



Úvod do počítačovej grafiky ako marketingového nástroja pre managerov

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Comenius University Bratislava

25. septembra 2017, FMFI UK



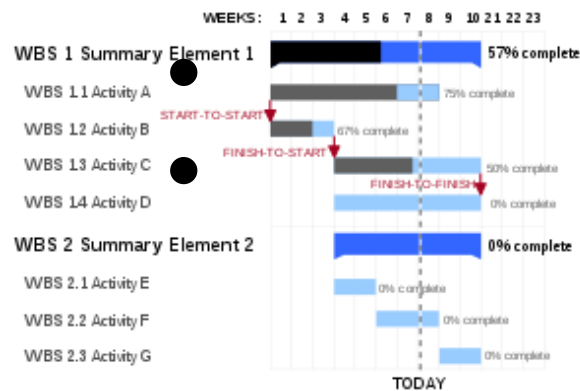
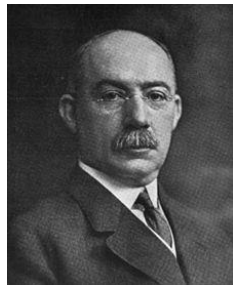
Motivating Timeline

- Frederick W Taylor (1856–1915), leading proponent of scientific management...
- analyze and synthesize workflows...
- to improve economic efficiency, especially labor productivity (money machine metaphor)
- Henry L Gantt (1861 –1919) ... Gantt chart

Učiace sa Slovensko 2017

Fialová krava

Modrý oceán... ESET, Sygic, FB

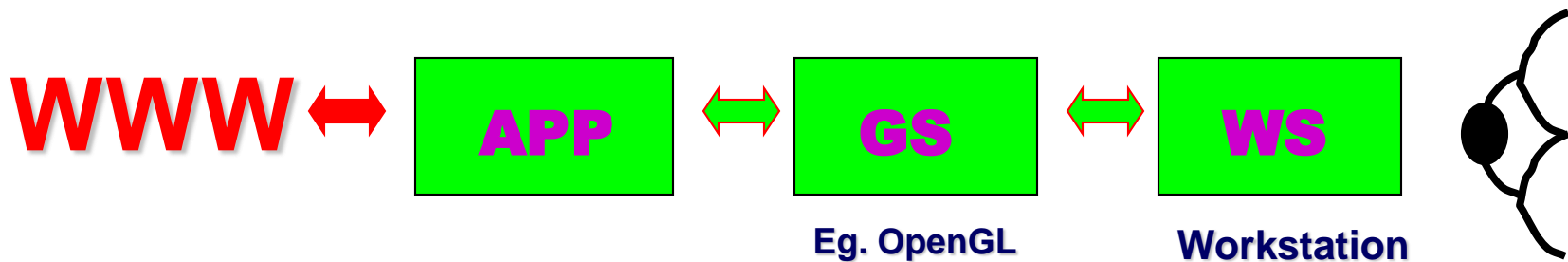


Principles of geometric analysis and synthesis of a mathematic model

- princíp kontinuity (nepřerývnost: koherencia)
 - princíp zhody (sootvetstviye)
 - princíp kompatibility (sovmestimost)
-
- Baganyan, GA. 1985. Mašinnaĵa grafika v upravlenii. Jerevan: Ajastan.

Communication Interfaces

- Author - Application Programmer - GS Author - User

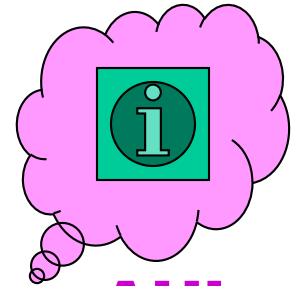


- What is interesting for users?

Ambiguity Interesting Unlimited

- Communication

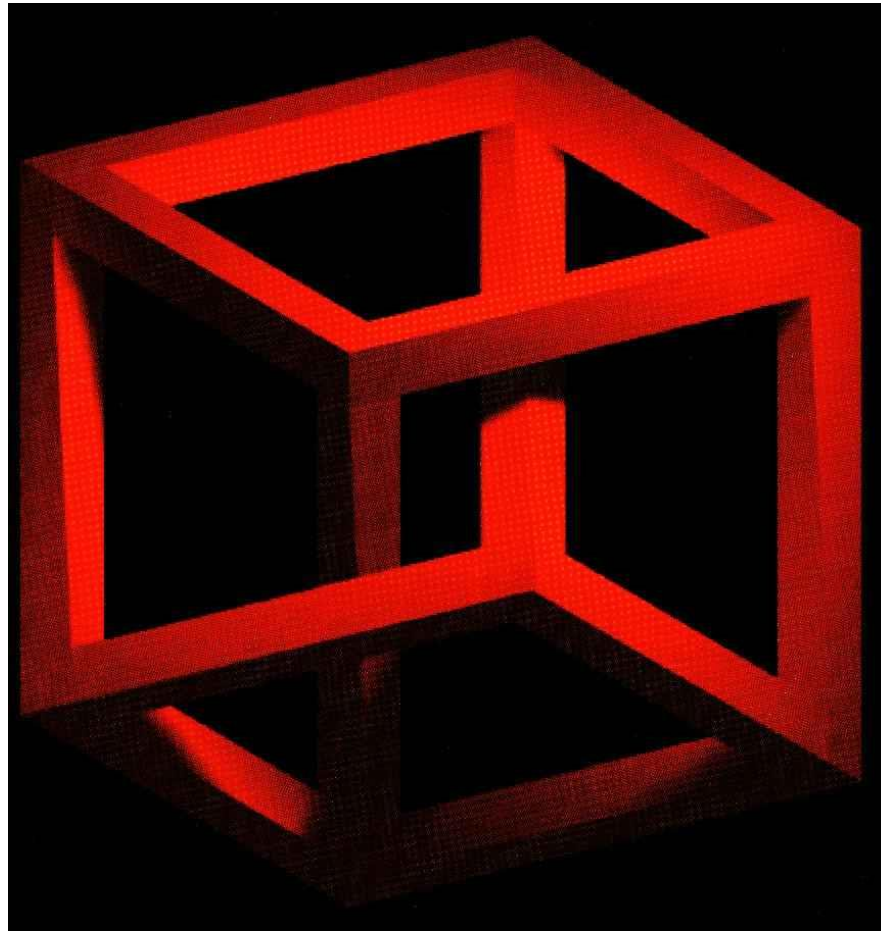
A
S
H



AH!
AHA!
HAHA!

