


Course 251-0502-00L:
Visual Computing

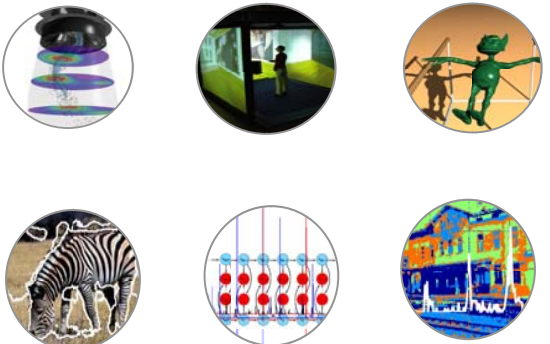
Prof. Dr. Markus Gross
Computer Graphics Laboratory
Institute of Computational Science
ETH Zürich

Prof. Dr. Joachim Buhmann
Machine Learning Group
Institute of Computational Science
ETH Zürich

SSo6




Visual Computing

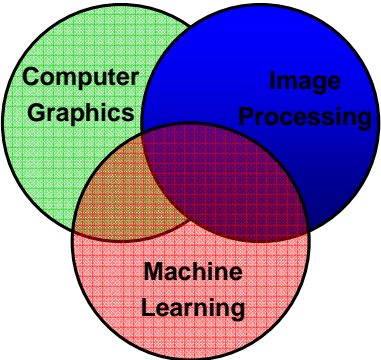


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Course Organization




Areas




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Course Organization



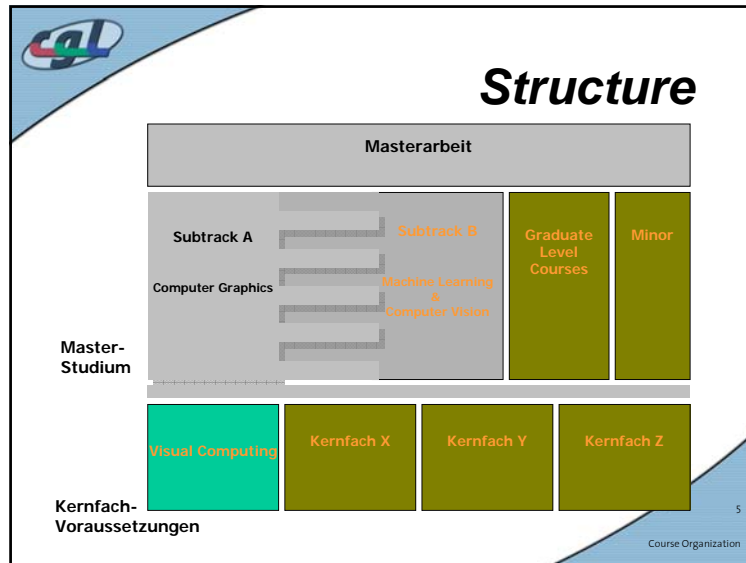
Goals

- In-depth introduction to core concepts in graphics, vision and machine learning
- Basis of the specialization track in visual computing
- Entry point for a variety of specialized courses
- Both theoretical and practical issues



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Course Organization



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- Advanced Courses (Ex.)**
- Summer semester 2006:
- Advanced Image Synthesis
 - Realistic Image Synthesis
 - Advanced Rendering Techniques
 - Physically-Based Modeling
 - Animation, deformation, fracture, flow, collision detection
 - Surface Representations and Geometric Modeling
 - Geometric Modeling, Splines, Meshes, Processing
 - Scientific Visualization
 - Volume Rendering, flow visualization
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Course Organization

Course Organization Overview

Lecturers Prof. Dr. Markus Gross
Prof. Dr. Joachim Buhmann

Locations Course: Di. 11-12 CAB G61
Mi. 10-12 IFW A36
Exercises: Di. 14-16 CAB H52, H56
Do 8-10 G52, G56


Credits 3V / 2U

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Course Organization

Course Organization Team

Markus Gross	Dozent	grossm@inf.ethz.ch
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Christian Sigg	Assi	chrsigg@inf.ethz.ch

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Course Organization **Schedule**

Course modules (part 1 - Prof. Gross):

- Introduction – graphics pipeline – API – architecture
- Colors and color models, perception
- Transformations, projections, camera models
- Lighting, reflection, shading models, ray tracing
- Texturing and aliasing, parametrization
- Sampling theorem, Fourier transform, convolution, LTI
- Linear filtering (low pass, high pass, band pass), Laplace pyramids, recursive filtering

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Course Organization **Schedule**

Course modules (part 2 - Prof. Buhmann):


- Nonlinear Filtering, edge detection, non-linear diffusion
- Shape from X
- Bayes rules, optimal classifiers
- Linear classifiers, support vector machines
- Dimensionality reduction, PCA, ICA, local linear embedding
- Clustering – K-means, C-means, EM-compression
- MRF models, Bayes nets

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Course Organization **Schedule**

Exercises:



- Both practical and theoretical exercises.
- Weekly submissions.
- Electronic registration (during first week).
- Additional details on webpage.
- First exercise handed out on April 11.

