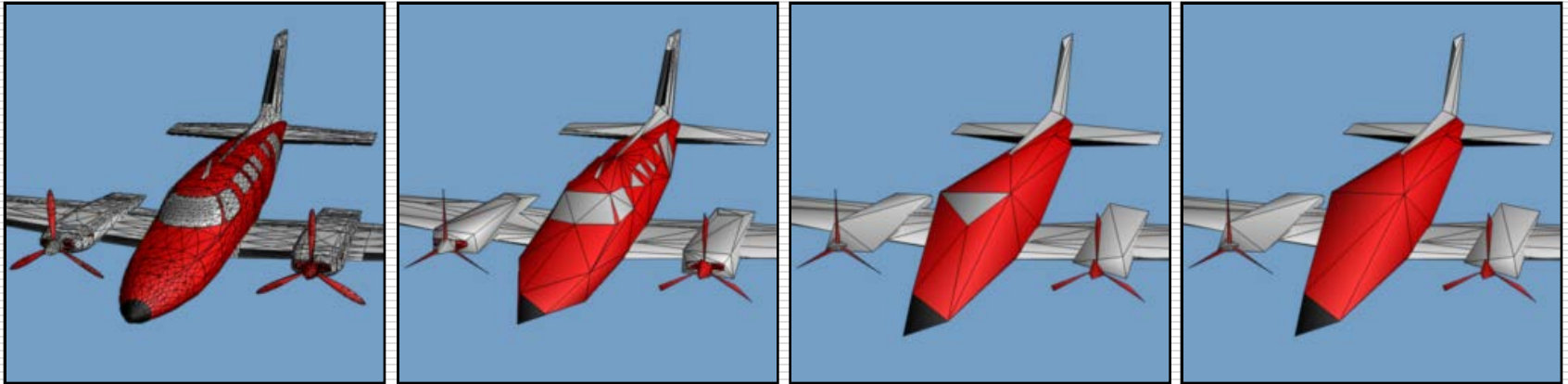


[Jones *et al.* 03']

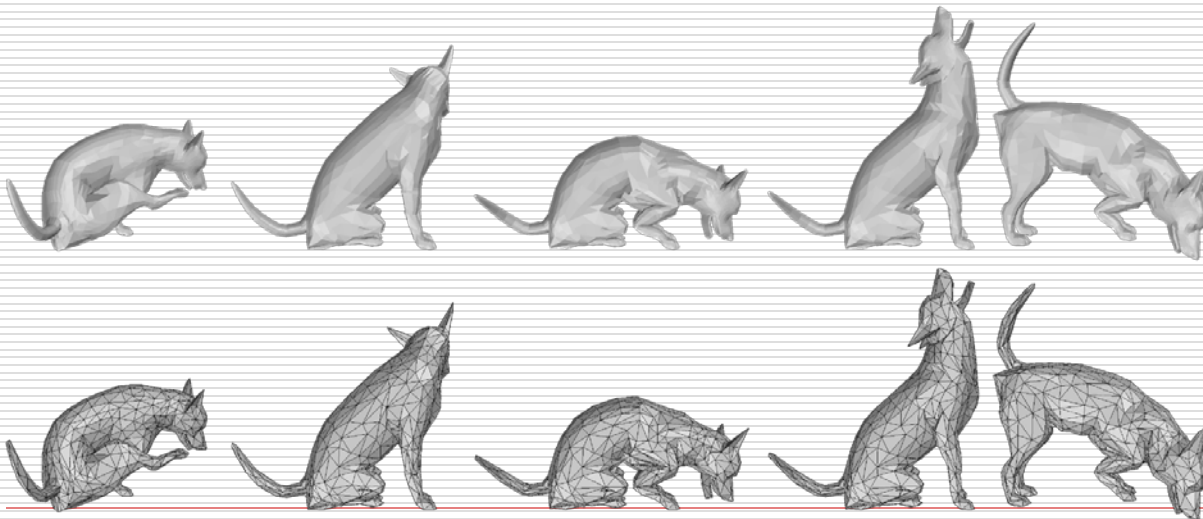


[Warren and Weimer 02']