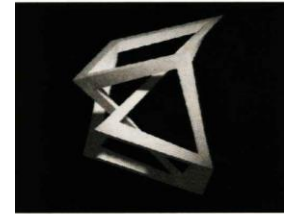
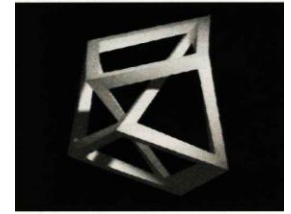
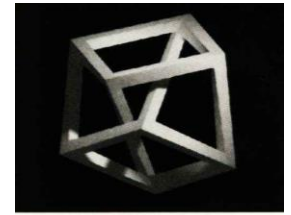
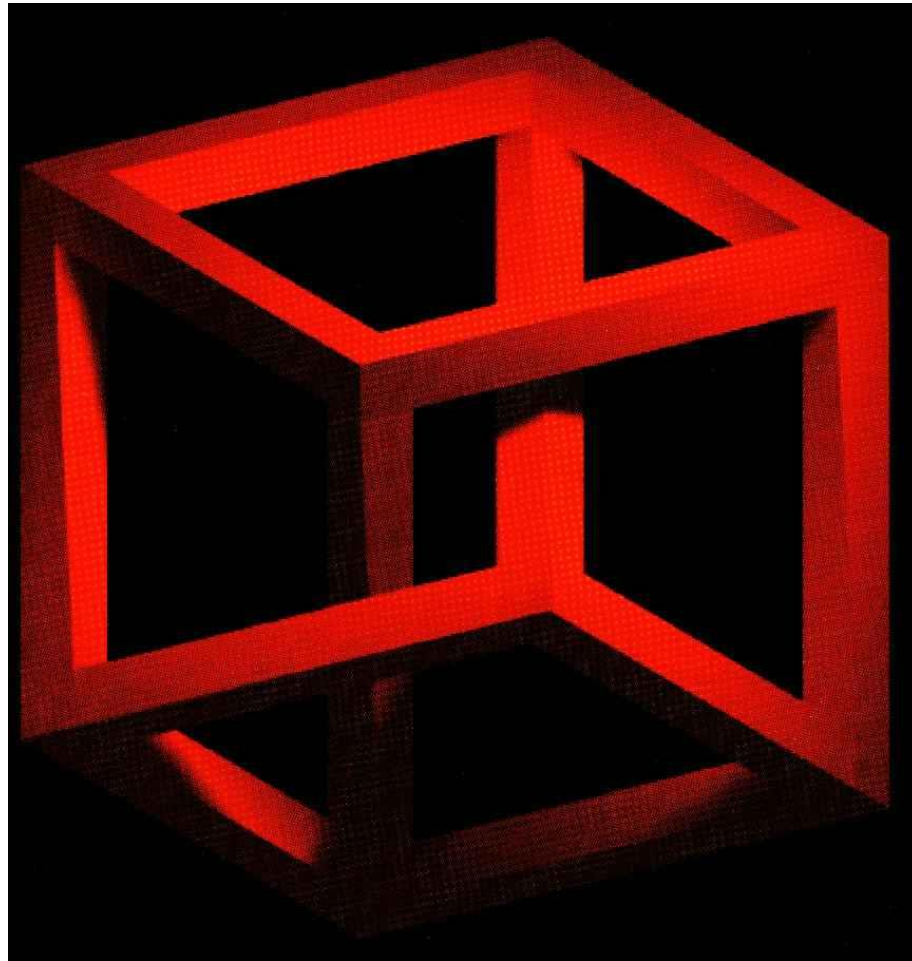
- Arthur KOESTLER, 1964

Does this exist ?



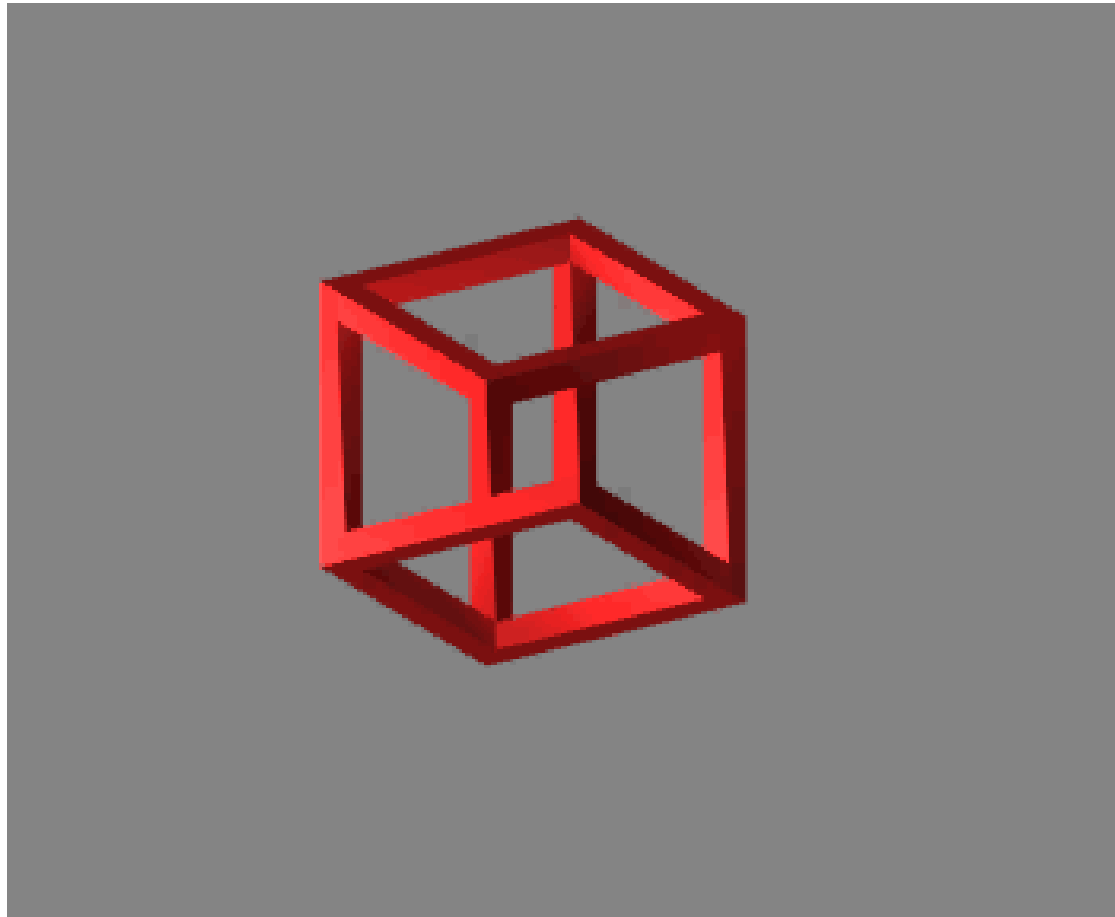
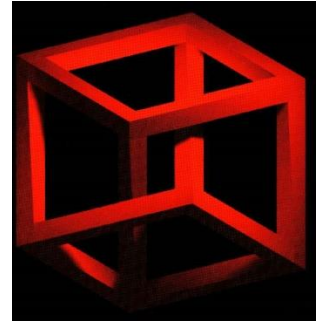
- $\exists?$

KUBOID by P. Eliáš



- E!

