Computer Graphics

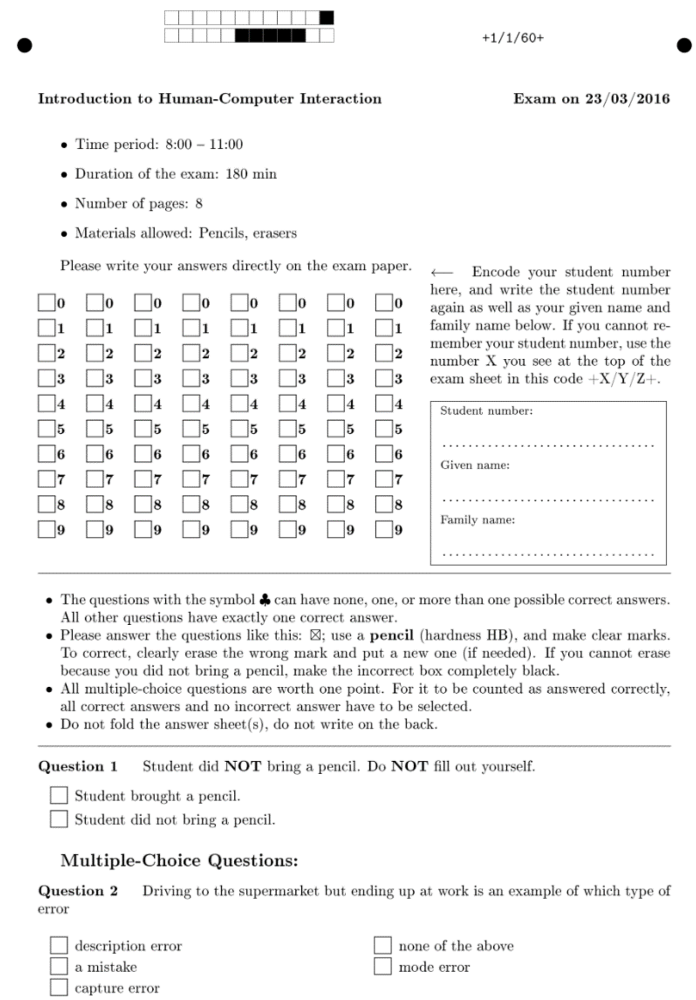
…. and beyond

What will the exam be about?

- what we talked about in class
  - principles
  - algorithms
  - techniques
  - approaches
  - deriving core algorithms/techniques
- use slides to study
- use book for in-depth repetition

Exam

- multiple-choice
- in English
- statements about the contents of the lecture
- mark the correct statements
- typically not time-limited
- **no negative points**



+1/1/60+

Introduction to Human-Computer Interaction **Exam on 23/03/2016**

- Time period: 8:00 – 11:00
- Duration of the exam: 180 min
- Number of pages: 8
- Materials allowed: Pencils, erasers

Please write your answers directly on the exam paper.

☐0	☐0	☐0	☐0	☐0	☐0	☐0	☐0
☐1	☐1	☐1	☐1	☐1	☐1	☐1	☐1
☐2	☐2	☐2	☐2	☐2	☐2	☐2	☐2
☐3	☐3	☐3	☐3	☐3	☐3	☐3	☐3
☐4	☐4	☐4	☐4	☐4	☐4	☐4	☐4
☐5	☐5	☐5	☐5	☐5	☐5	☐5	☐5
☐6	☐6	☐6	☐6	☐6	☐6	☐6	☐6
☐7	☐7	☐7	☐7	☐7	☐7	☐7	☐7
☐8	☐8	☐8	☐8	☐8	☐8	☐8	☐8
☐9	☐9	☐9	☐9	☐9	☐9	☐9	☐9

← Encode your student number here, and write the student number again as well as your given name and family name below. If you cannot remember your student number, use the number X you see at the top of the exam sheet in this code +X/Y/Z+.

Student number:

....

Given name:

....

Family name:

....

- The questions with the symbol ♣ can have none, one, or more than one possible correct answers. All other questions have exactly one correct answer.
- Please answer the questions like this: ☒; use a **pencil** (hardness HB), and make clear marks. To correct, clearly erase the wrong mark and put a new one (if needed). If you cannot erase because you did not bring a pencil, make the incorrect box completely black.
- All multiple-choice questions are worth one point. For it to be counted as answered correctly, all correct answers and no incorrect answer have to be selected.
- Do not fold the answer sheet(s), do not write on the back.

Question 1 Student did **NOT** bring a pencil. Do **NOT** fill out yourself.

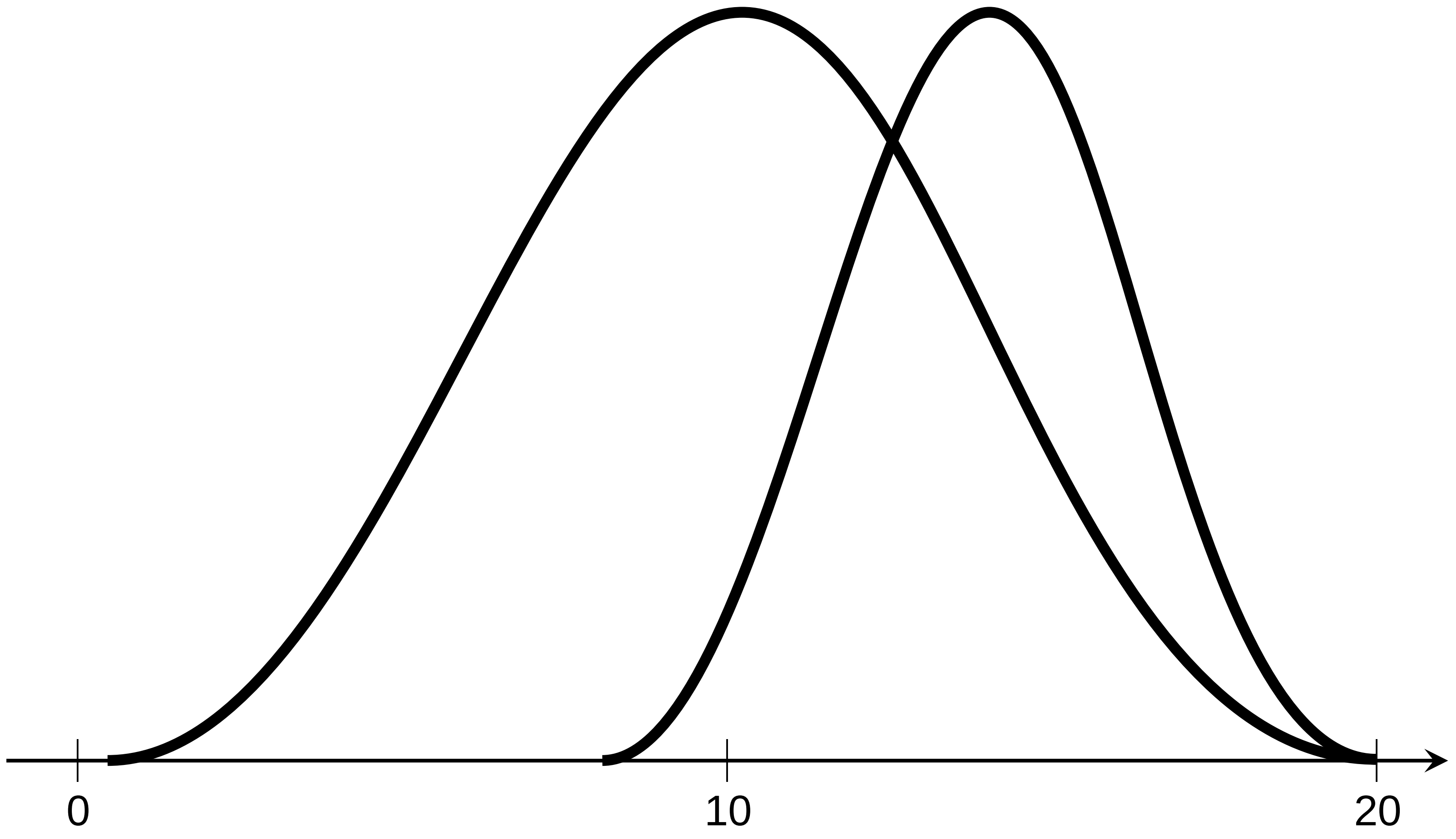
☐ Student brought a pencil.
☐ Student did not bring a pencil.

Multiple-Choice Questions:

Question 2 Driving to the supermarket but ending up at work is an example of which type of error

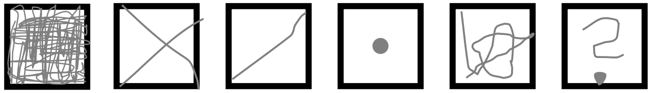
☐ description error
☐ a mistake
☐ capture error
☐ none of the above
☐ mode error

Exam: Hypothetical negative points



Exam: How-To

- bring **soft pencil & eraser** (HB or softer)
- or some other pen that you can erase/fix
- bring your **student ID card** (not ISIC)

- please fill in the boxes as follows: 
- not ok: 
- possibly multiple correct answers (marked by ♣) vs. single correct answer (no ♣)
  - use of consistency checks (“none of the answers are correct”)

Exam: Grading

- each box (☐) is a binary decision
  - if it should be marked:
    - gets you points if you mark it (correctly)
    - does not get you points if you do not mark it
  - if it should not be marked:
    - gets you points if you do not mark it (correctly)
    - does not get you points if you mark it
  - each question is worth 1 point
  - partially correctly answered questions are graded proportionally
  - e.g., 3/5 boxes correctly marked: 0.6 points

Exam: Example question (single)

- What is greatest/coolest algorithm in CG?

■ Bresenham's midpoint algorithm. 1/1 points

□ Cohen and Sutherland's bitmask clipping.

□ Liang and Barsky's intersection point method.

□ Flood fill.

□ None of these answers is correct.

Exam: Example question (single)

- What is greatest/coolest algorithm in CG?

☐ Bresenham's midpoint algorithm.

0/1 points

☐ Cohen and Sutherland's bitmask clipping.

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■ Flood fill.

☐ None of these answers is correct.

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☒ None of these answers is correct.

Exam: Example question (multiple ♣)

- ♣ Which of these statments is/are correct?

☐ The speed of rendering does not matter, as long as the results are correct.

☐ The precision of rendering does not matter, as long as it is fast.

☒ Rendering should be both fast and correct.

☒ The needed rendering precision is guided by the pixel resolution.

☐ None of these answers is correct.

1/1 points

Exam: Example question (multiple ♣)

- ♣ Which of these statments is/are correct?

☐ The speed of rendering does not matter, as long as the results are correct.

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☐ None of these answers is correct.

0.75/1 points

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☐ None of these answers is correct.

0.5/1 points

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☐ None of these answers is correct.

0.5/1 points

Exam: Example question (multiple ♣)

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☐ Rendering should be both fast and correct.

☐ The needed rendering precision is guided by the pixel resolution.

☐ None of these answers is correct.

0.25/1 points

Exam: Example question (multiple ♣)

- ♣ Which of these statments is/are correct?

- [ ] The speed of rendering does not matter, as long as the results are correct.
- [x] The precision of rendering does not matter, as long as it is fast.
- [ ] Rendering should be both fast and correct.
- [ ] The needed rendering precision is guided by the pixel resolution.
- [x] None of these answers is correct.

0/1 points

Exam: Example question (multiple ♣)

- ♣ Which of these statments is/are correct?

- The speed of rendering does not matter, as long as the results are correct.
- The precision of rendering does not matter, as long as it is fast.
- Rendering should be both fast and correct.
- The needed rendering precision is guided by the pixel resolution.
- None of these answers is correct.

0/1 points

Exam: Example question (multiple ♣)

- ♣ Which of these statments is/are correct?

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☐ None of these answers is correct.

0/1 points

Exam: Strategies

- not answering a question definitely does not get you any points
- marking all boxes for all questions will be considered as trying to cheat
- if you don't know an answer, use your best guess (pure chance gets you 50% on average [for ♣ questions])
  $\rightarrow$ educated guesses get you more!
- please **no empty questions**!

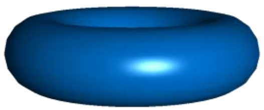
Computer Graphics and Beyond

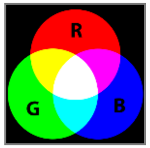
- only basics covered so far
  - fundamental algorithms & techniques
  - fundamental issues & approaches
    - approximations that are visually good enough
    - speed, speed, speed
  - tools to apply for larger problems
- many more topics open or to come (a bit biased)
  - animation & advanced rendering techniques
  - scientific and information visualization
  - interaction & interfaces

Advanced Graphics Class in ET5

1. quick CG recap
   advanced illumination
   models, BRDFs

$$\begin{bmatrix} x' \\ y' \\ w' \end{bmatrix} = \begin{bmatrix} a & c & b \\ d & e & f \\ g & h & i \end{bmatrix} \begin{bmatrix} x \\ y \\ w \end{bmatrix}$$





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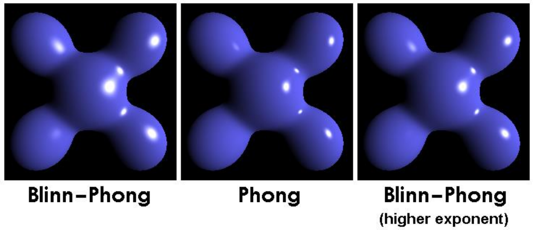

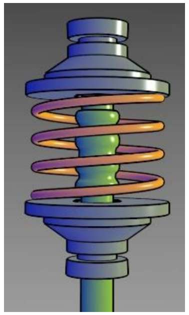

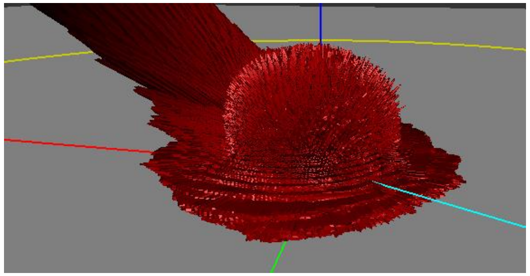

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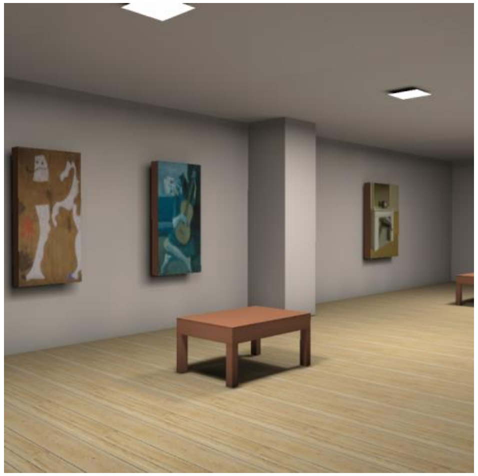

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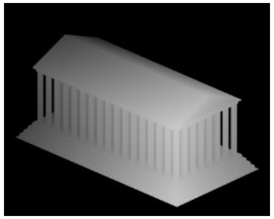
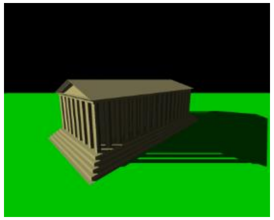
   sub-surface scattering





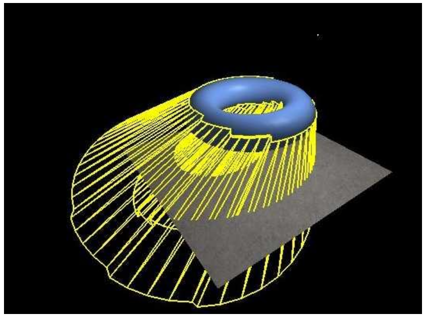


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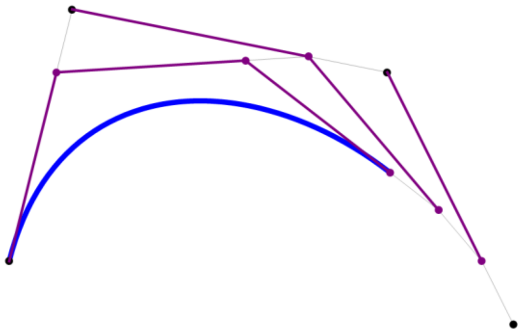
   image-based rendering