Simplification



[Hoppe 96']

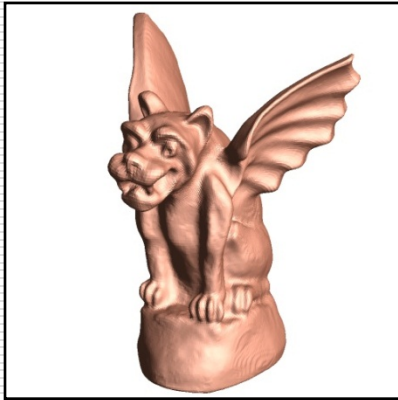


[Huang *et al.* 06']

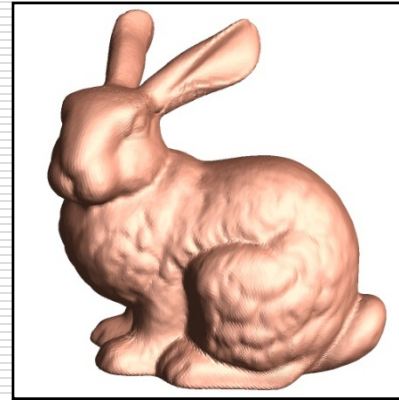
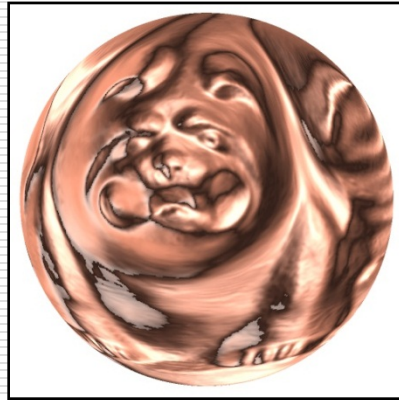


[Hoppe 99']

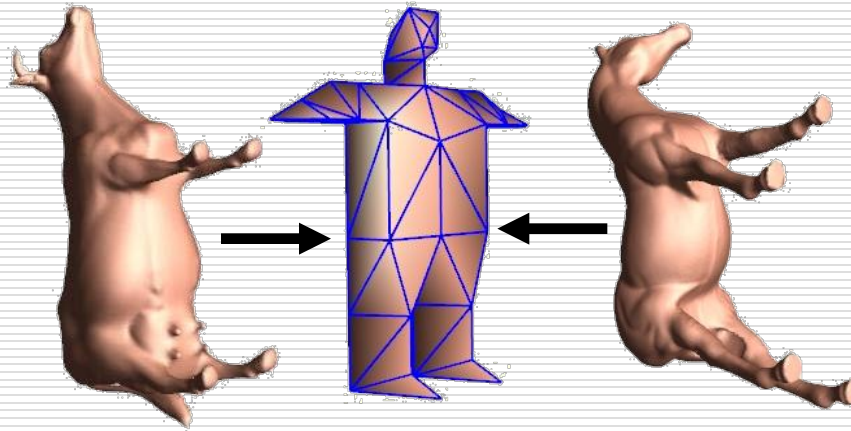
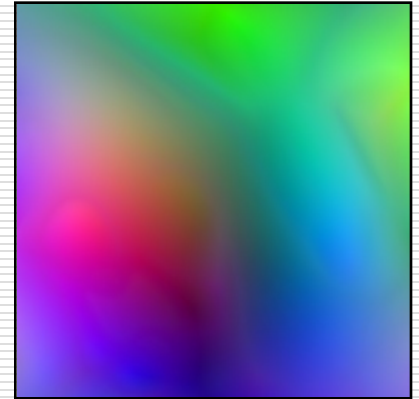
Parameterization