KUBOID by P. Eliáš

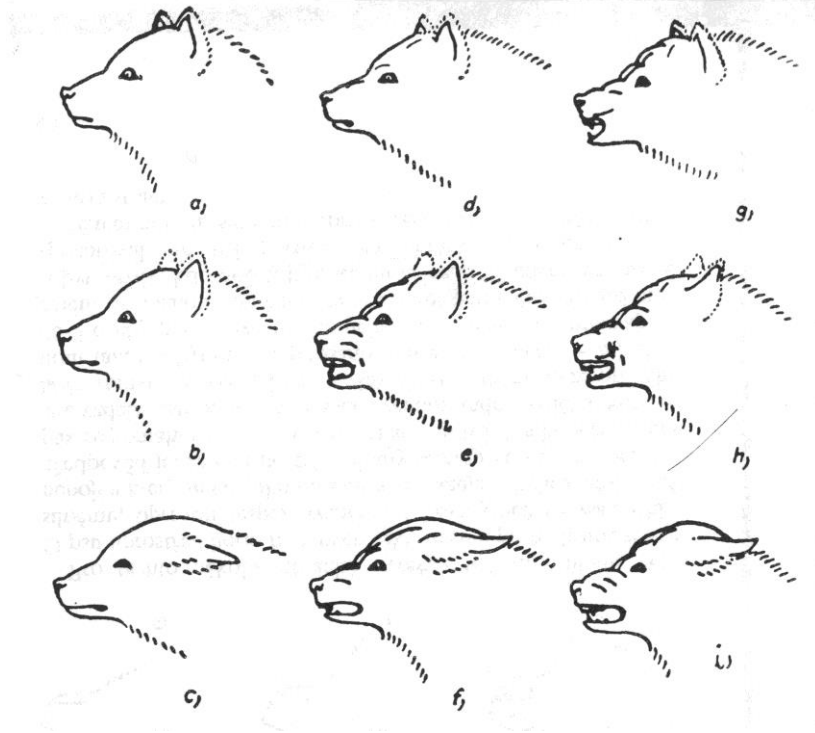


- <http://www.dunako.com/pavol/cuboid/>

On Model of a Human Being

- Each living animal or human:
- Aggression, anger, very fast!
- Escape, fear, very fast!
- Food, hunger, slower
- Sex, sex, the slowest one...
- ... and a Great Parliament of Emotions
- Konrad LORENZ, Das sogenannte Böse. 1963.

Emotional Ambiguity

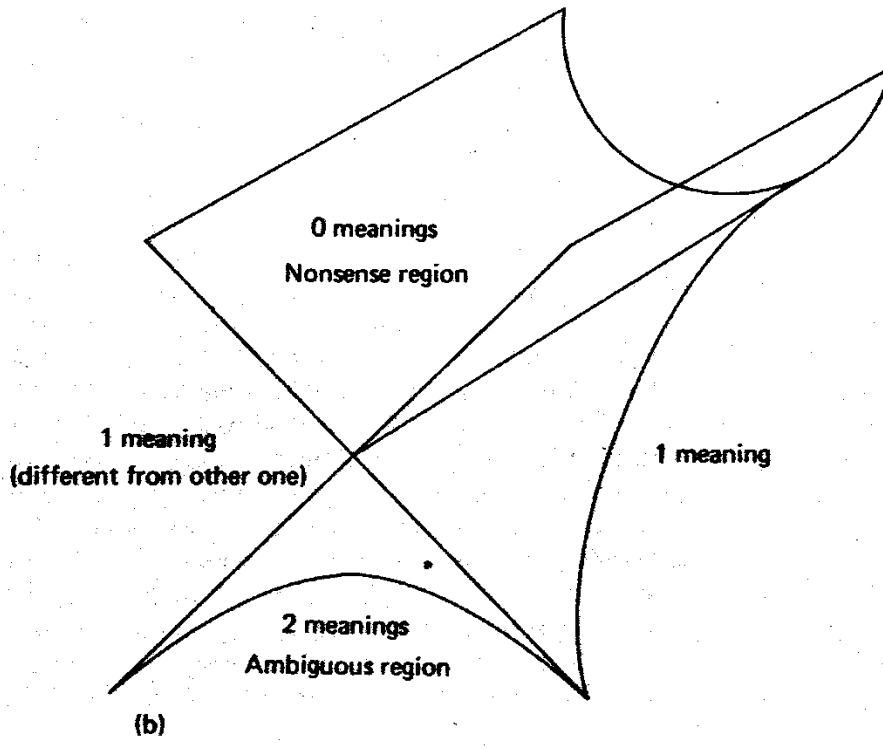
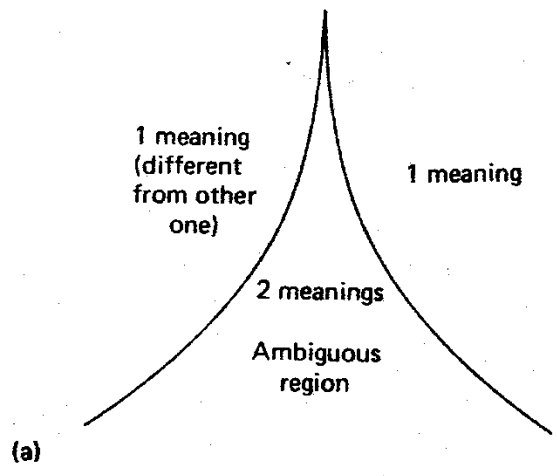


Ambiguous

- ... and a Great Parliament of Emotions
- Konrad LORENZ, Das sogenannte Böse. 1963.

On Model of a Human Being

- Each human being includes 3 personalities:
- Child, visual, emotional, creative ... **Visual**
- Adult, symbolic, rational ... **Symbolic**
- Parent, auditory, moral ... **Audio**
- and something “crowded” (mass hysteria)
- D. GOLEMAN, Emotional Intelligence. 1998.



Model of Joke (2 meanings)