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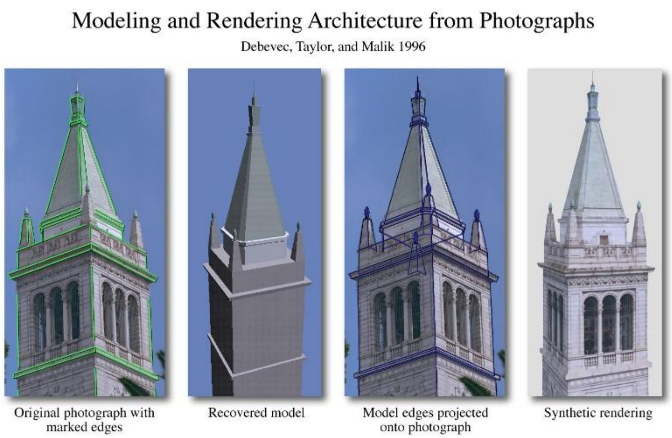

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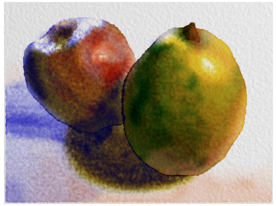
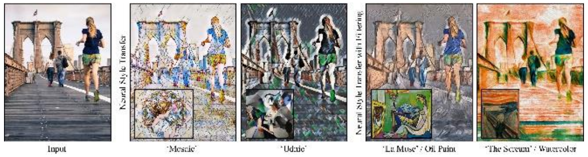
6. non-photorealistic rendering





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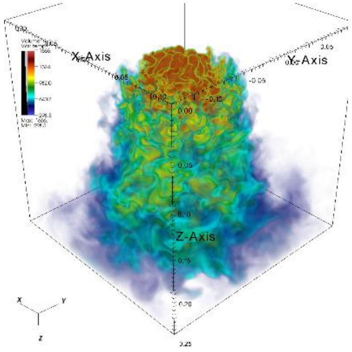
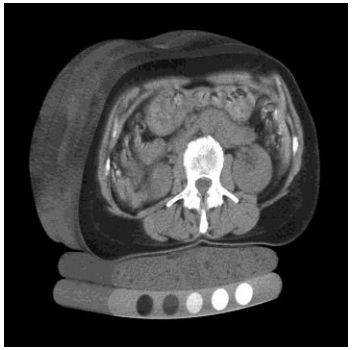
7. voxels & volume rendering
   applications, topics in visualization





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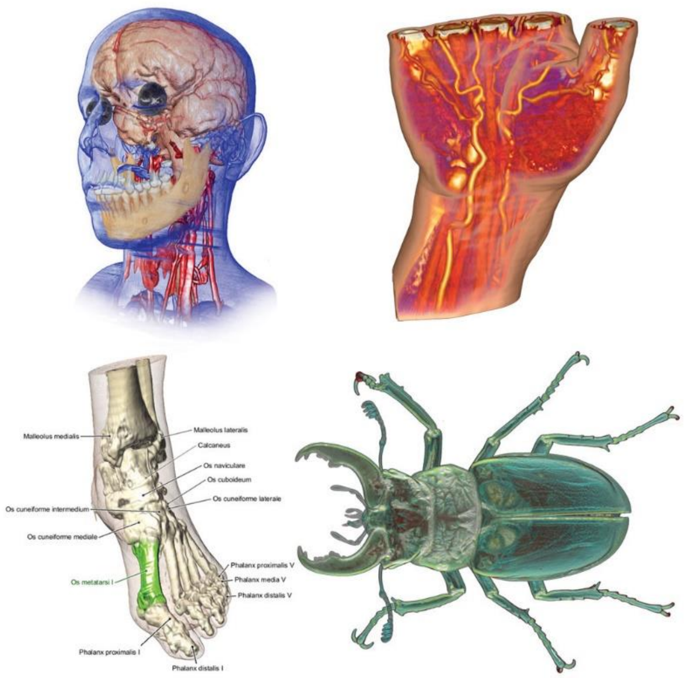
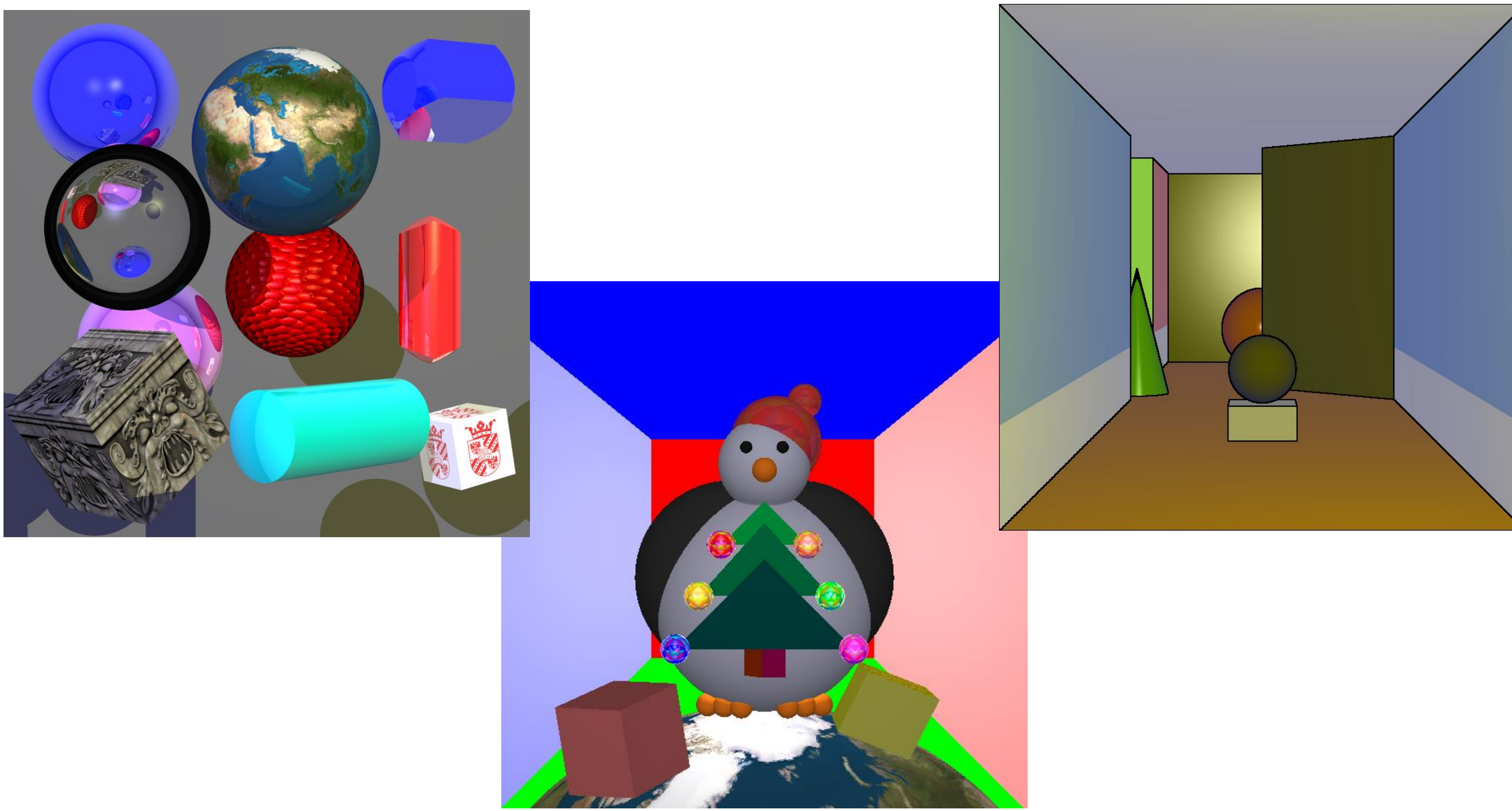


Advanced Graphics Class in ET5

- implementation of a raytracer



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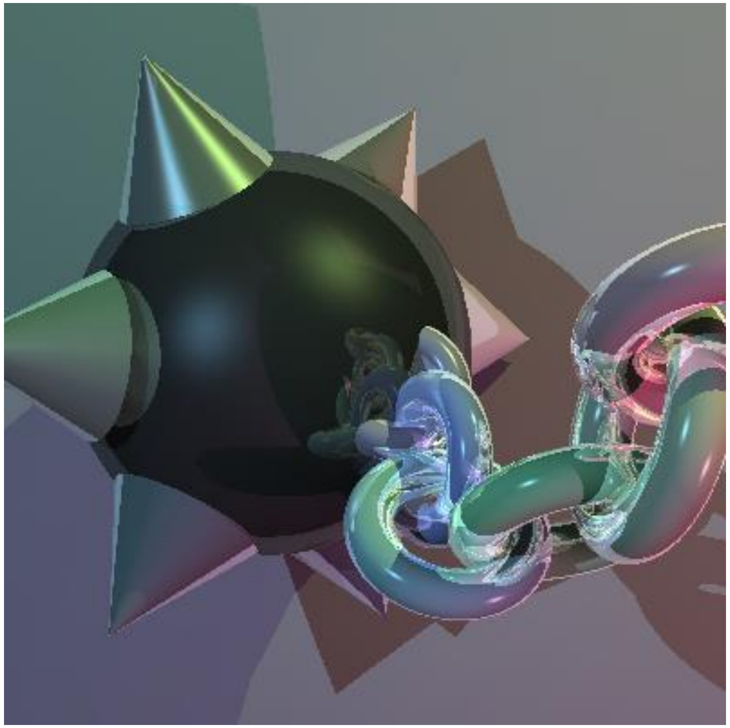
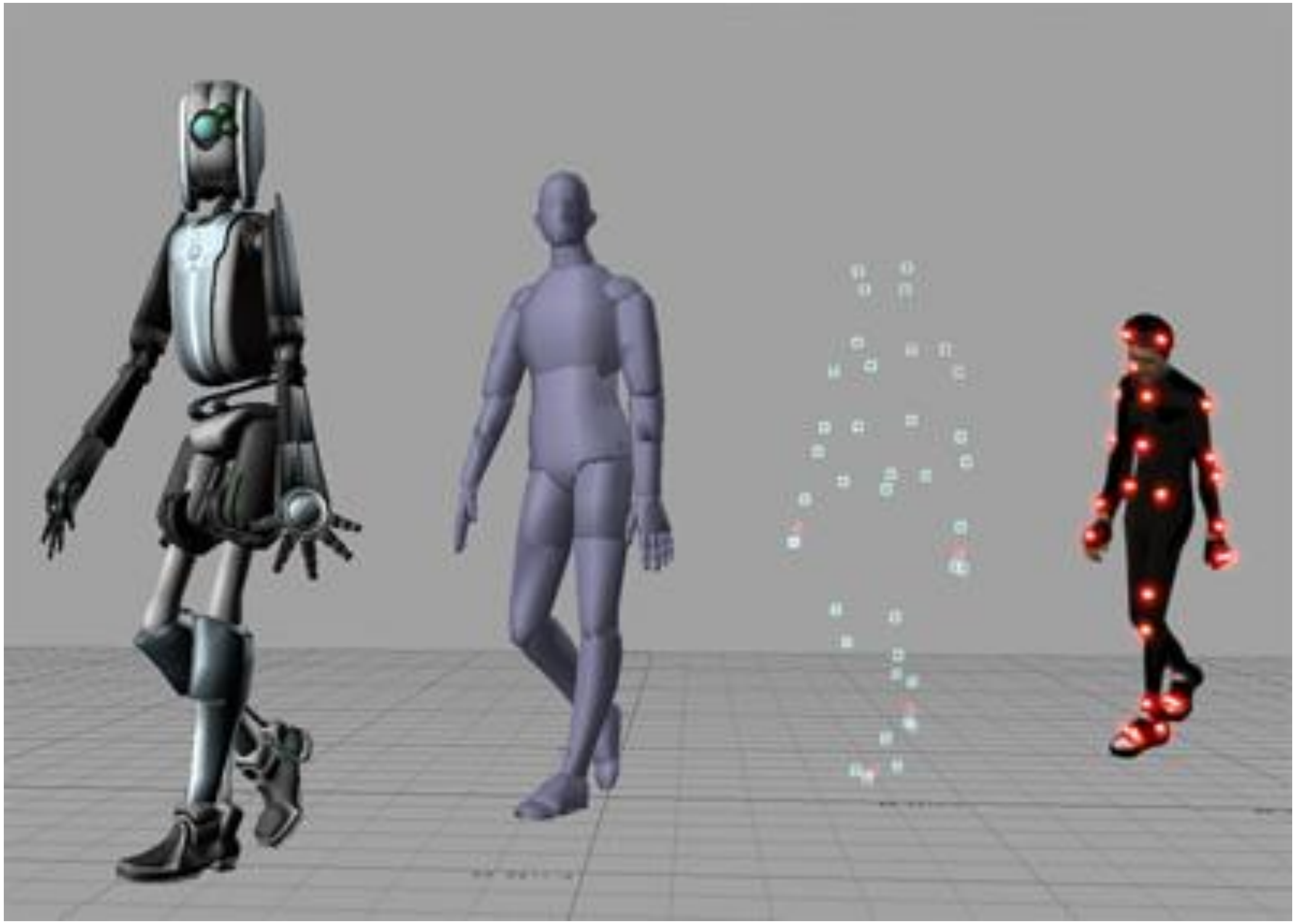


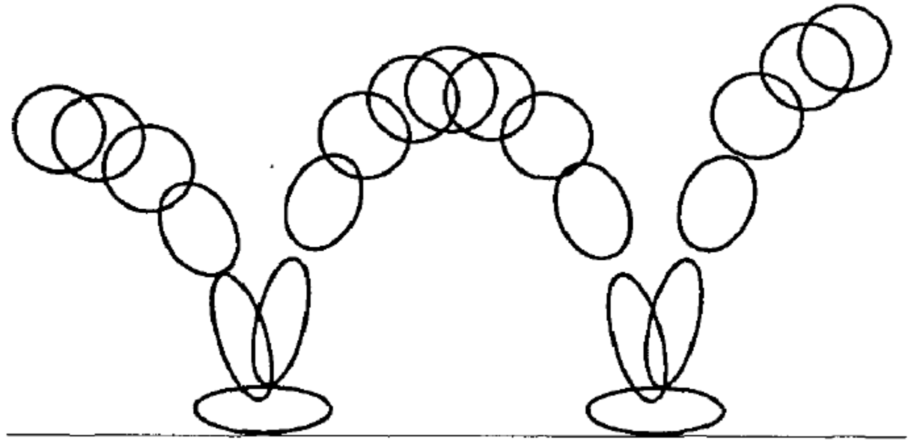
Animation Techniques

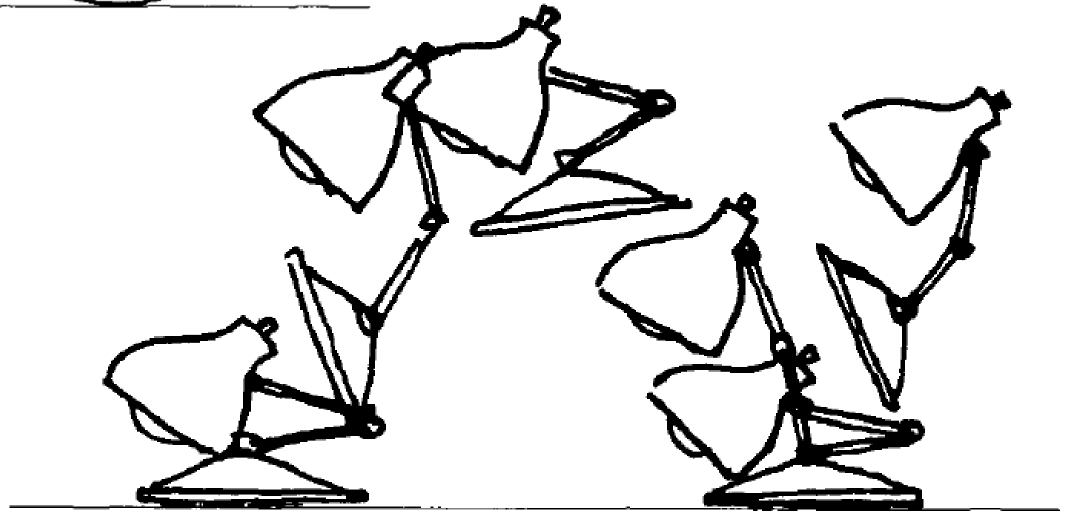
- hierarchies & bones, mocap, cloth etc.



Animation Techniques

- animation principles: squash & stretch etc.