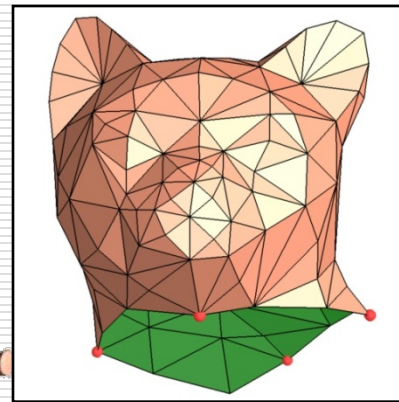
[Praun and Hoppe 03']



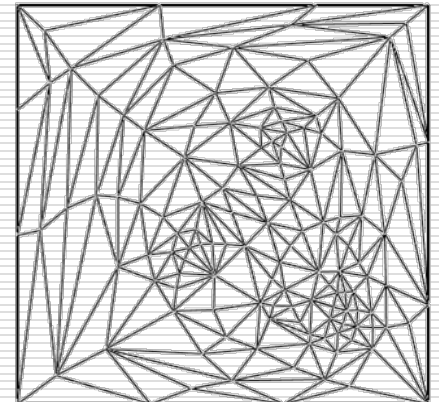
[Gu et al. 02']



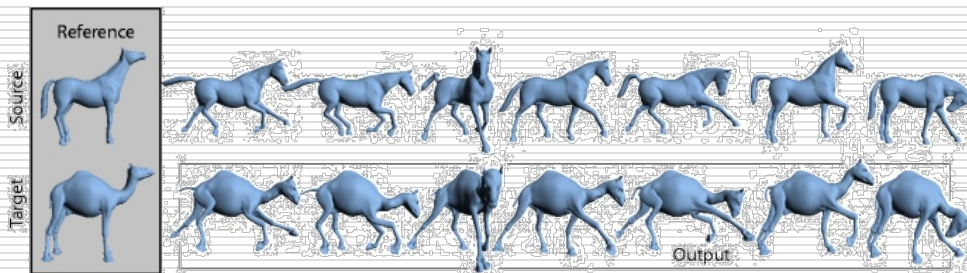
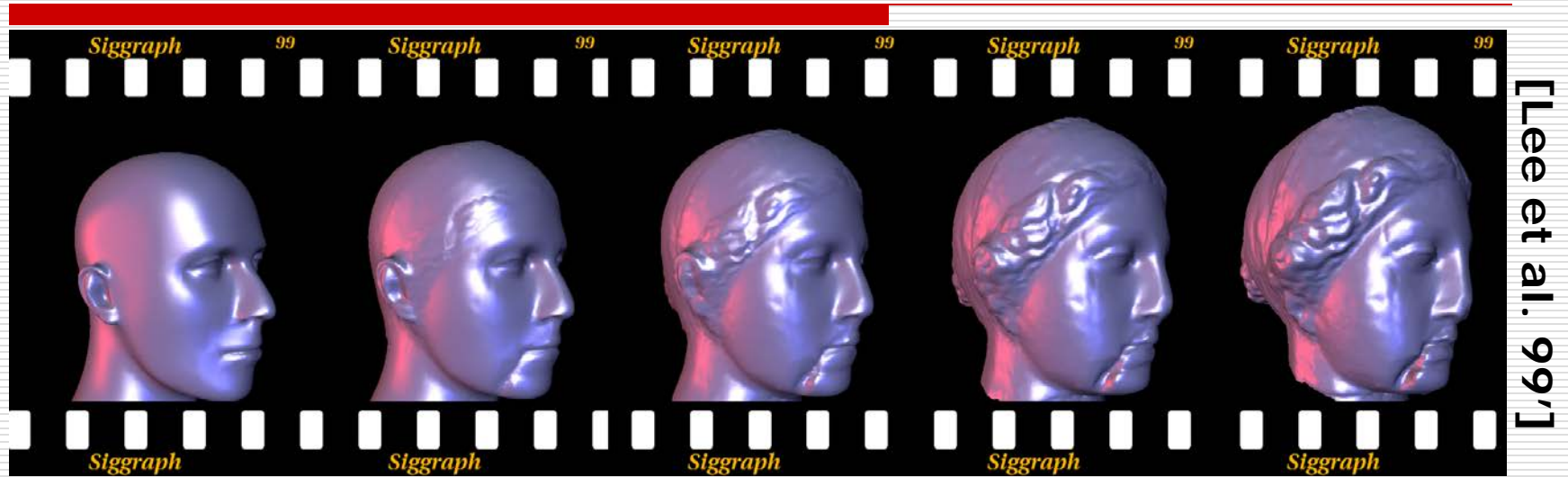
[Schreiner et al. 04']