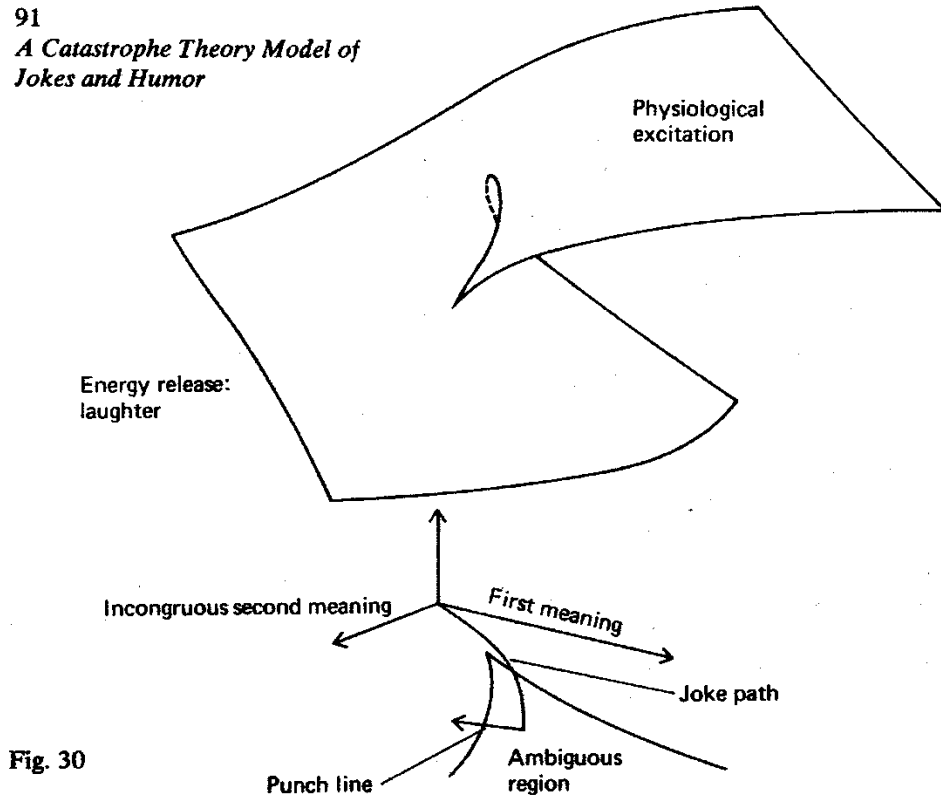
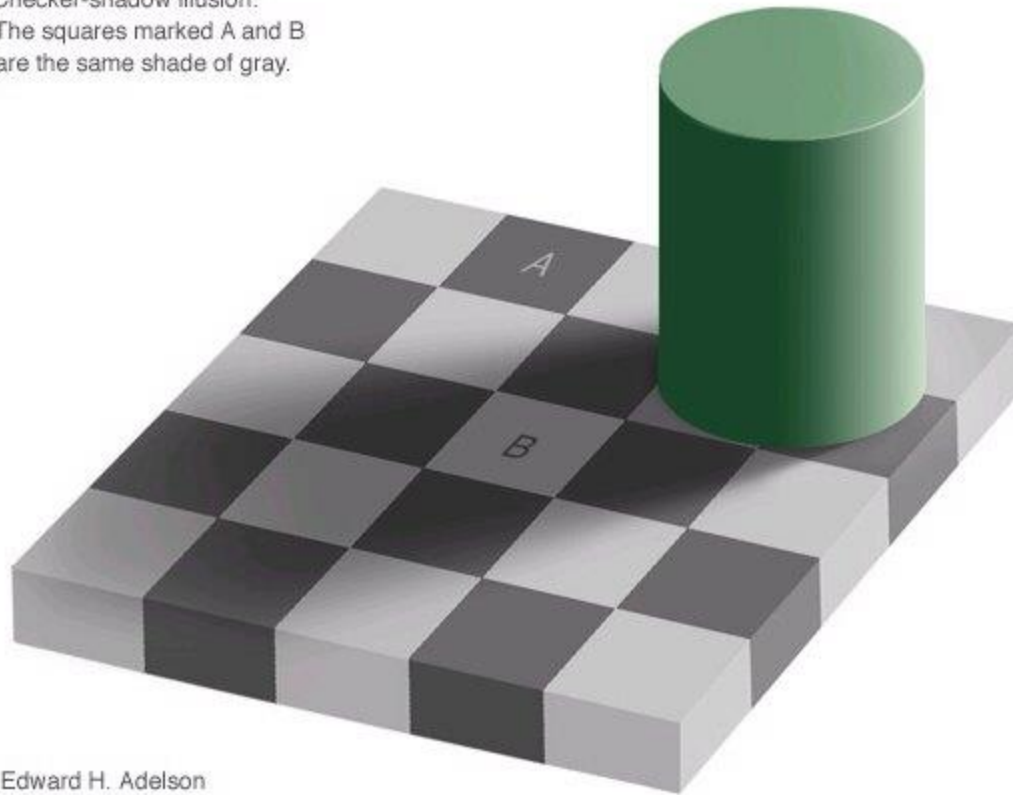


Fig. 30

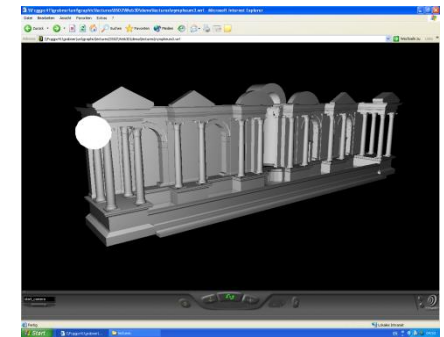
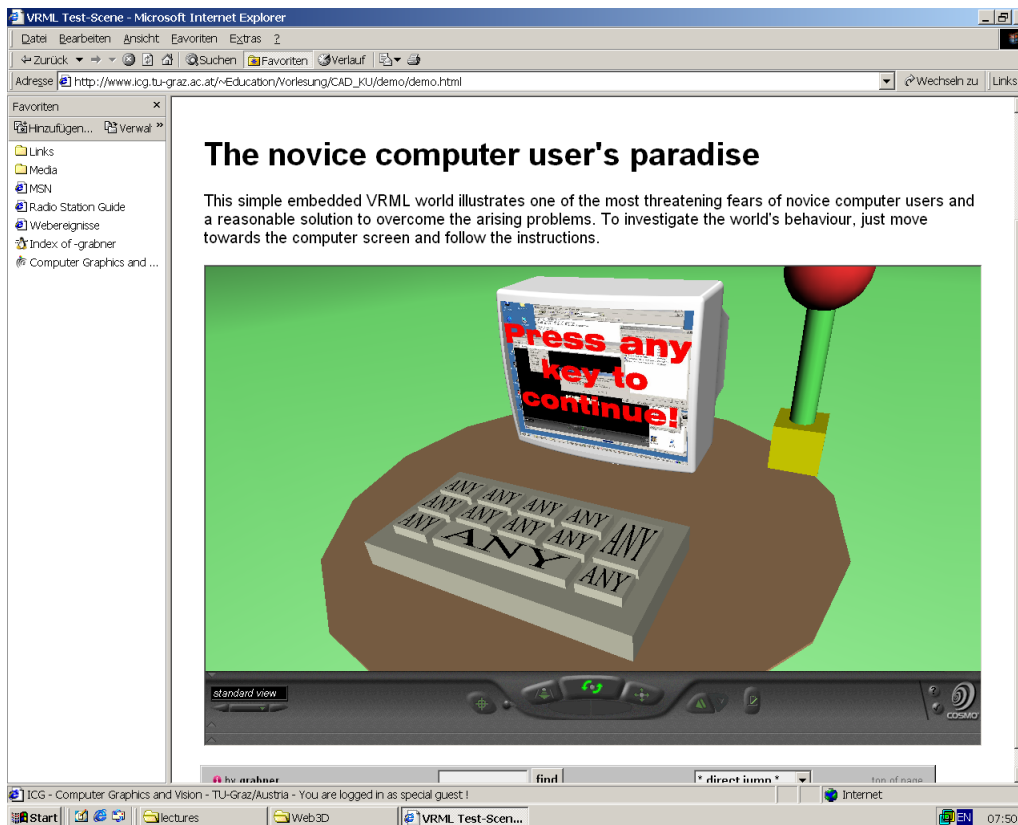
- A catastrophe theory model of joke, J. A. Paulos

Checker-shadow illusion:
The squares marked A and B
are the same shade of gray.