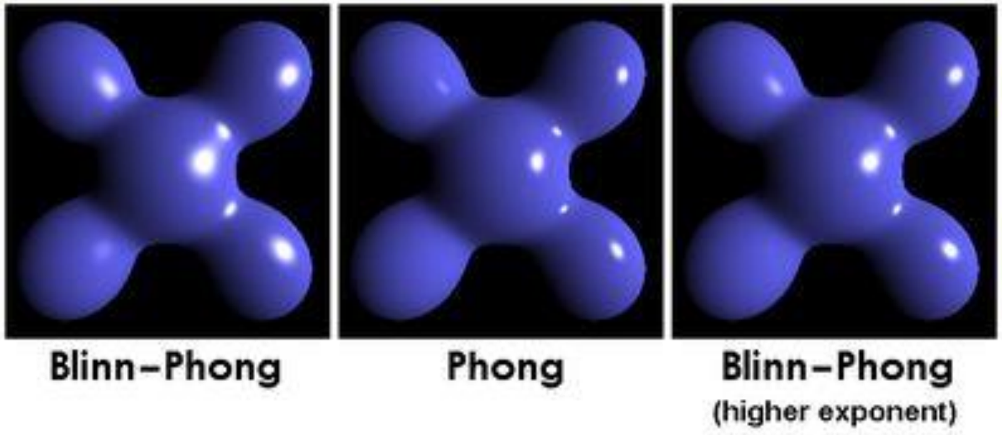




Lasseter 1987

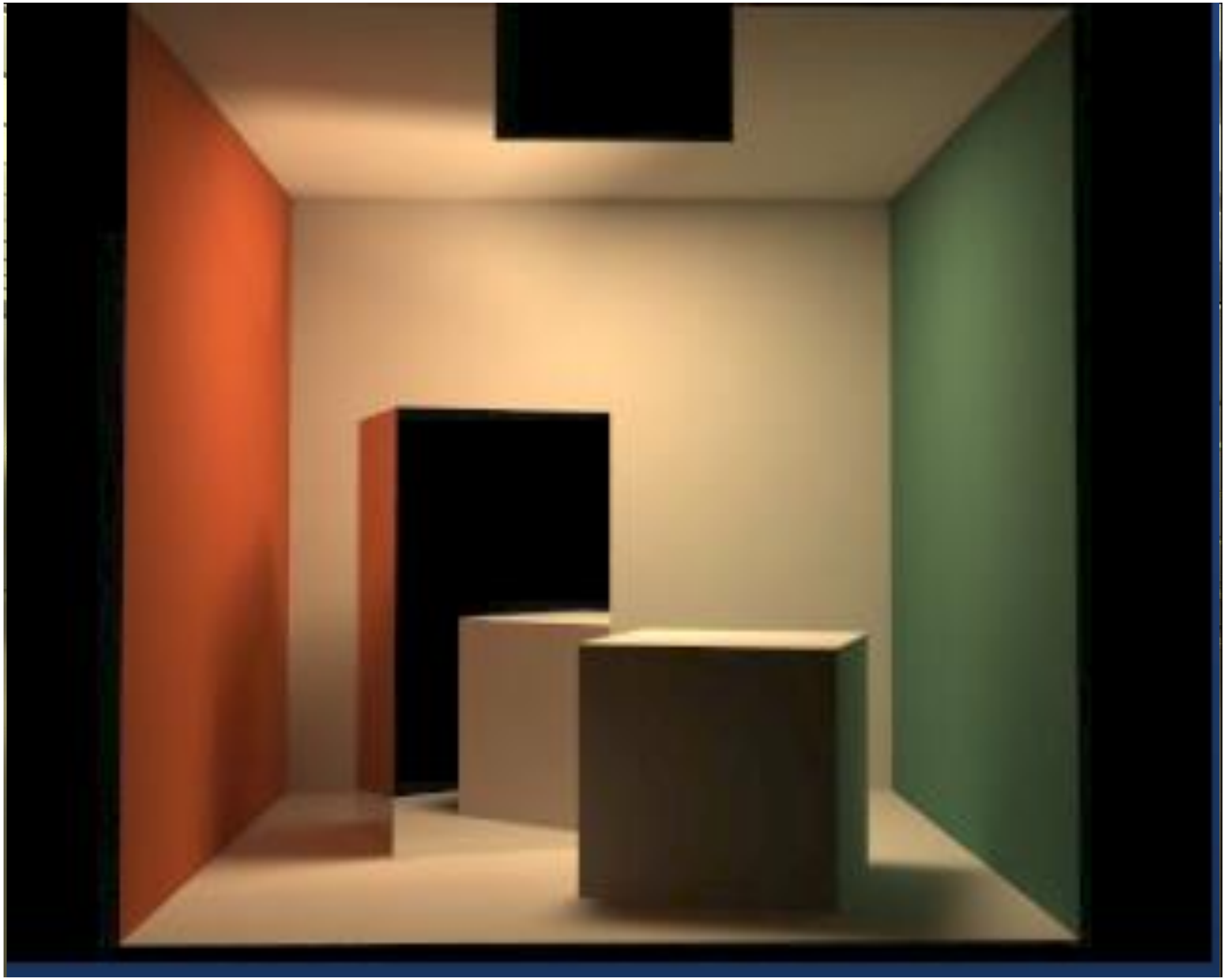
Other Illumination Models

- Blinn-Phong model



- Cook-Torrance model

Global Illumination: Radiosity



Ambient Occlusion

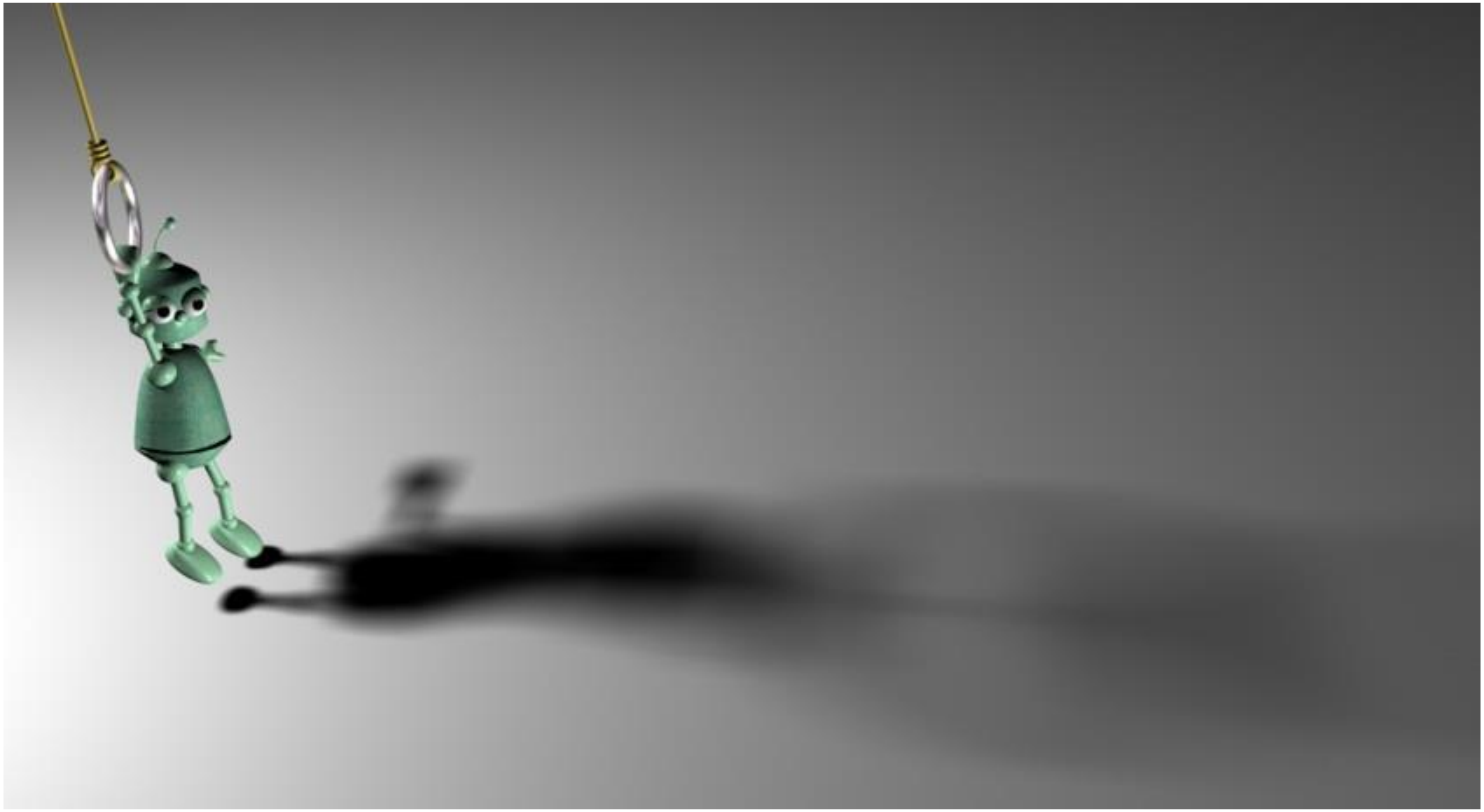
Global Illumination: Raytracing

Realtime Raytracing

Hardware-Supported Rendering

[nVidia]

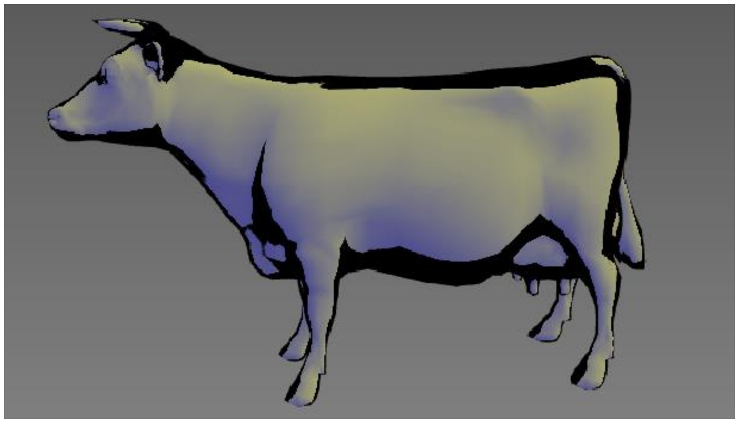
Shadow Rendering



Sub-Surface Scattering

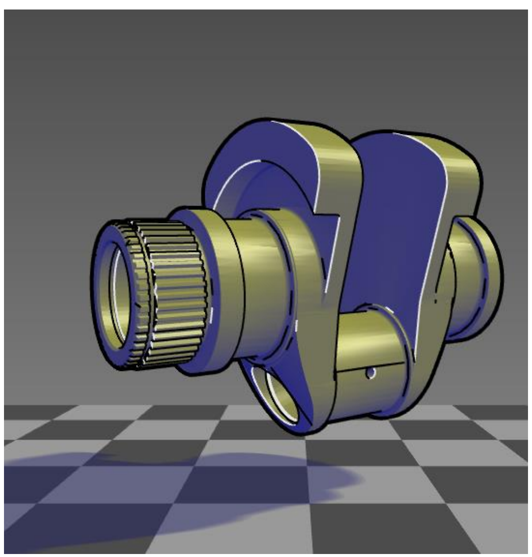
Non-Photorealistic Rendering

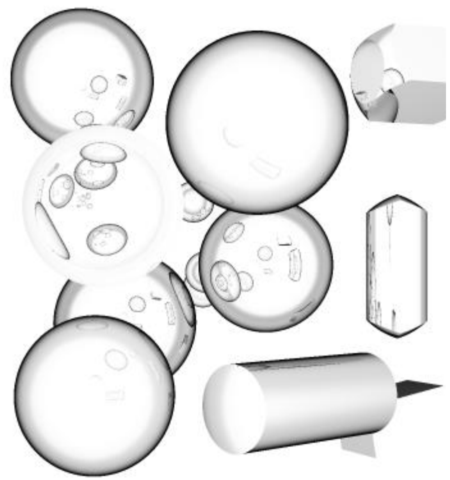
- rendering silhouettes, outlines, features

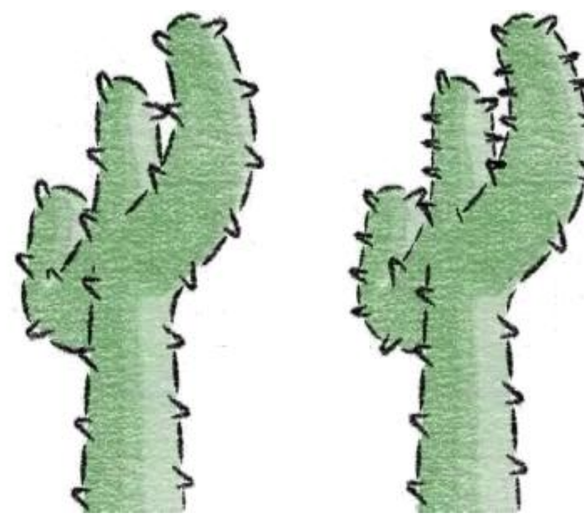


DeCarlo et al., 2003

Gooch et al., 1999







Kalnins et al., 2003

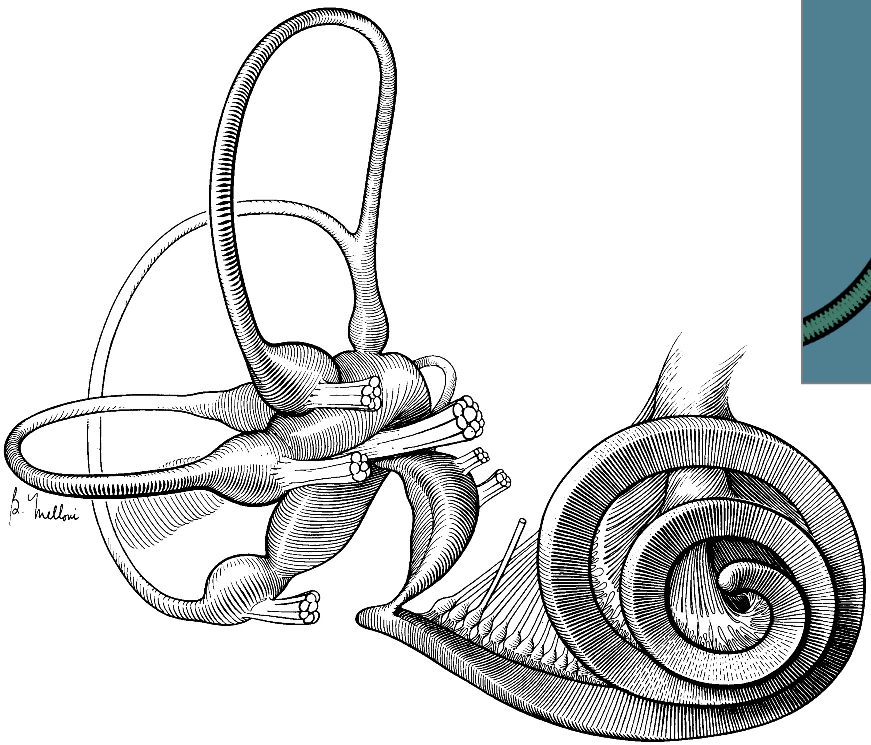
Non-Photorealistic Rendering

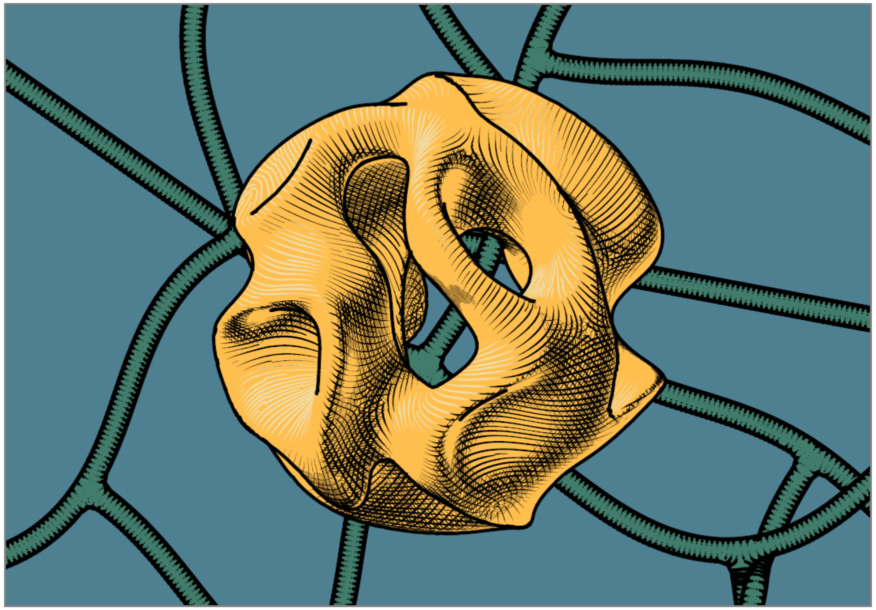
- cartoon shading and other shading styles