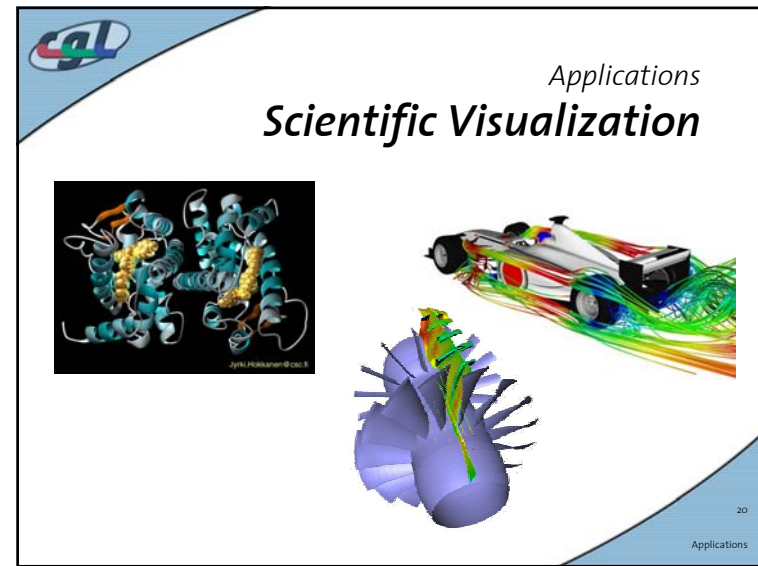
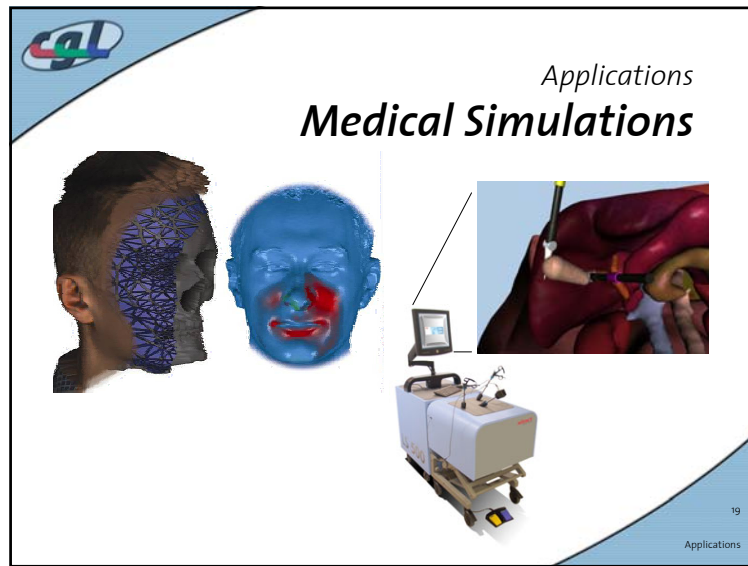
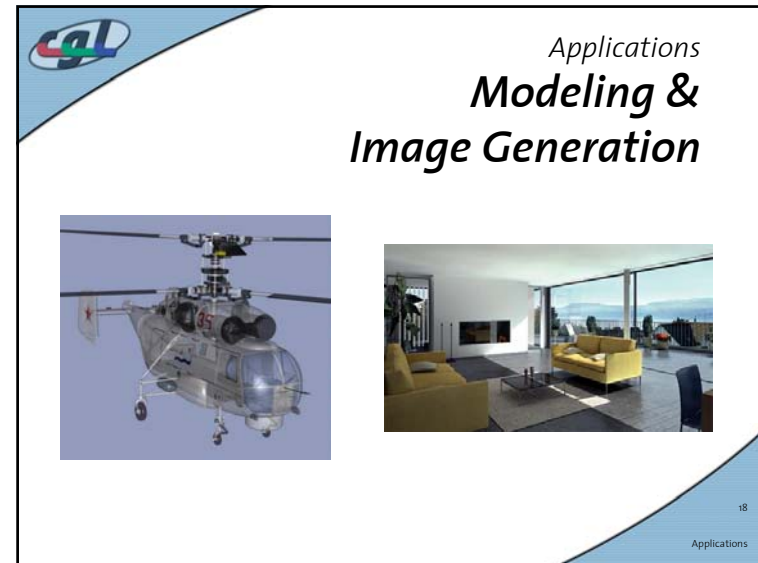
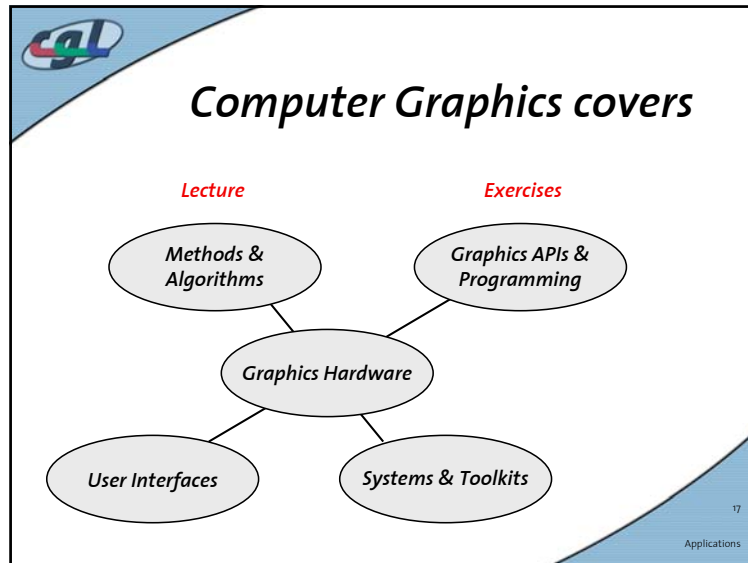
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Course Organization **Material**