Edward H. Adelson

Even the Interactive Ambiguities



- VRML worlds by M. Grabner, TU Graz 2002

AH!



Earth in the Night **AHA!**



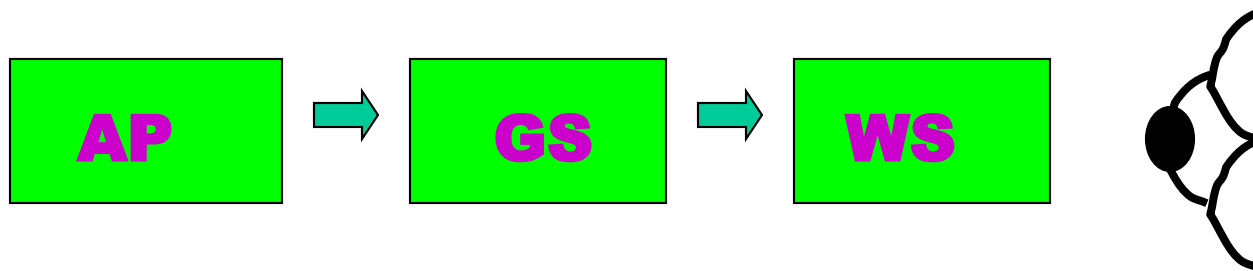
<http://antwrp.gsfc.nasa.gov/apod/ap001127.html>

HAHA!

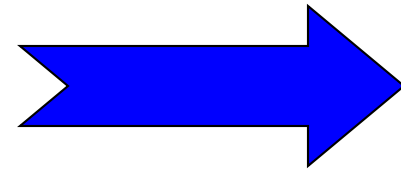


On Model of a Human Being

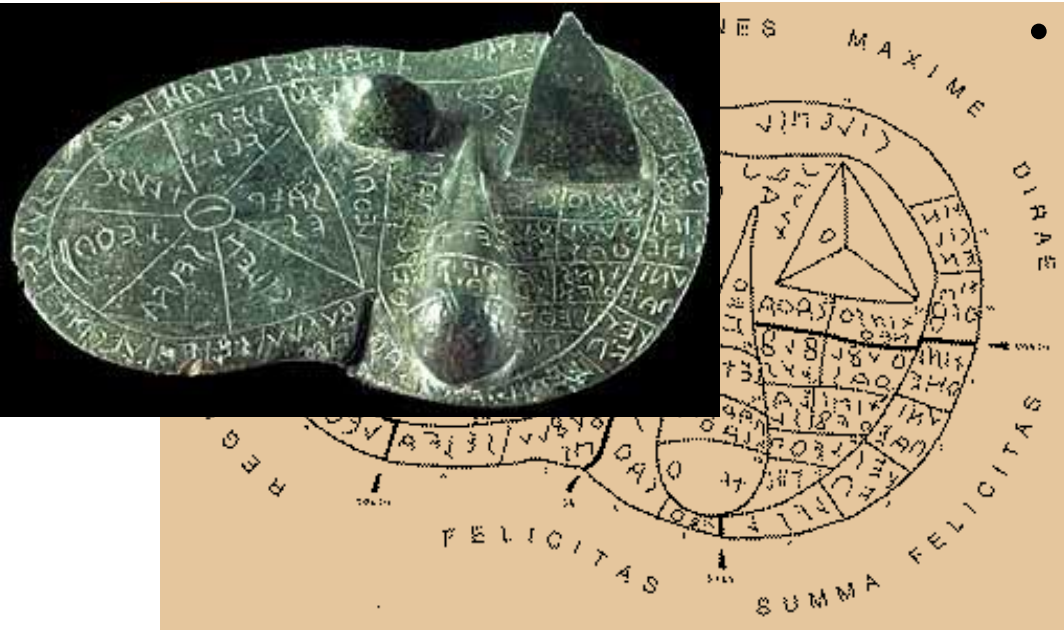
- Controlled Error: Model, Algorithm... Solution



- Computer Graphics \gg Visualization
 $\varepsilon \rightarrow 0$ \gg $\varepsilon \rightarrow \text{infinity}$