Lee et al, 2007

Non-Photorealistic Rendering

- rendering illustration styles: hatching

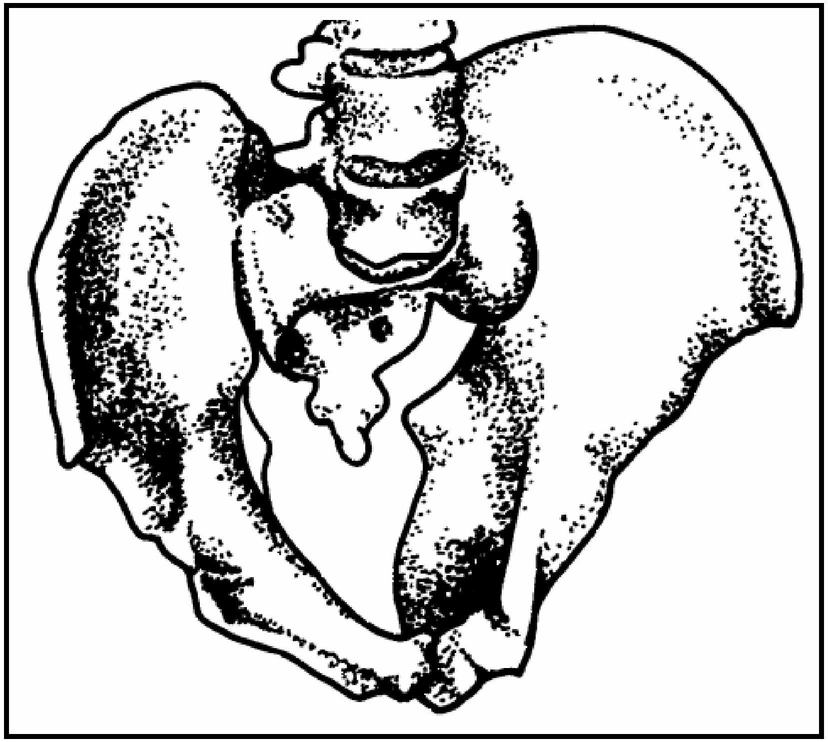


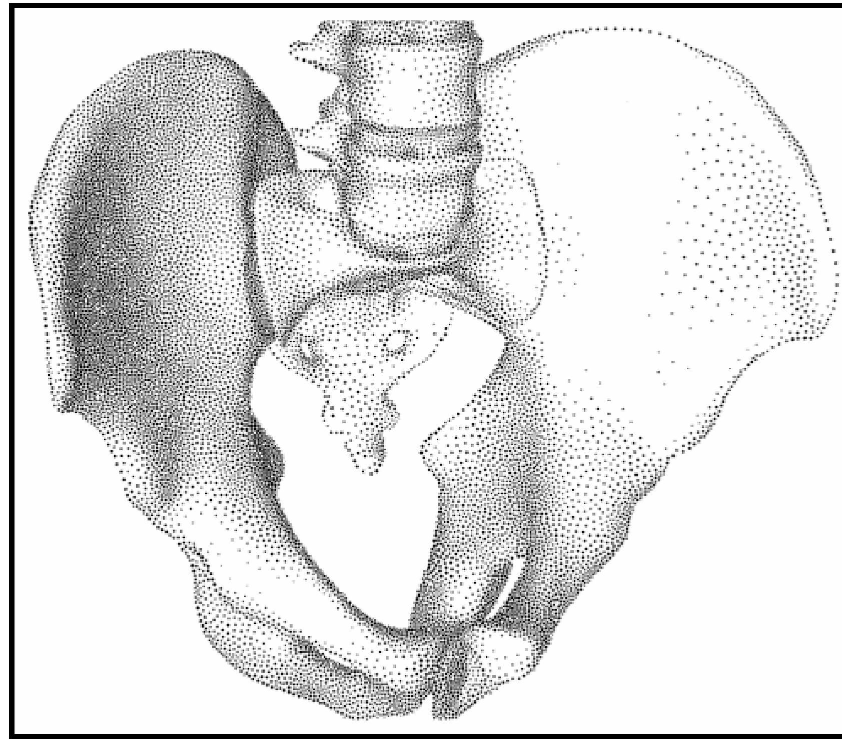


Zander et al. 2004

Non-Photorealistic Rendering

- rendering illustration styles: stippling





Non-Photorealistic Rendering

- stroke-based rendering: “cg painting”