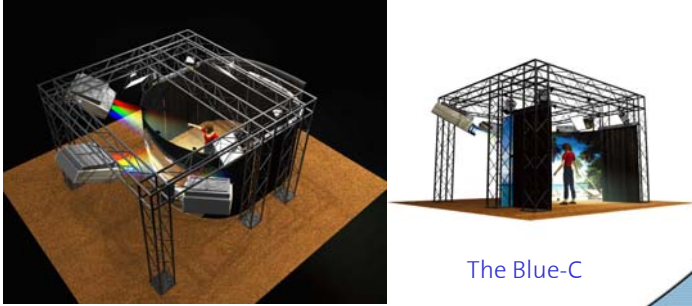
- Lecture notes:
 - Covering first part of lecture
 - CHF 20.–
- Slide set in PDF format
- Java applets.
- Course webpage:
 - http://graphics.ethz.ch/main.php?Menu=4&Submenu=5&Course=vc_master&Hornav=1

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Applications
Collaborative VE



The Blue-C

21
Applications



Markets
Feature Films




22
Applications



Markets
Games



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Applications



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Further Readings

- D. F. Rogers:
Procedural Elements of Computer Graphics
2nd edition, McGraw-Hill, 1997.
- A. Watt:
3D Computer Graphics
3rd edition, Addison-Wesley, 1999.
- J. Foley, A. van Dam, S. Feiner, J. Hughes:
Computer Graphics – Principles and Practice
Addison-Wesley, 1990.
- J. Encarnacao, W. Strasser, R. Klein:
Graphische Datenverarbeitung
4th edition, Oldenburg, 1996.

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Course Organization Further Readings

- T. Akenine-Möller, E. Haines:
Real-time Rendering
2nd edition, A. K. Peters Ltd, 2002.
<http://www.realtimerendering.com>
- M. Woo, J. Neider, T. Davis:
OpenGL Programming Guide
4th edition, Addison Wesley,
OpenGL Version 1.4





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A Brief History of Computer Graphics


A Summary of
Wayne Carlson's
A Critical History of Computer Graphics
accad.osu.edu/~waynec/history/lessons.html



*The discipline is so recent in its early
developments
and so rapidly changing
that we are in fact living it,
and it evolves as we speak.*

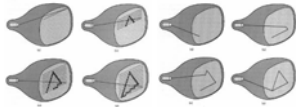


Wayne Carlson

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History




Beginnings

- 1885 Invention of CRT
(Cathode Ray Tube)
- 1927 First 60 line raster scanned
image by Philo Farnsworth
- 1938 First mechanical computer
Z1 by Konrad Zuse
- 1946 ENIAC: Electronic Numerical
Integrator And Computer
based on vacuum tubes