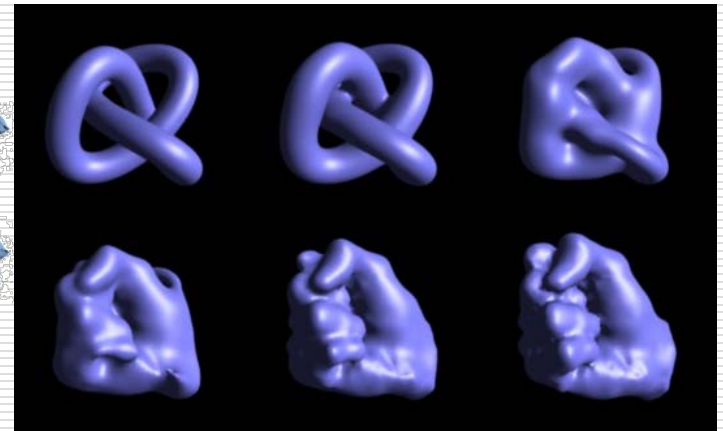
[Sander et al. 01']



Metamorphosis/Animation

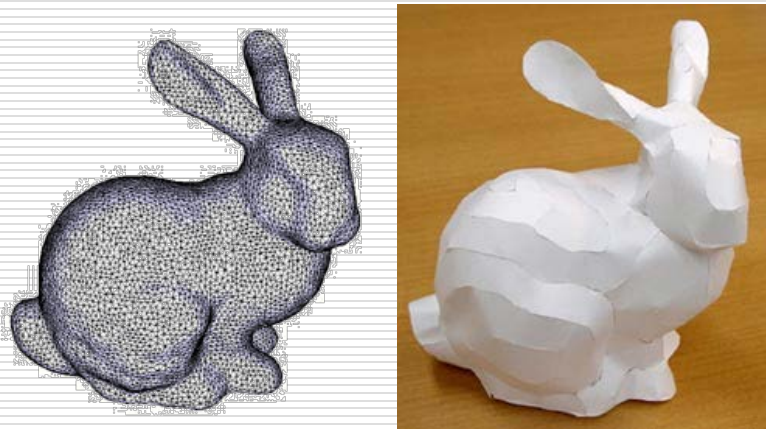


[Sumner and Popović 03']

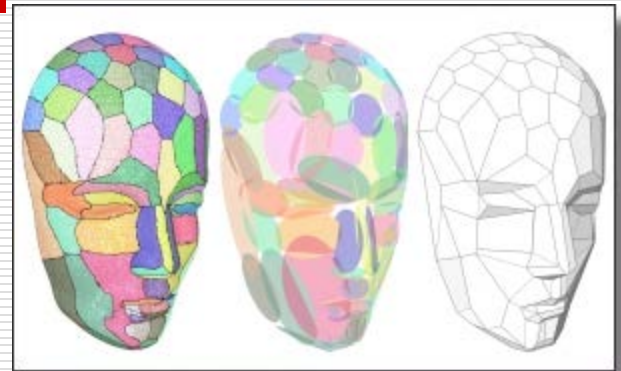


[Turk and O'Brien 99']