Meier 1997

Curtis et al. 1997

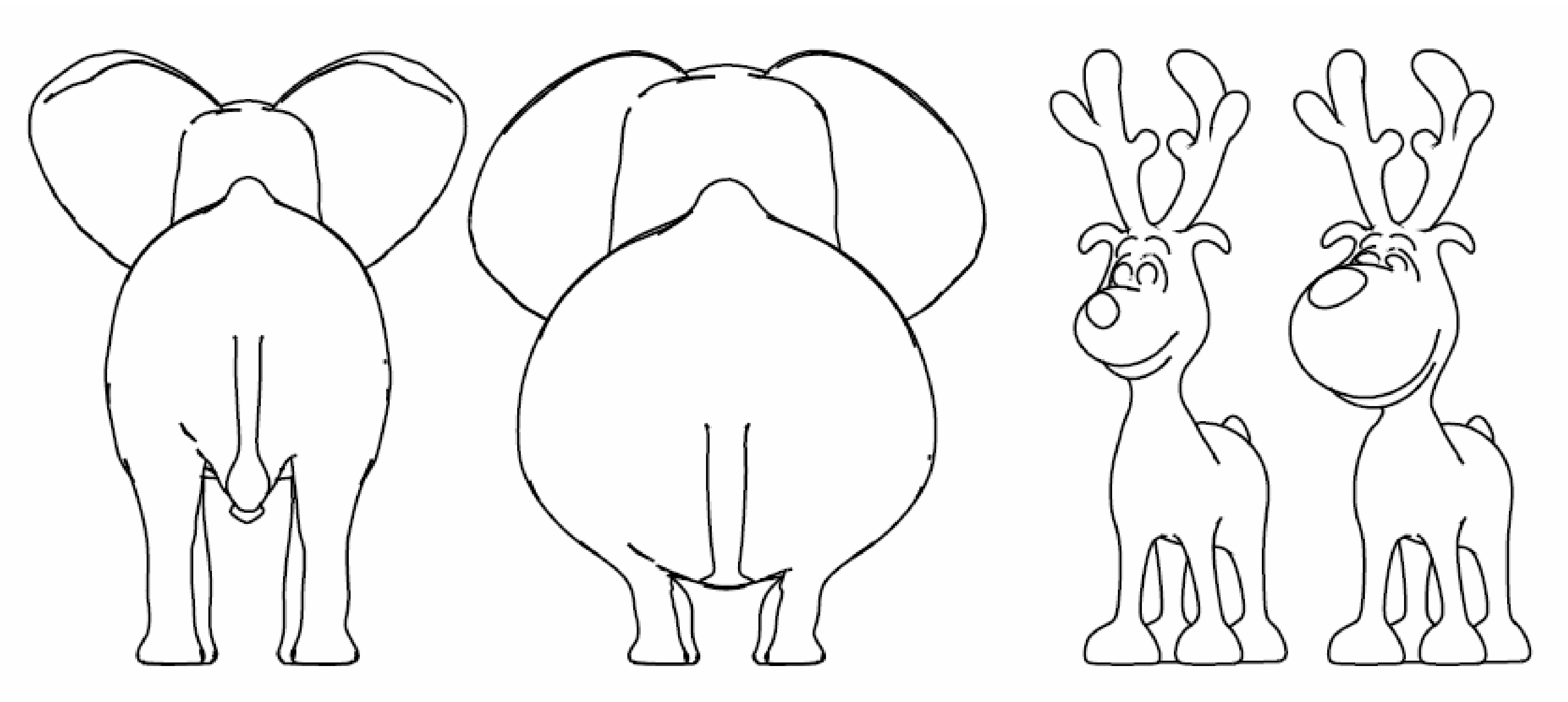
Non-Photorealistic Rendering

- distortion & non-real modeling

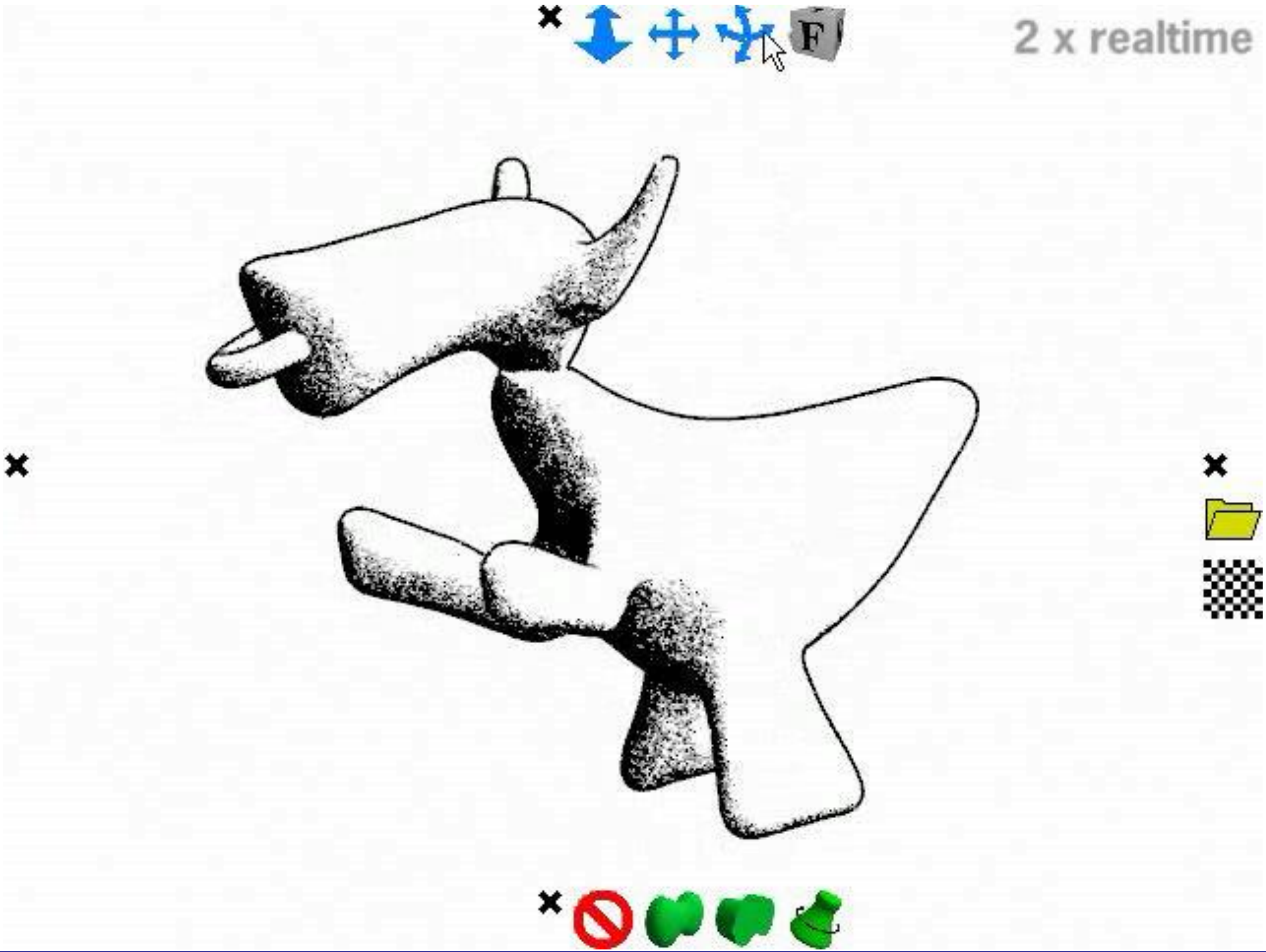
Coleman & Singh 2004

Non-Photorealistic Rendering

- distortion & non-real modeling

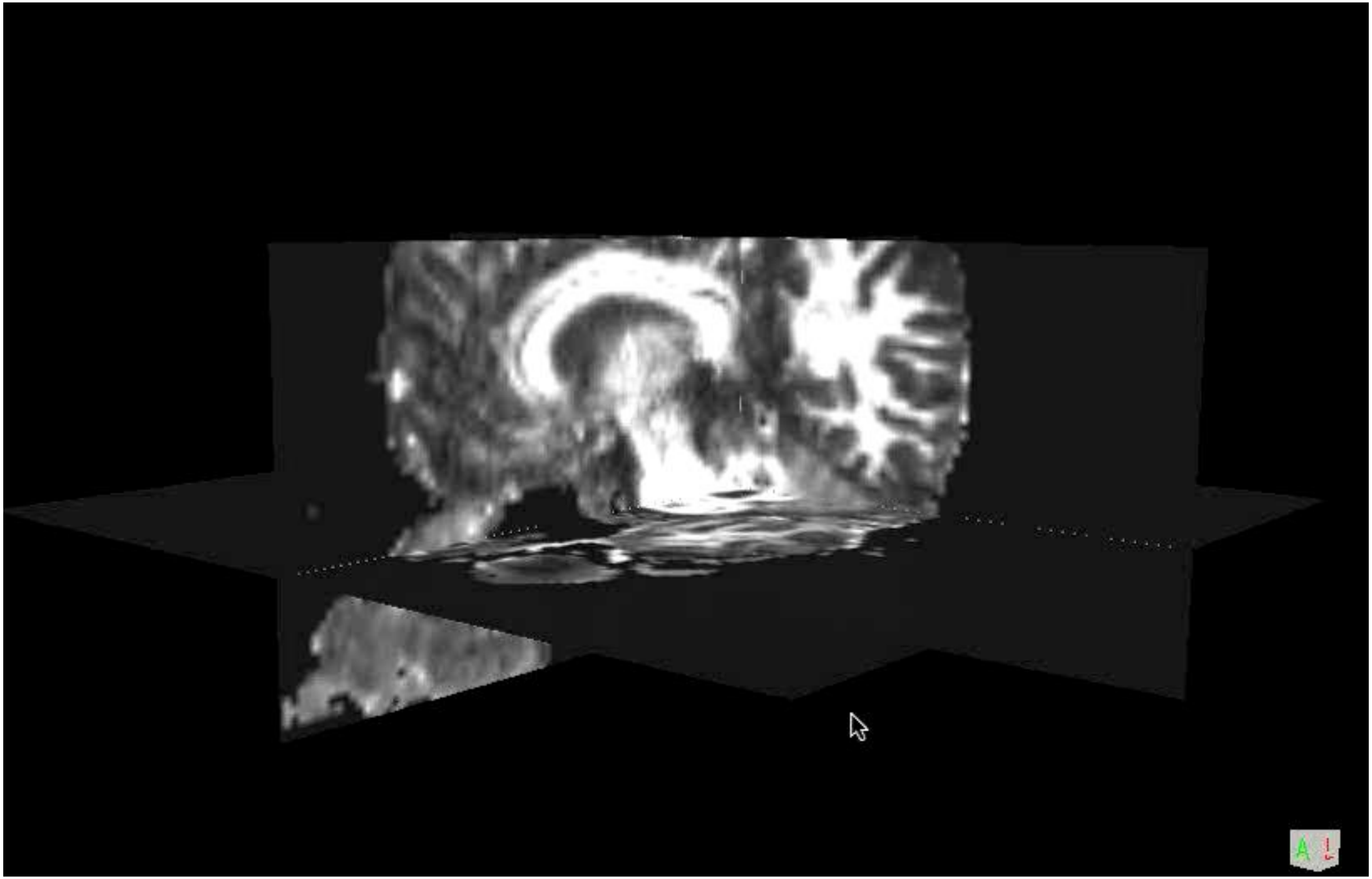


Sketch-Based Modeling & NPR



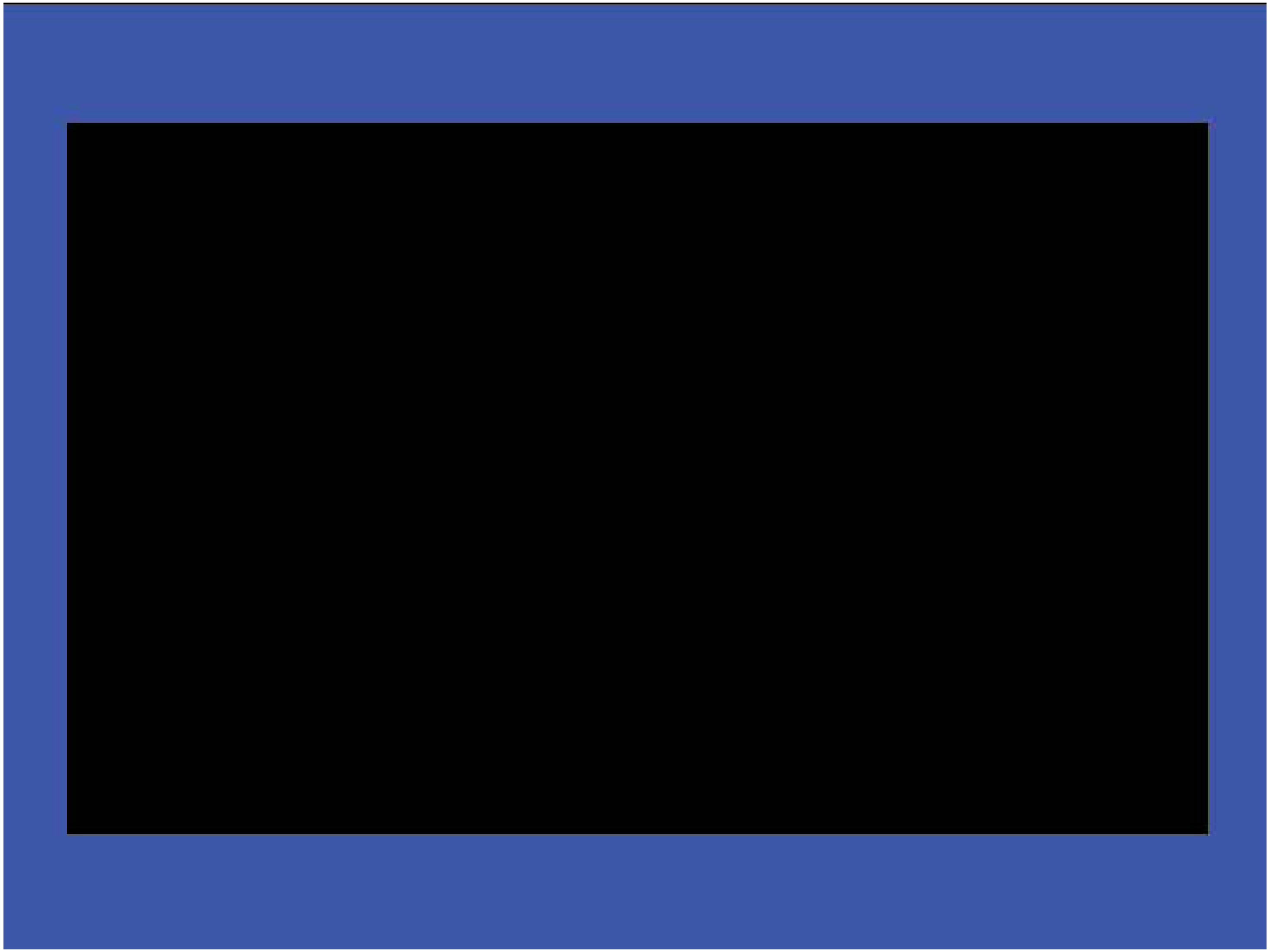
with R. Schmidt, P. Jepp, K. Singh, & B. Wyvill

Scientific Vis / Volume Rendering



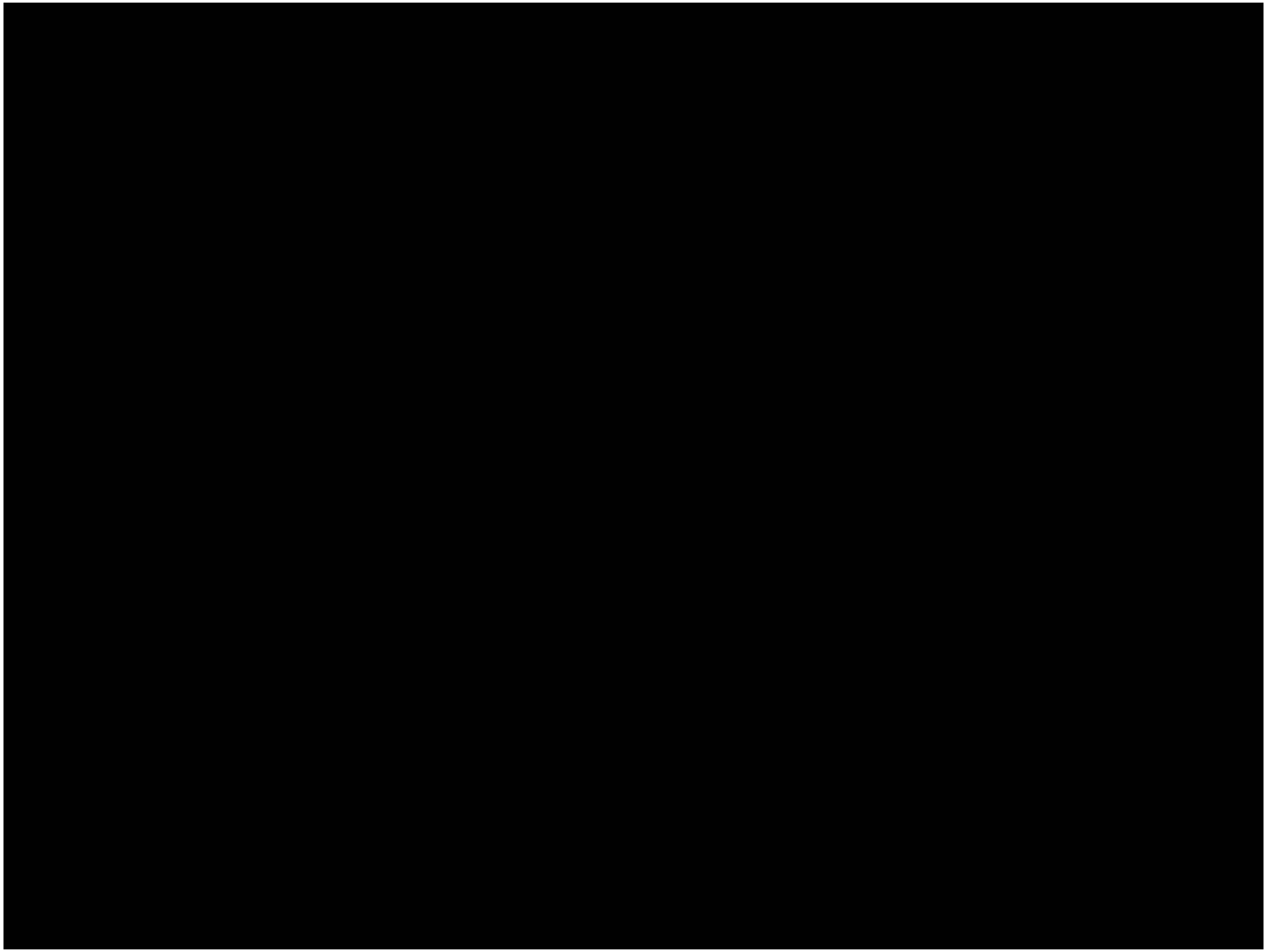
created with TrackVis

Scientific Vis / Volume Rendering



Westenberg et al., 2004

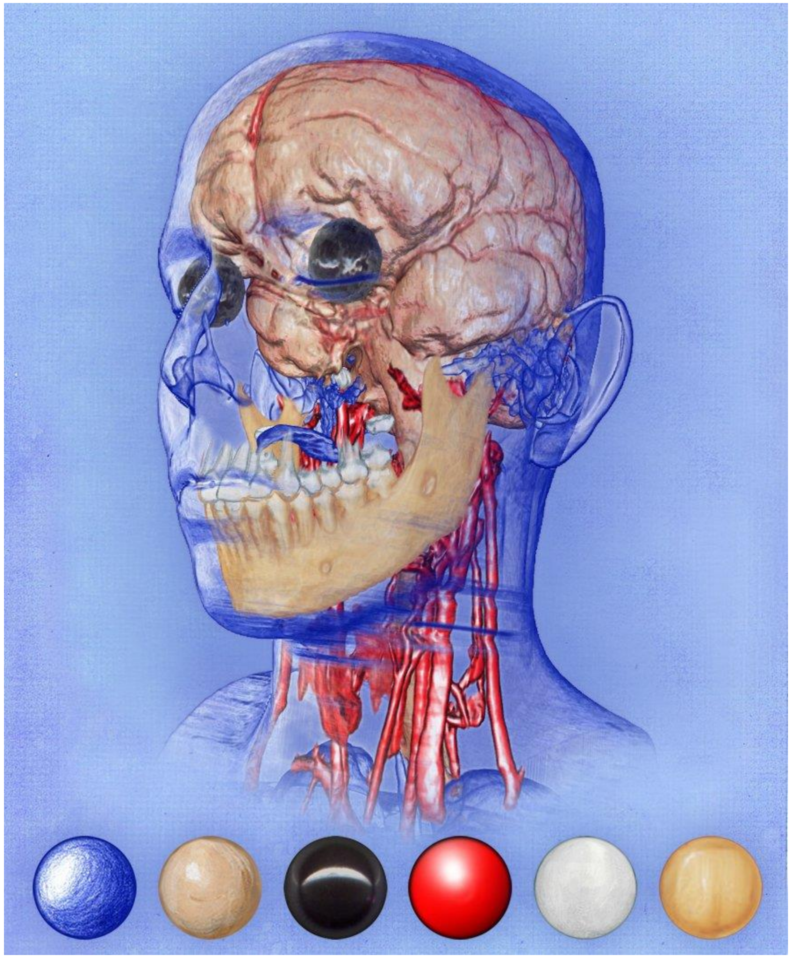
Scientific Vis / Volume Rendering



Burns et al., 2007

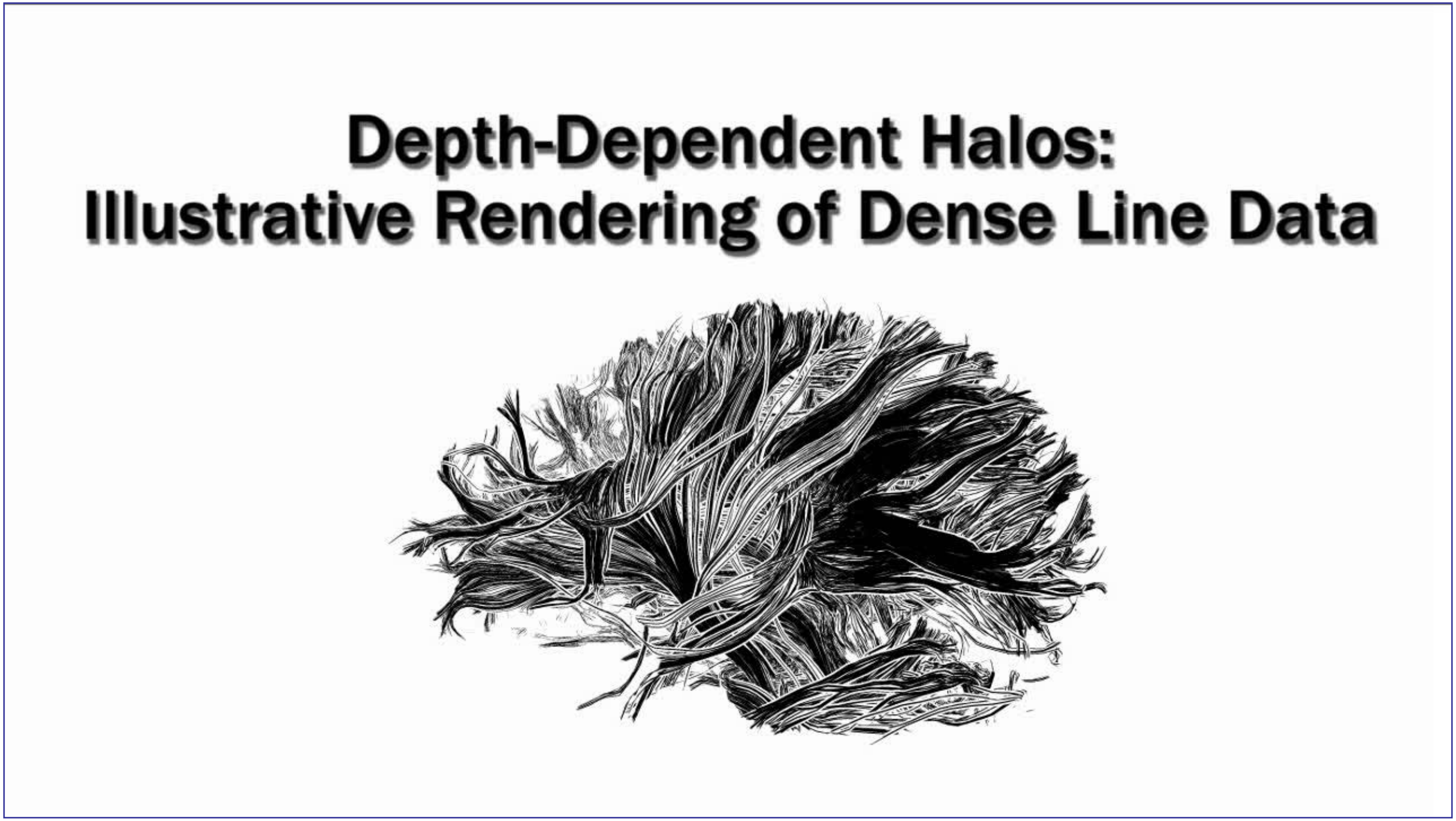
Scientific Vis / Volume Rendering

- medical visualization and illustration



2 x Bruckner and Gröller, 2007

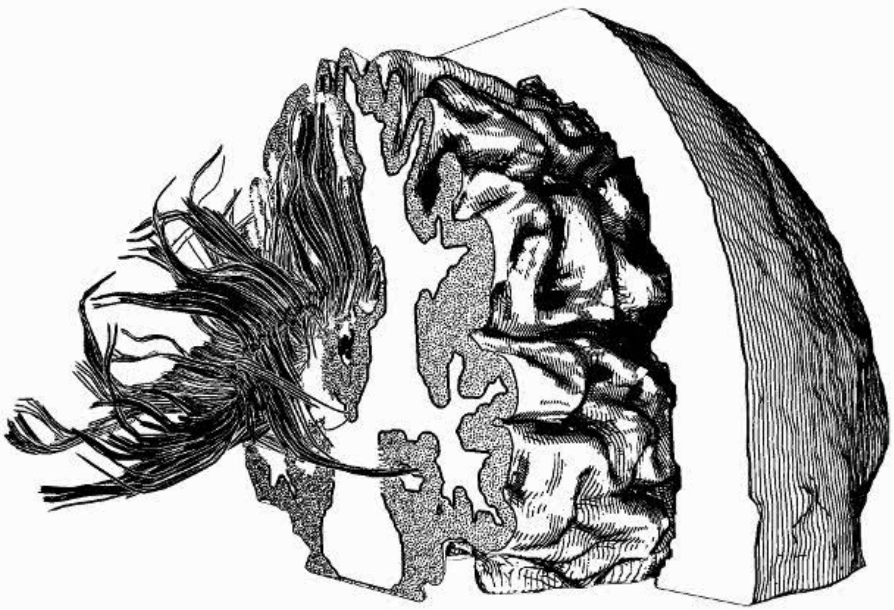
Scientific Vis / Volume Rendering



Everts et al., 2009

Scientific Vis / Volume Rendering

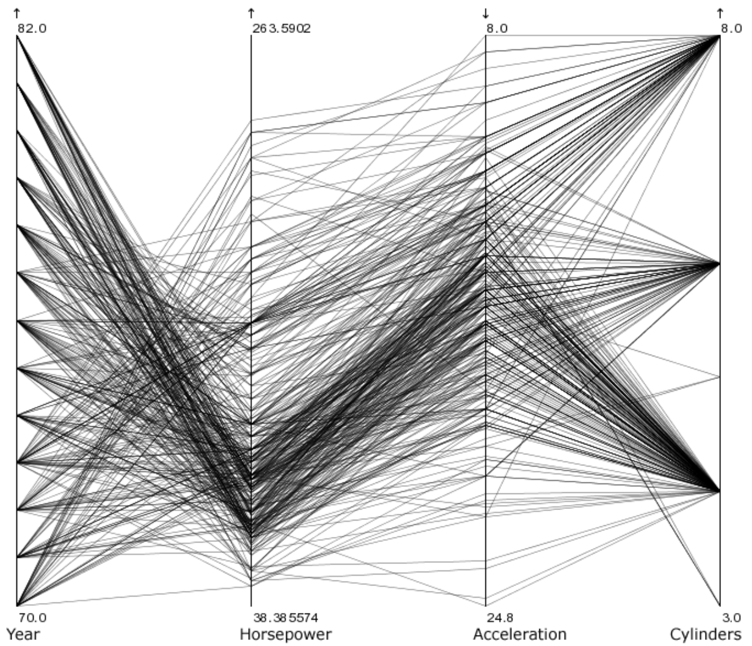
DTI in Context:
Illustrating Brain Fiber Tracts in Situ