Etruscan Liver, Cholera in London



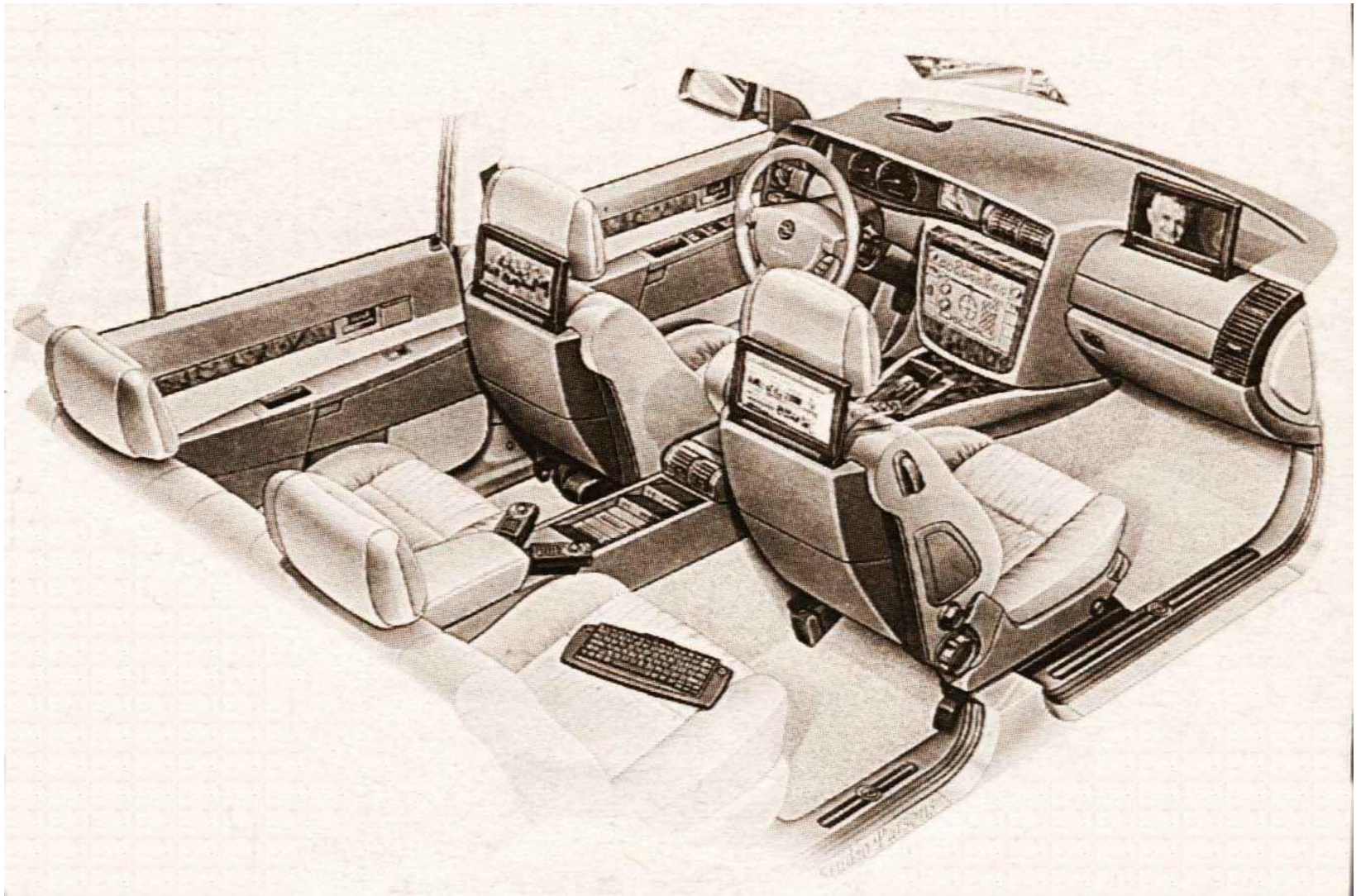
• Sheep Liver & Names of Gods

• <http://www.ou.edu/class/ahi4163/files/bronz12.html>



The idea of representing data visually has been around for much longer than computer based visualisation. The linking of the spread of cholera to water supply provides an early example of the use of visualisation in problem analysis. During the 1853-54 cholera outbreak in London, Dr. John Snow identified a large grouping in the Soho area. He went on to plot the homes of the 500 victims who died in the first 10 days of September 1854 on a map of the area. This simple representation of the data he had collected showed that the grouping of cholera sufferers in the area was centred round a particular water pump. Investigation of this water pump established that it had been contaminated by a leaking cesspool.

Opel OMEGA



Bratislava



Chatam Sófer M. by J. Krizik

- WCH?

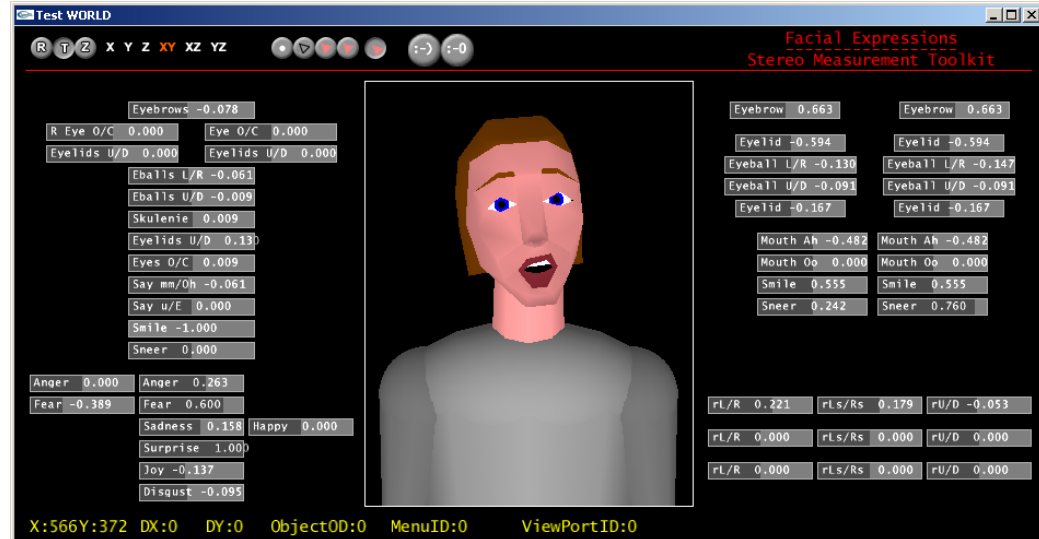


Virtual Heart of Central Europe, Culture



- Awarded by EuroPrix Quality Seal
www.VHCE.info
- 330 kEUR, 150 kEUR from EC, ready to submit – Pirelli Award
- follow-up 2005-2006 (SK, SI, PL, CZ), submitted, 256 kEUR

Navigation & Cooperation in VEs: Virtual Bratislava (2002-2004)



<http://www.sccg.sk/~projects/>

- 900 000 SKK, 506 000 SKK from Slovak government, APVT agency
- Follow-up 2005++
- Key researchers M. Zimanyi, S. Stanek & P. Kubini

Metaphor

- **Confrontation of Meanings**
- **Pritaca, comparison...**
- **For example, desktop metaphor, GUI**
- **...Sweeping, D&C, Simulated Annealing...**
- **Recall Koestler & bisociation**
-

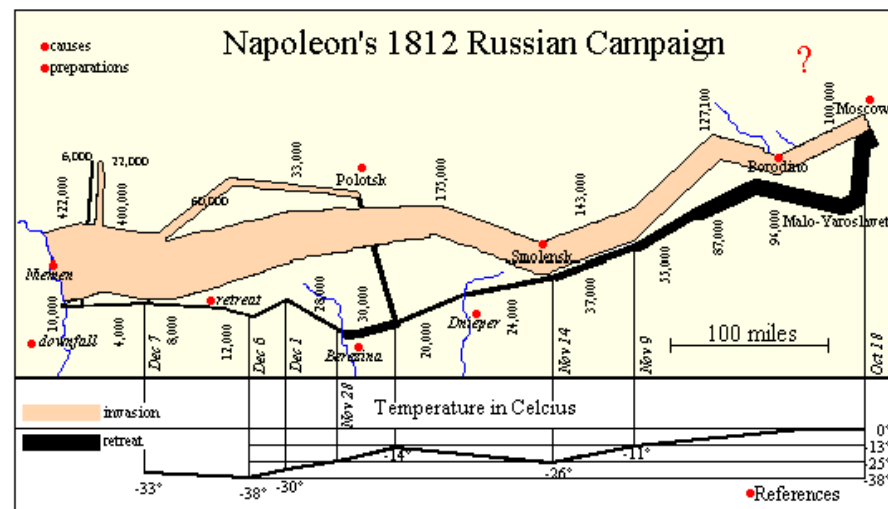
March of the Napoleon Army

Computer-generated Visualization

1. Introduction to Visualization



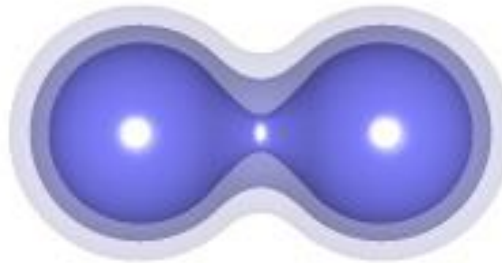
Examples of Visualization



This graphic is an adaptation of M. Charles Joseph Minard's „March of the Napoleon Army“ by Sunny McClendon, as part of an Information Design Class at the University of Texas at Austin.