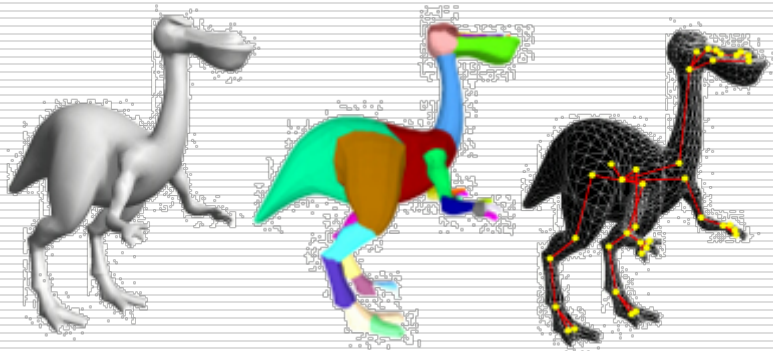
Segmentation/Decomposition



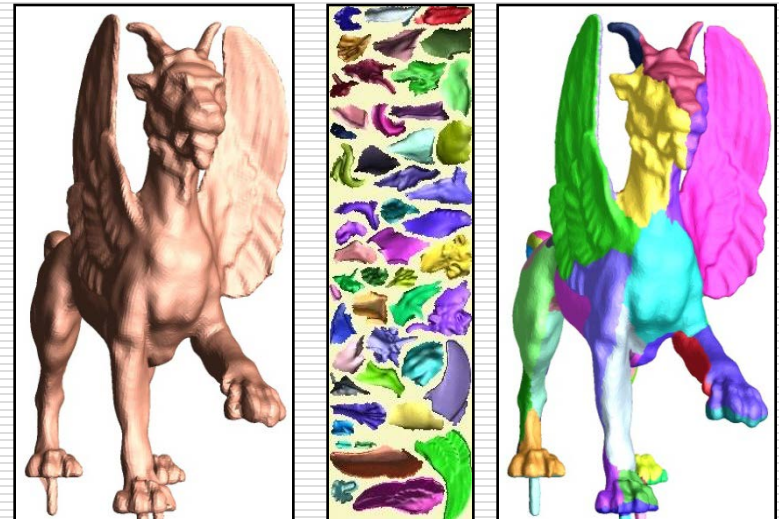
[Mitani and Suzuki 04']



[Cohen-Steiner *et al.* 04']

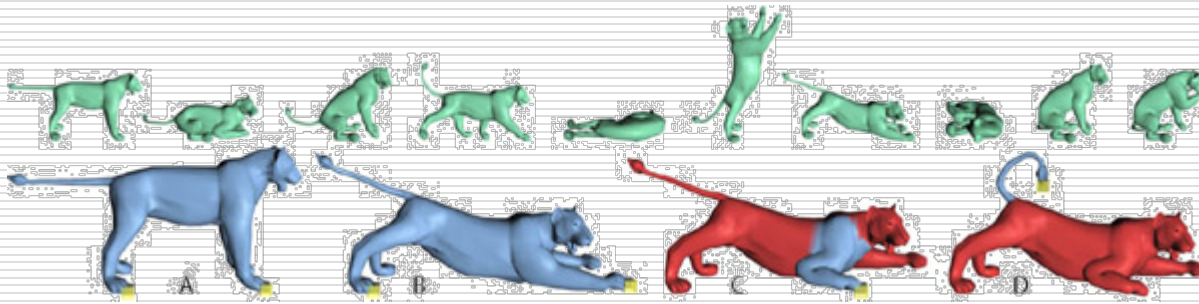


[Katz and Tal 03']



[Sander *et al.* 03']

Editing



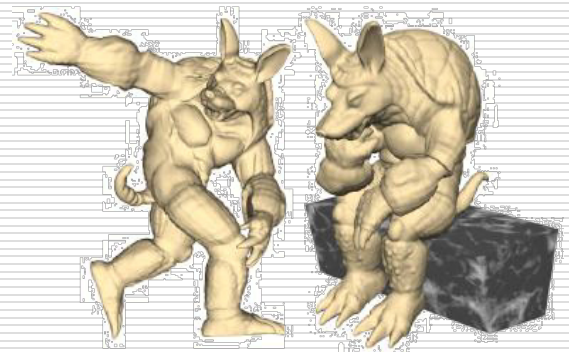
[Sumner *et al.* 05']



[Funkhouser *et al.* 04']



[Igarashi *et al.* 99']



[Huang *et al.* 06']