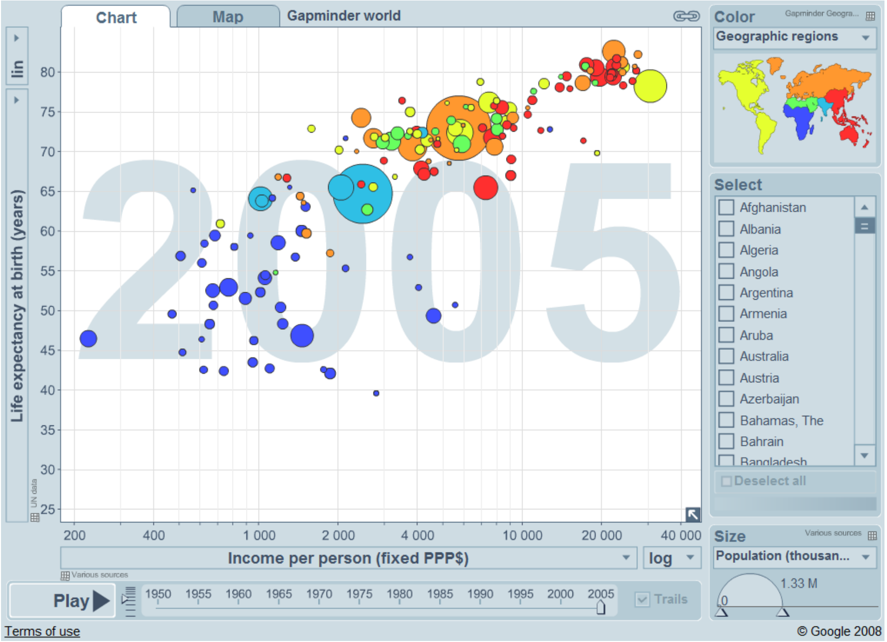
Svetachov et al., 2010

Information Visualization

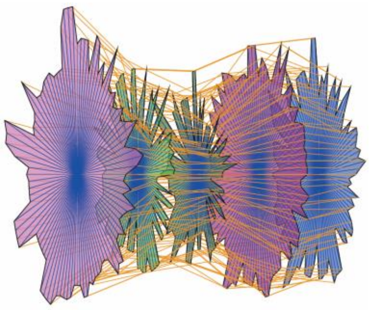
- visualization of multi-dimensional data



Hauser et al., 2002



Gapminder



Fanea et al., 2005

Information Visualization: A Quiz

- Which country of each pair has the higher child mortality rate?

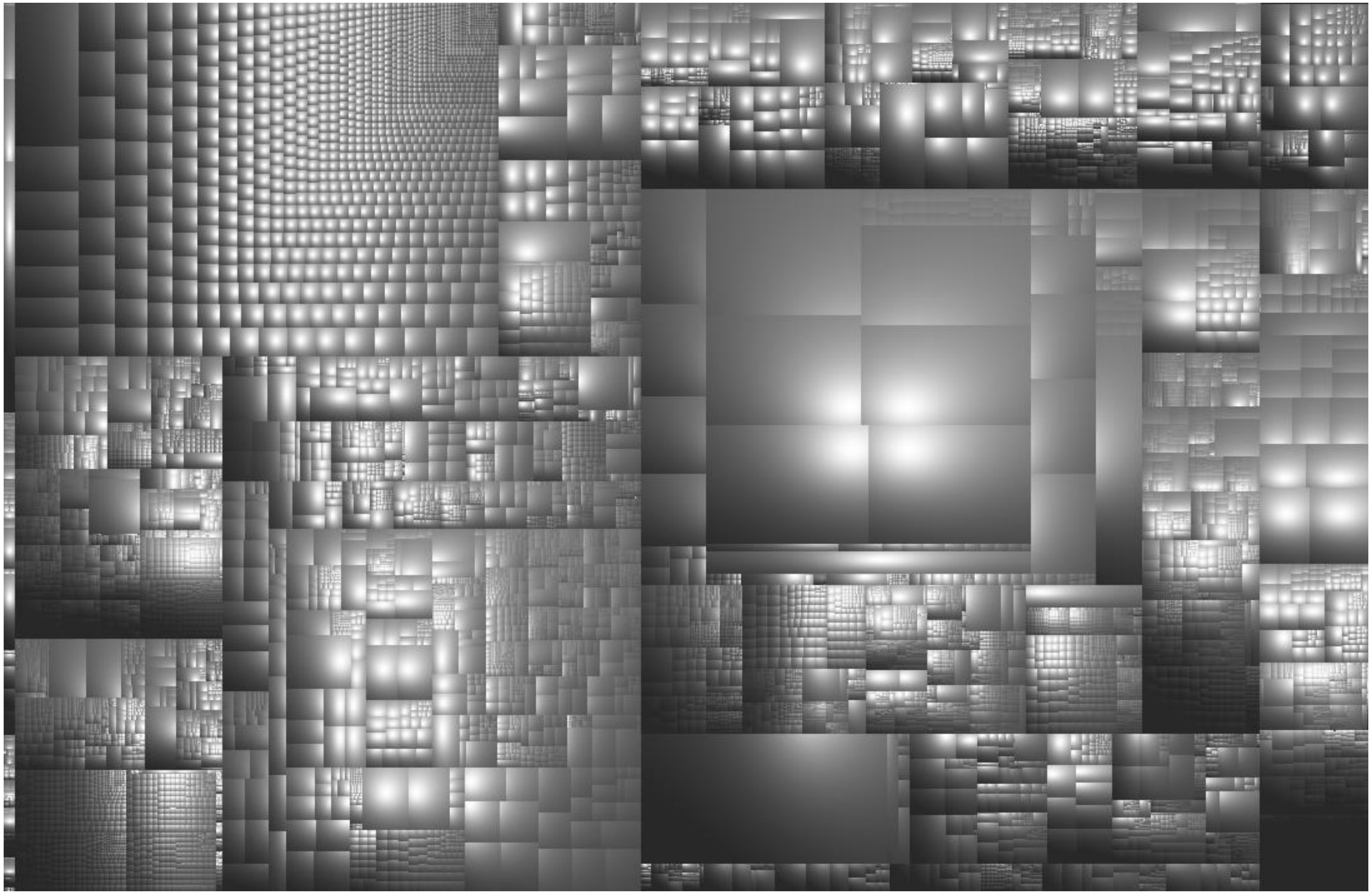
Sri Lanka	or	Turkey
Poland	or	South Korea
Malaysia	or	Russia
Pakistan	or	Vietnam
Thailand	or	South Africa

Information Visualization

Hans Rosling, 2006, at TED (http://www.ted.com/talks/view/id/92)

Information Visualization

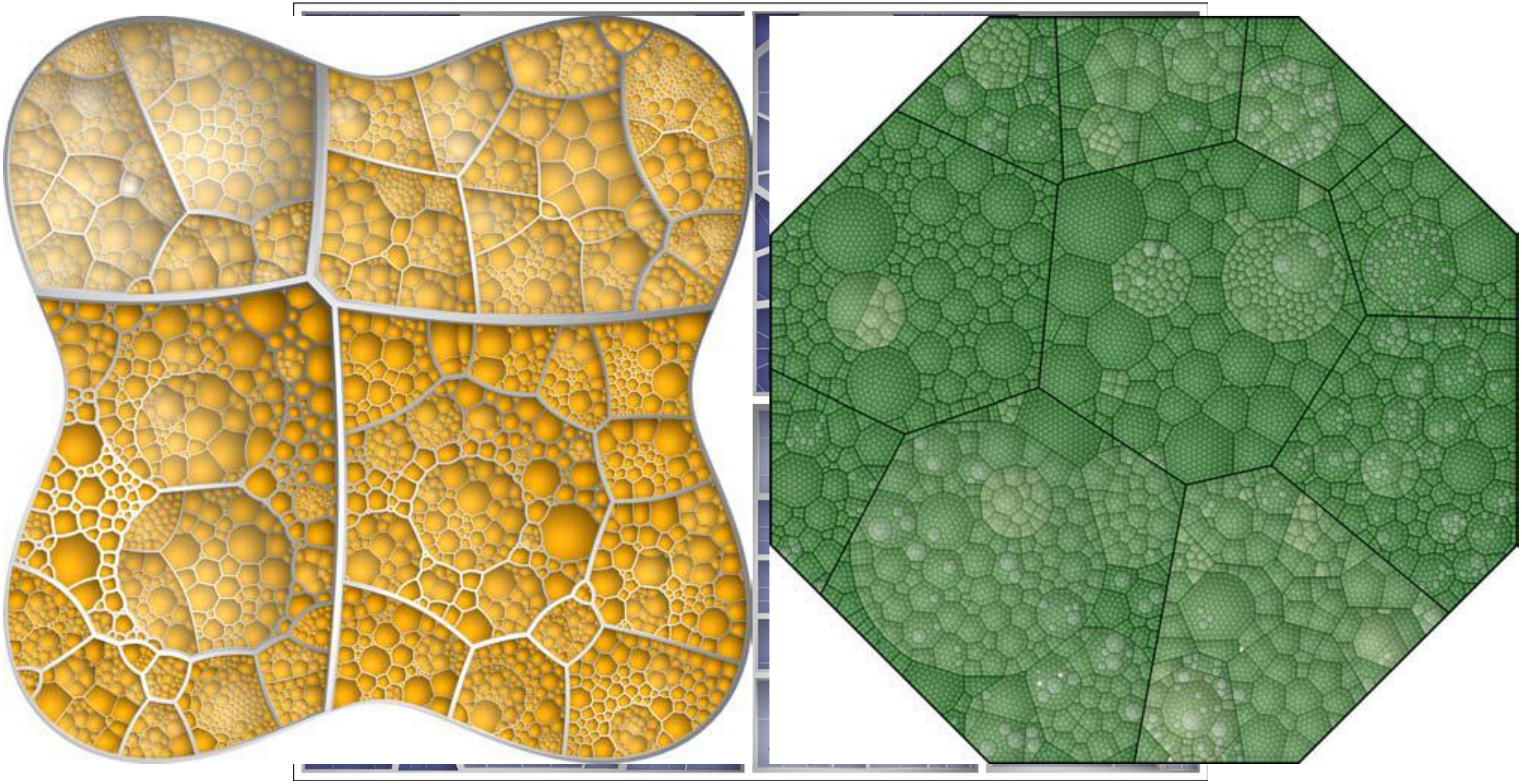
- visualization of multi-dimensional data



Treemaps: Shneiderman 1991 & many others; this tool: van Wijk

Information Visualization

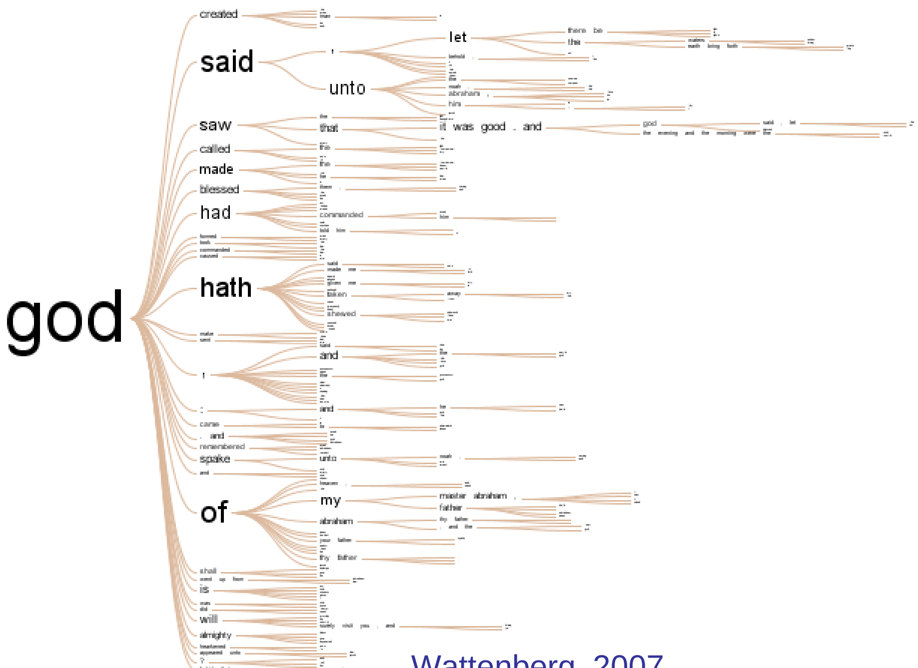
- visualization of multi-dimensional data