Volume .. Surface

sampled data



geometric model

3D reconstruction

image synthesis

discrete voxel space

isosurfacing

continuous geometric space

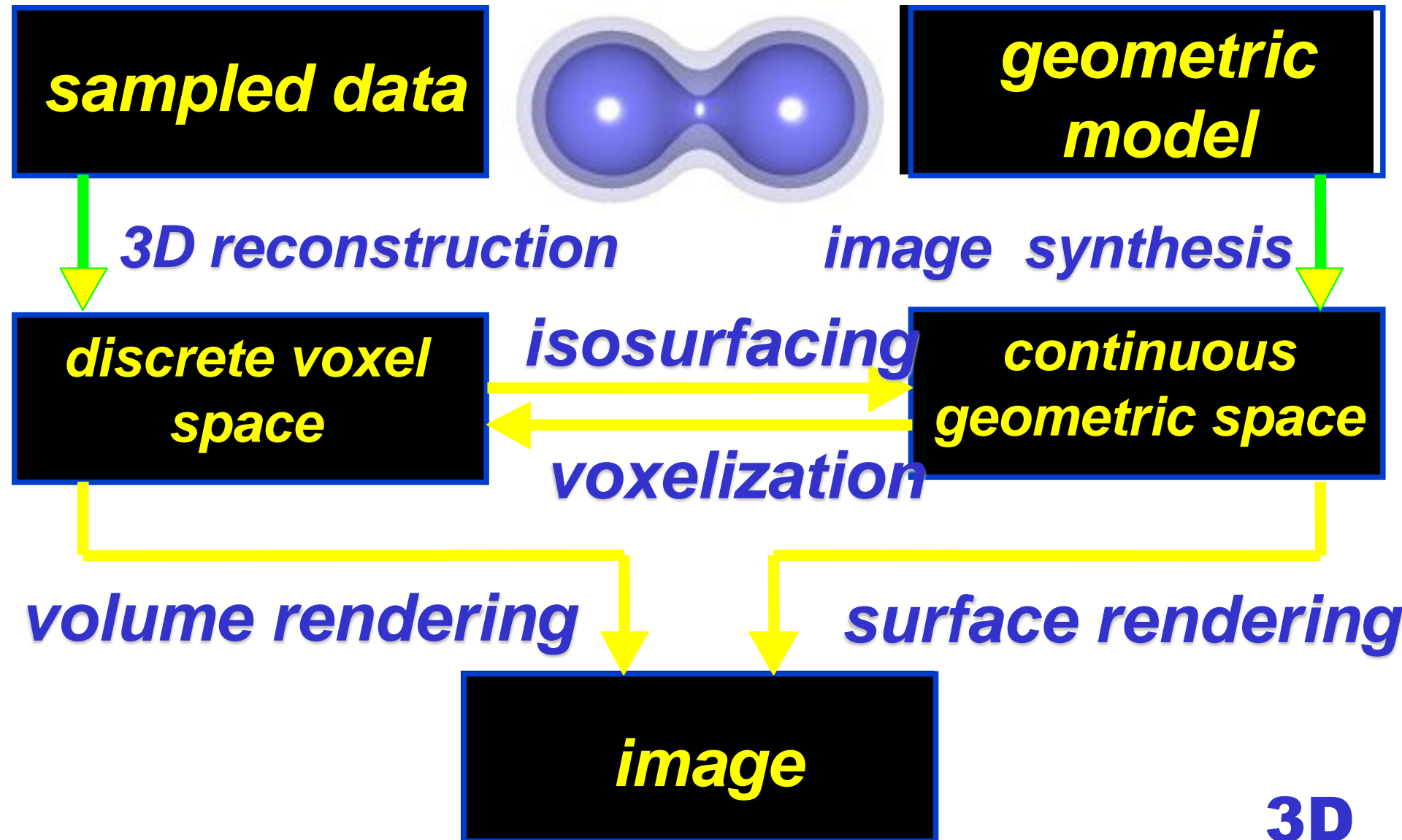
voxelization

volume rendering

surface rendering

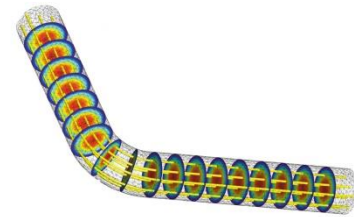
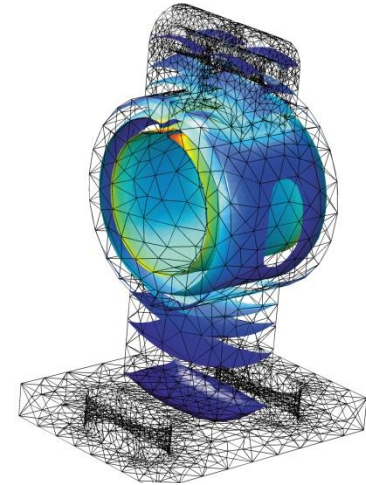
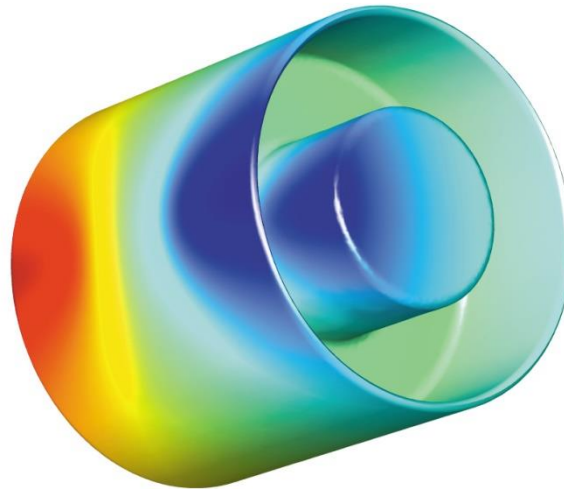
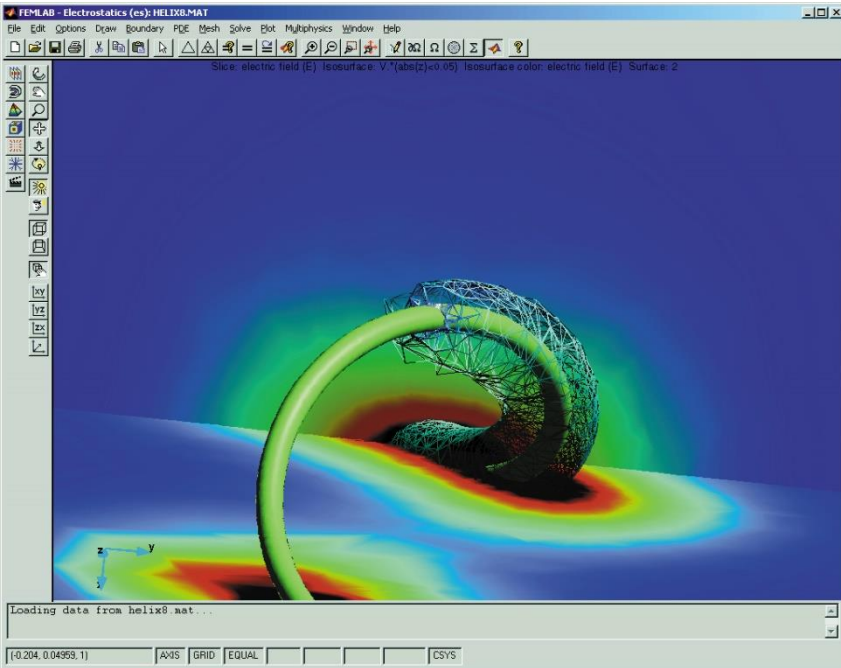
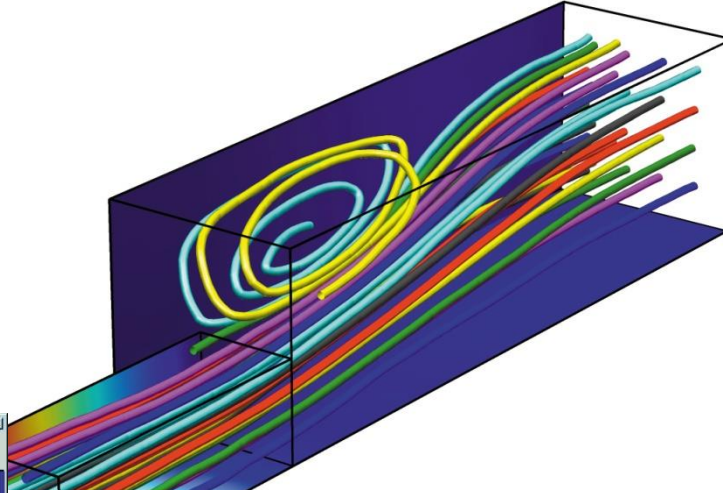
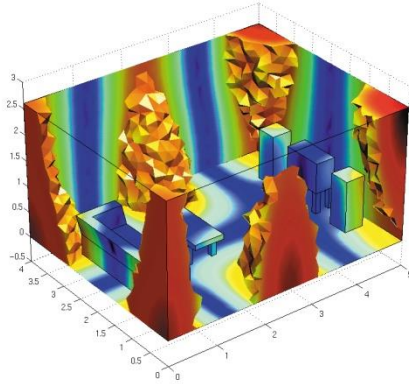
image

3D



MatLab: www.femlab.com

moreD



Viz-Course Contents

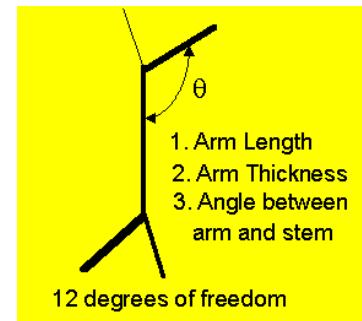
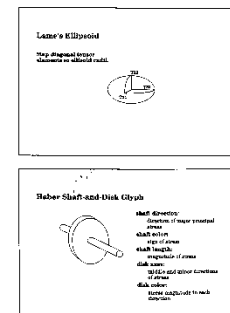
- **1. Introduction, motivation**
reference model, scenarios, graphics and visualization difference
- **2. Data**
data types, coordinate representations, data connectivity
- **3. Mathematical models and languages**
- **4. Representation**
scalar, vector, tensor, multivariate, using color, glyphs
- **5. Visualization software**
- **6. Information Visualization**
graph drawing, algorithm animation, ...
- **7. Recent Directions**