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History




Beginnings

- 1946 MIT: Whirlwind computer, first computer with real-time display airplanes on **vector CRT**, **interaction** with light pen
- 1947 Invention of **transistor** (transfer resistor)
- 1959 TX-2 developed at MIT first **transistor-based** computer with 9 inch CRT + light pen




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History




1960's

- 1961 **Spacewar** first computer game at MIT
- 1963 Sketchpad on TX-2 by **Ivan Sutherland** "grandfather" of interactive computer graphics
- 1968 Douglas Engelbart invents computer **mouse**
- 1969 ACM **Siggraph** founded
- 1969 First **frame buffer** at Bell Labs
- 1969 First **GUI** by Alan Kay (Xerox)



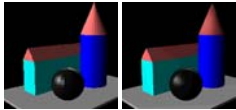




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History




1970's

- 1971 Henri **Gouraud**: Interpolated shading
- 1974 Ed Catmull: **Texture** mapping, Z-buffer
- 1974 Sutherland: Polygon **clipping**
- 1975 Bui-Tuong **Phong**: Normal interpolation shading
- 1975 Martin Newell: **Utah Teapot**
- 1976 Jim Blinn: **Environment mapping**
- 1977 Jack **Bresenham**: Scan conversion algorithms
- 1978 Blinn: **Bump mapping**









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History




1980's

- 1980 Turner Whitted: **Ray tracing**
- 1982 Silicon Graphics (**SGI**) founded
- 1982 TRON (Disney) 15 minutes of computer generated images
- 1983 Apple Lisa: First **PC with GUI**
- 1984 Goral et. al: **Radiosity**
- 1985 Microsoft **Windows 1.01**
- 1986 MIT: **X-Window** System









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History




1990's

- 1992 OpenGL released by SGI
- 1994 Greg Turk scans Stanford Bunny
- 1995 Toy Story: First full-length computer animated film
- 1996 3Dfx Voodoo: First 3D accelerator for PCs, textured triangles
- 1999 GeForce256: Transformation & Lighting (T&L)
- 1999 PC graphics outperform SGI graphics workstations








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History




2000 - present

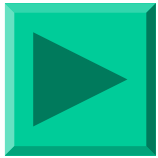
- 2001 GeForce3: Programmable T&L
- 2001 Final Fantasy: Human actors replaced by CG models
- 2004 GeForce FX, ATI Radeon 9800XT
ca. 4 billion texels/s,
ca. 400 million vertices/s
- 2005 Sony PS3 + cell chip, 2 TFlops


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History




Example Demo Realtime FEM



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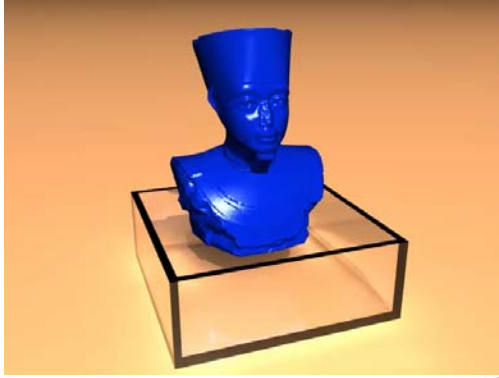
Vessel Rupture



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Heat Transfer and Melting



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Boiling

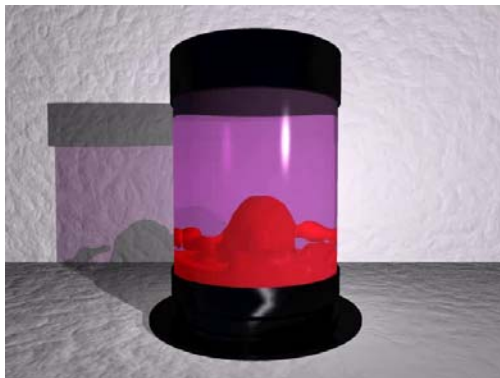


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Lava



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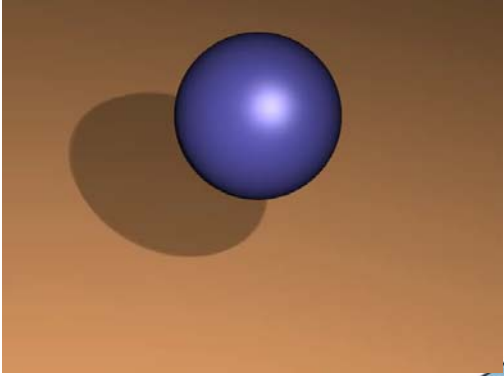
Brittle



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 *Shell Physics- Balloon*



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 *Shell Physics- Baloon*



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