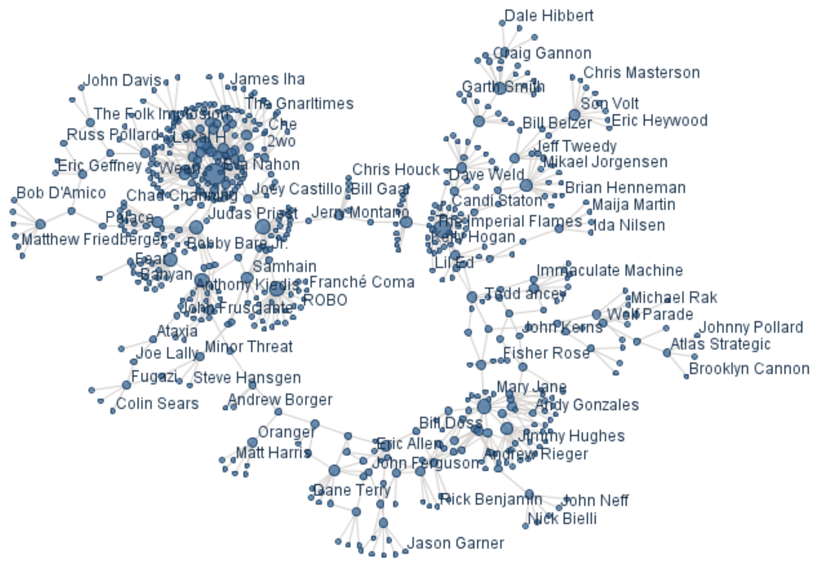
Balzer and Deussen, 2005

Information Visualization

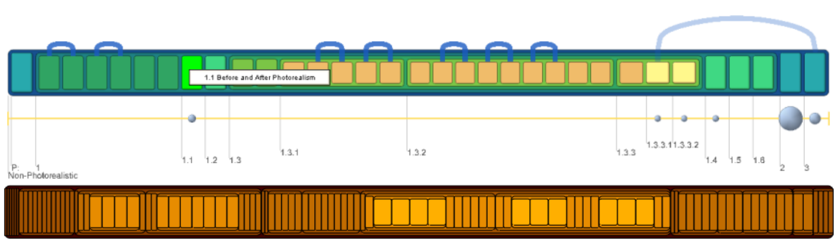
- visualization of graph structures

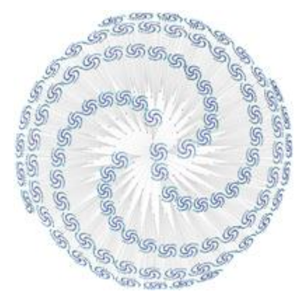


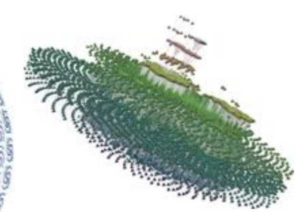
Wattenberg, 2007



from ManyEyes



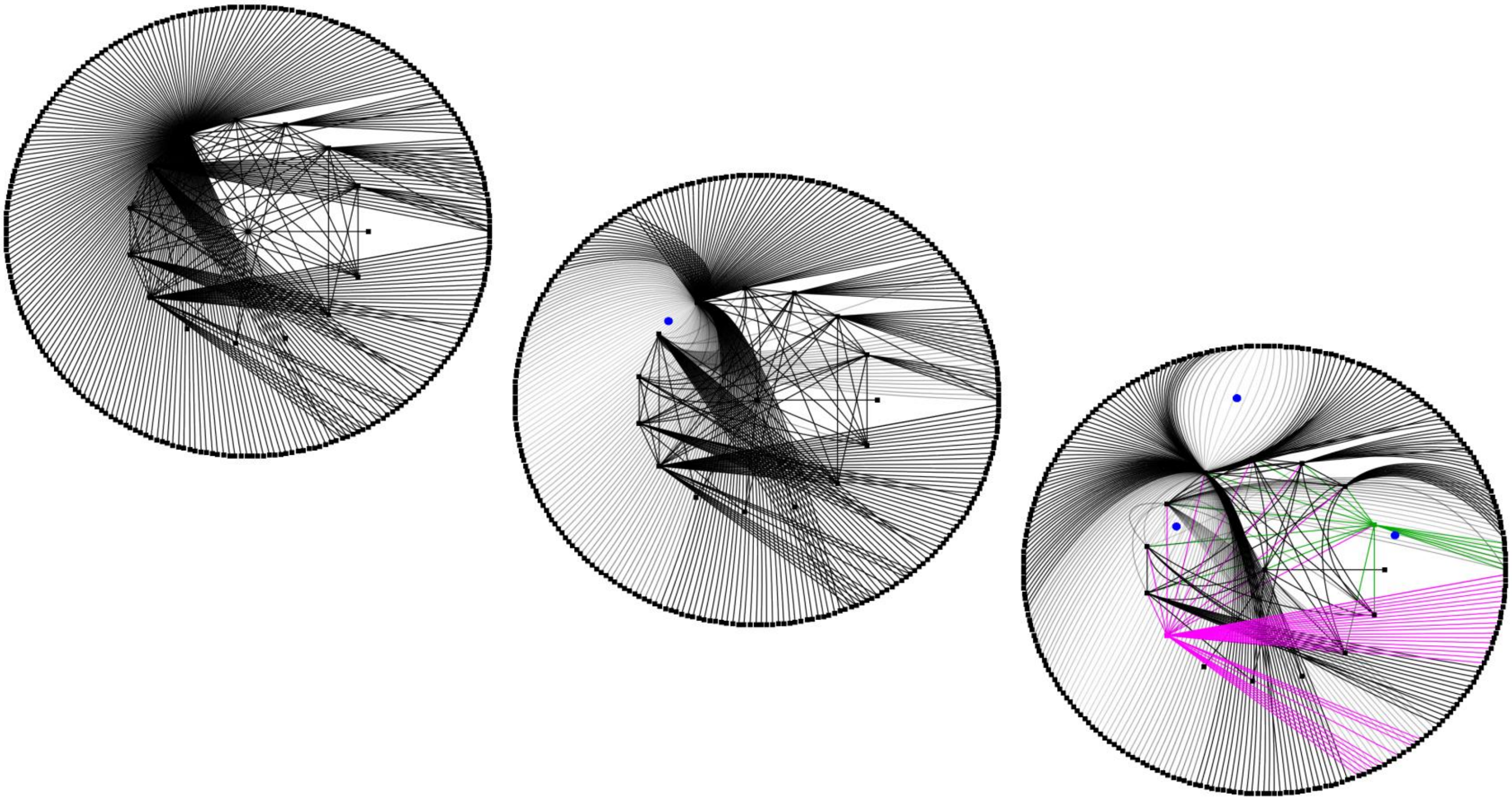




Neumann et al., 2005, 2006

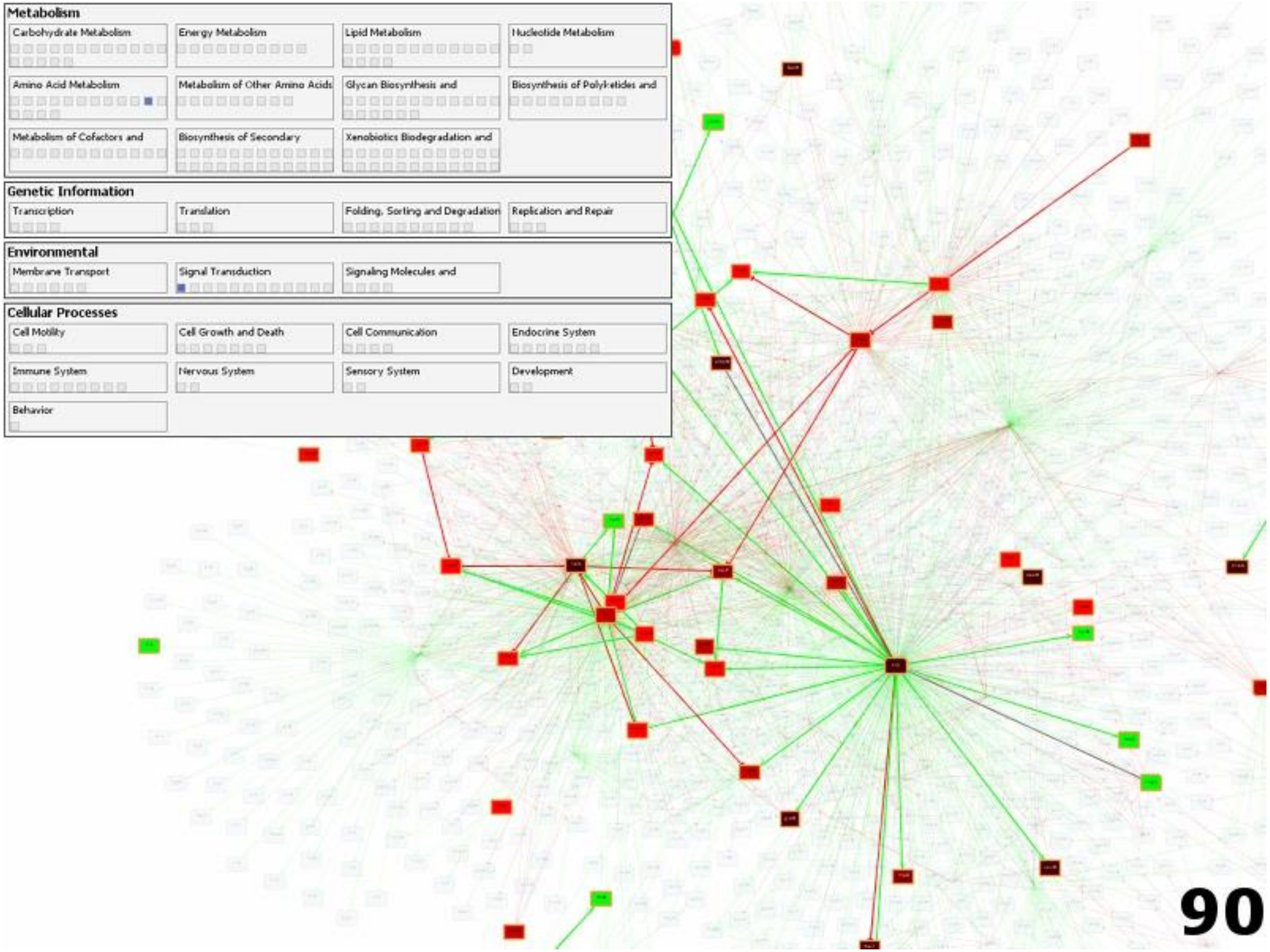
Information Visualization

- interaction with data visualizations



Wong et al., 2003

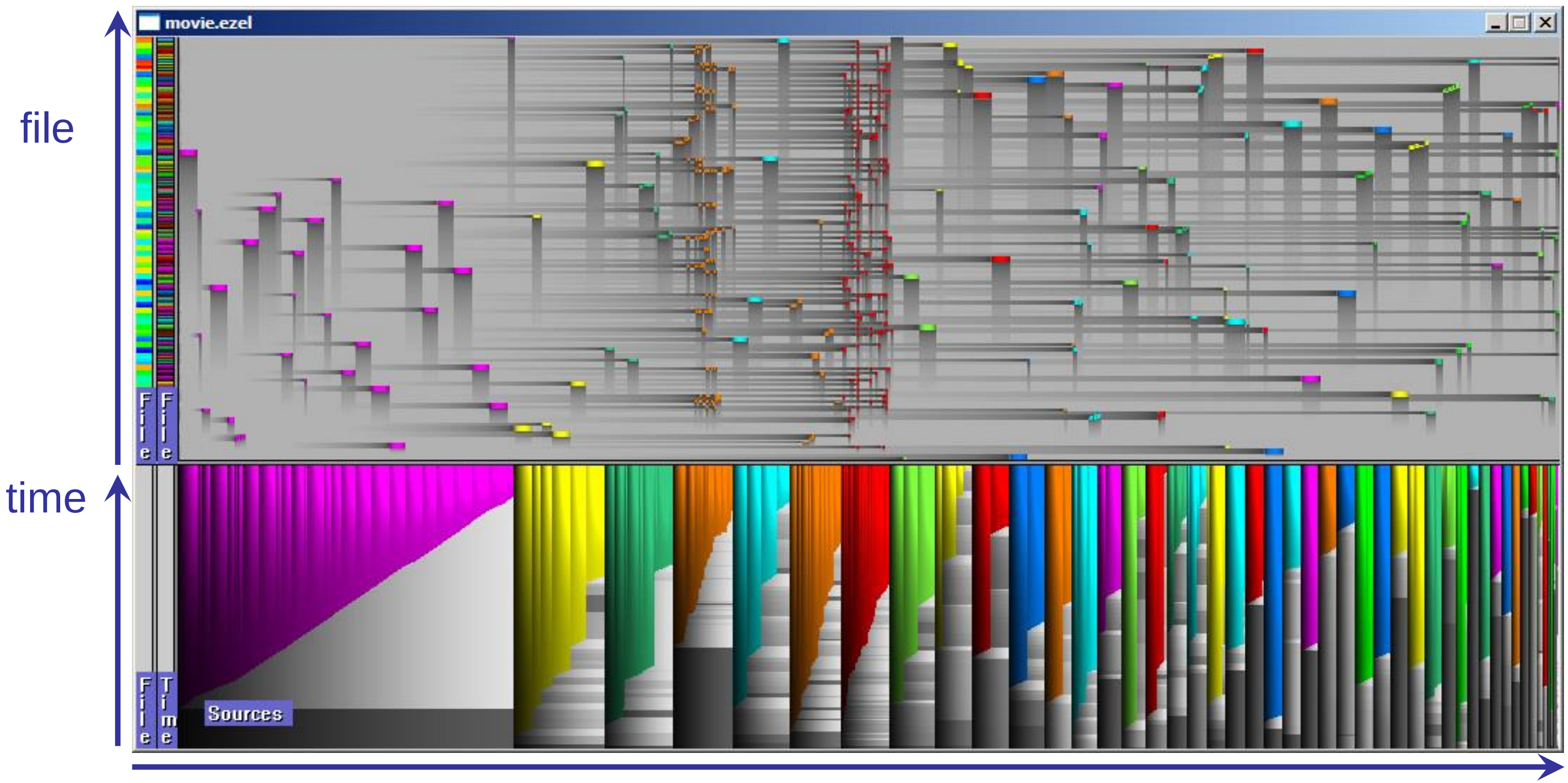
Information Visualization



Westenberg et al., 2008

Information Visualization

- software visualization

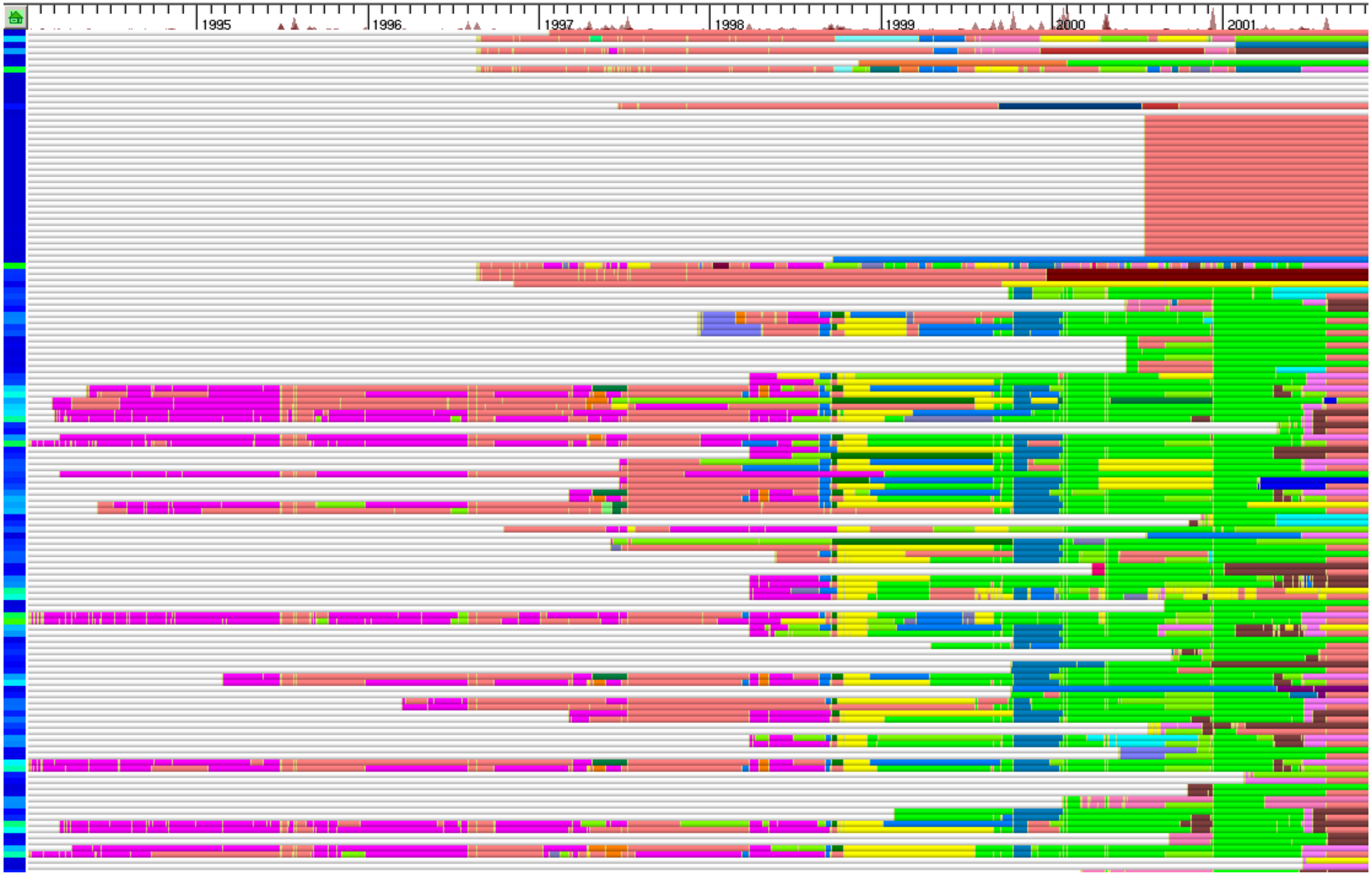


P2P traffic visualization in the EZEL tool, Voinea et al., 2004

peers

Information Visualization

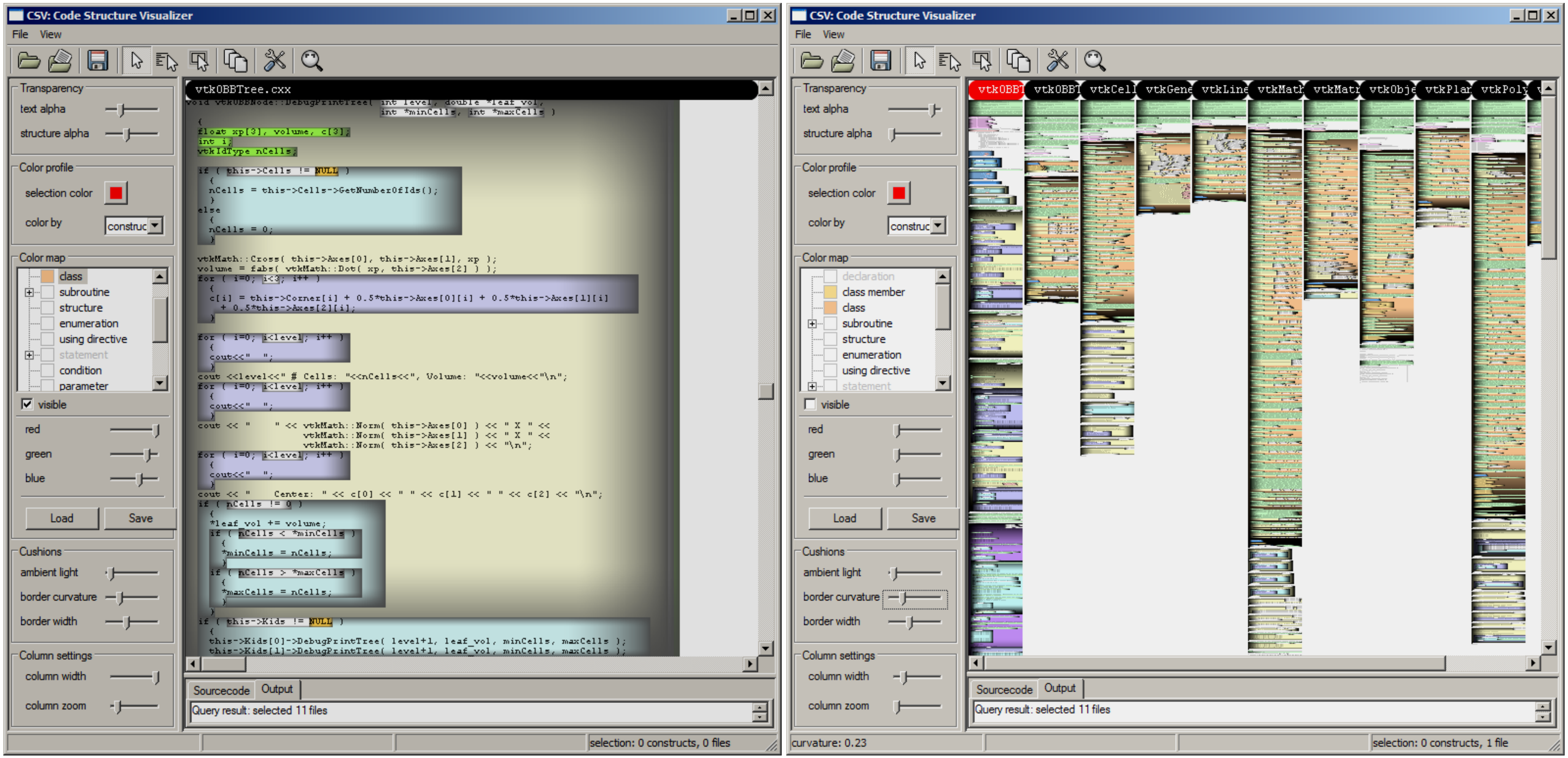
- software visualization



Moreta and Telea, 2007

Information Visualization

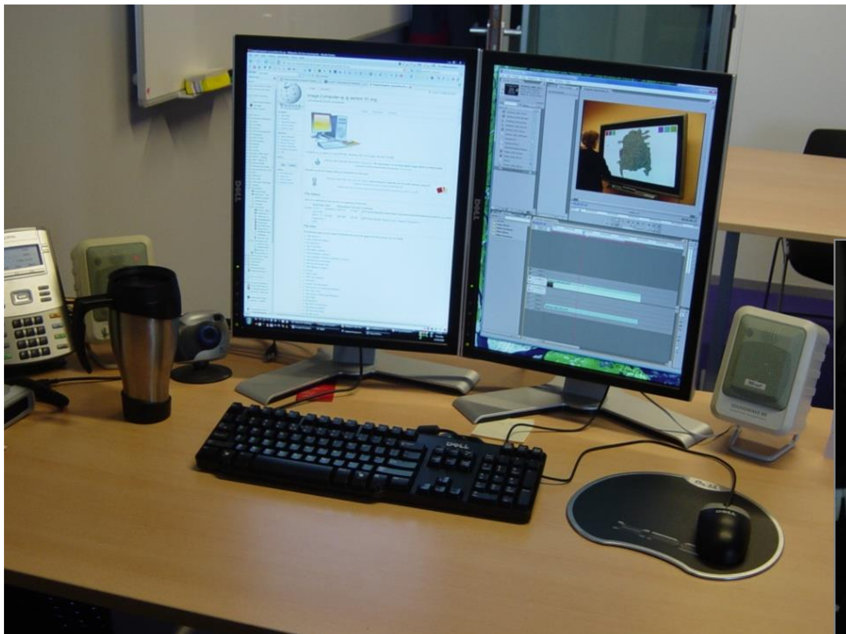
- software visualization



Lommerse et al., 2005

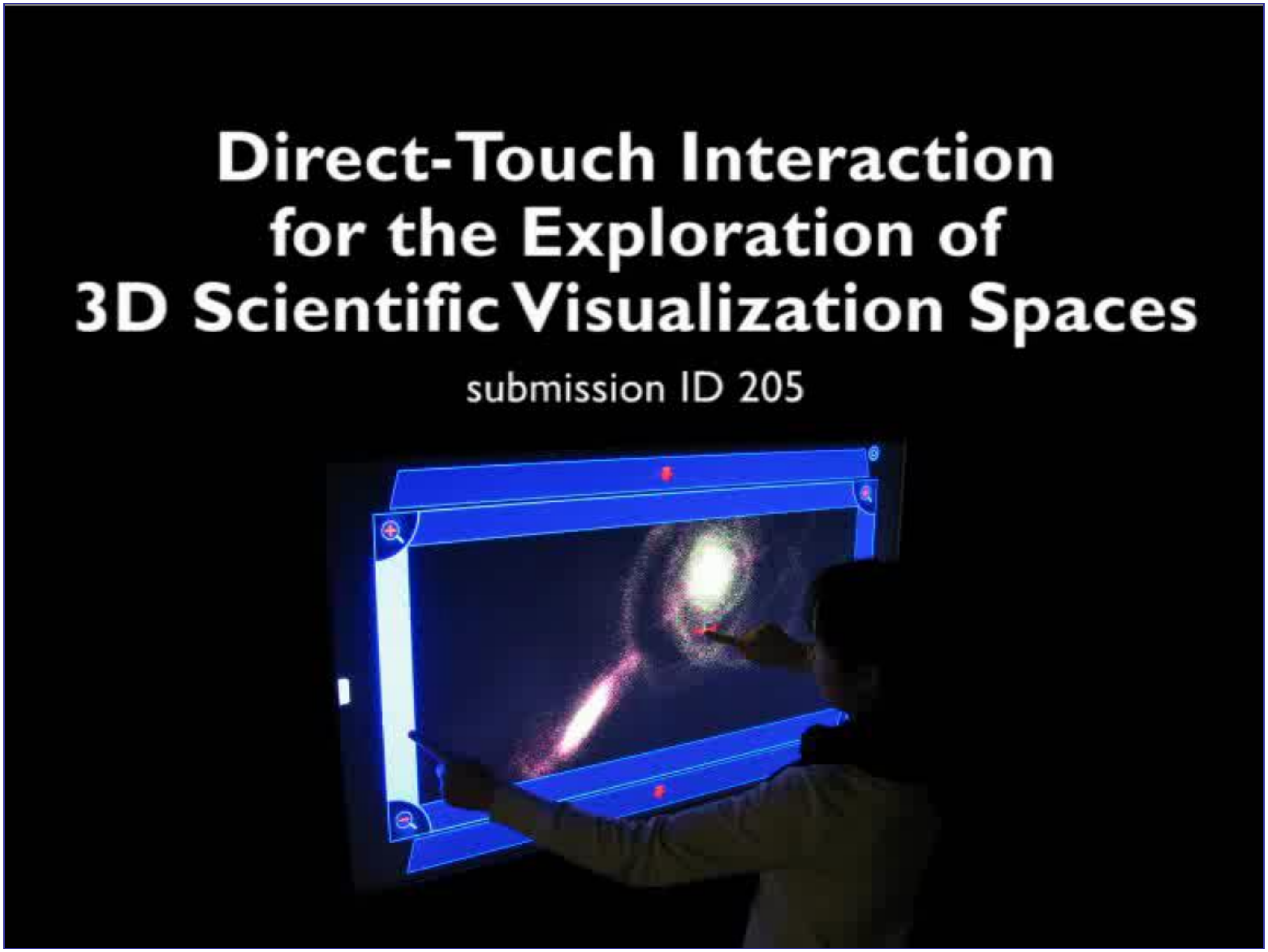
Interaction & User Interfaces

- traditional vs. novel interaction platforms



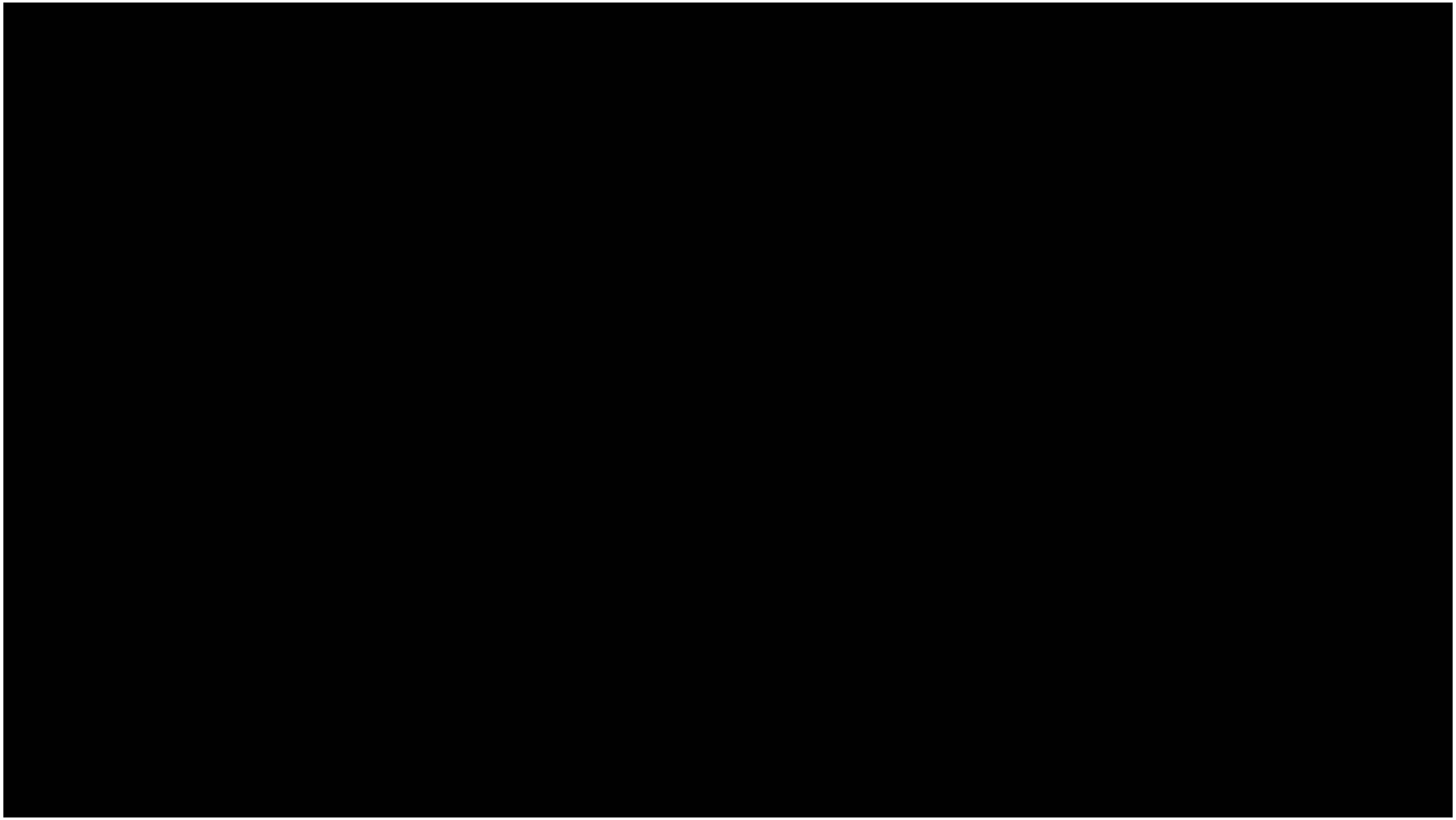
Carpendale et al.

Interaction & User Interfaces



[Yu et al., 2010]

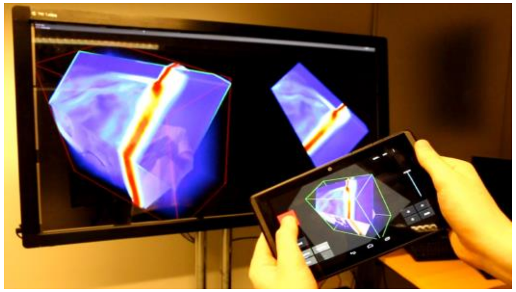
Interaction & User Interfaces

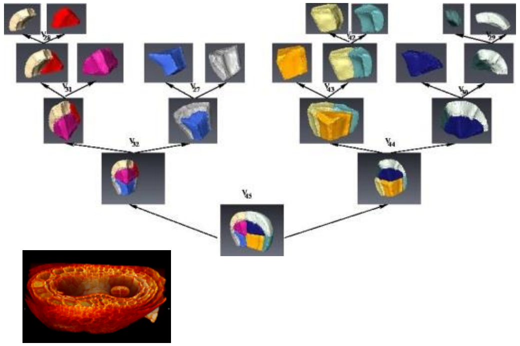


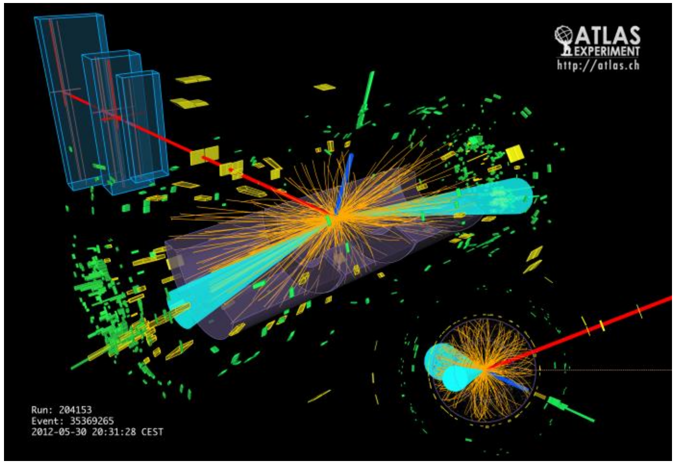
[Coffey et al., 2012]

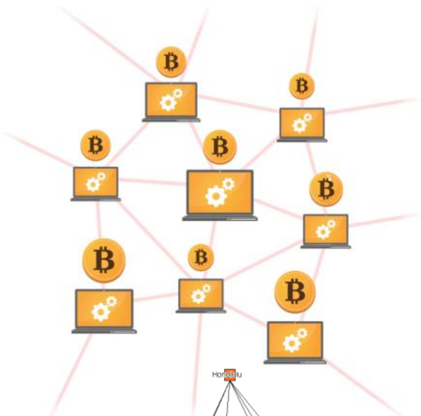
Internships @ Inria / Aviz

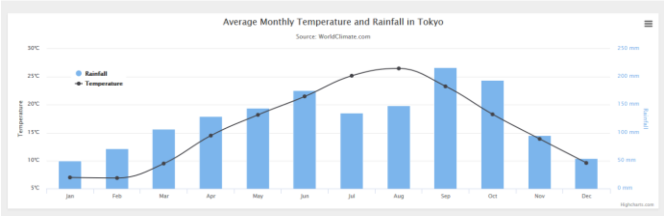
Visual Analytics Project

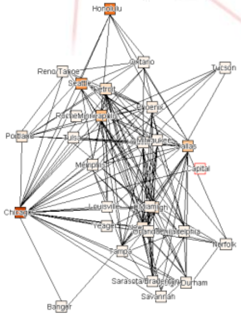


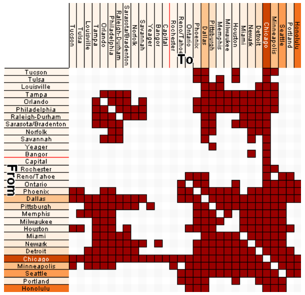












Gaming

Movies

The End