data sonification, visualizing relativity, NPR in scientific visualization...

Visualization of Data

- **1D, 2D, 3D: Rendering**
- **4D: Animation (Juran.)**
- **nD - in general: Open Problem**
- **Glyphs, faces by statistician Herman Chernoff**
 - <http://people.cs.uchicago.edu/~wiseman/chernoff/>
- **other metaphors: terrain, garden, IFS...**

Glyphs

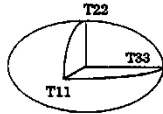
- **UNICODE glyphs: A, @, 7, α , β , γ , δ , Σ , θ , ω ... ?, *, §, ... symbolic information**
- **Visualization glyphs**



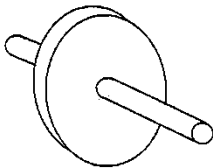
Visualization Glyphs

Lame's Ellipsoid

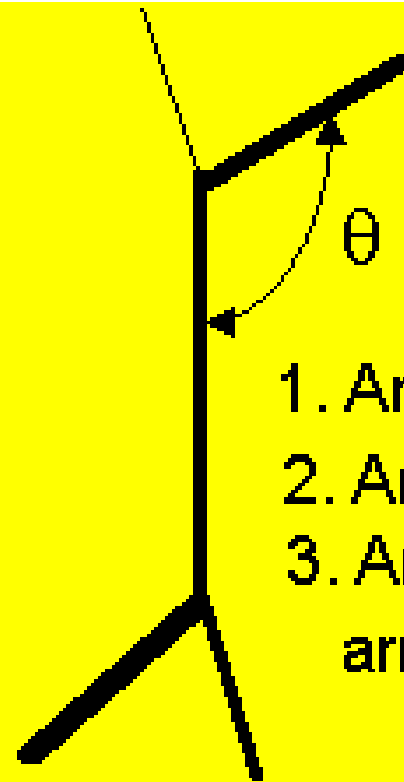
Map diagonal tensor elements to ellipsoid radii.



Haber Shaft-and-Disk Glyph



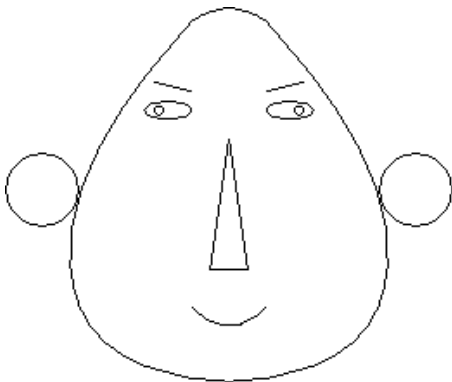
- shaft direction:**
direction of major principal stress
- shaft color:**
sign of stress
- shaft length:**
magnitude of stress
- disk axes:**
middle and minor directions of stress
- disk color:**
stress magnitude in each direction



1. Arm Length
2. Arm Thickness
3. Angle between arm and stem

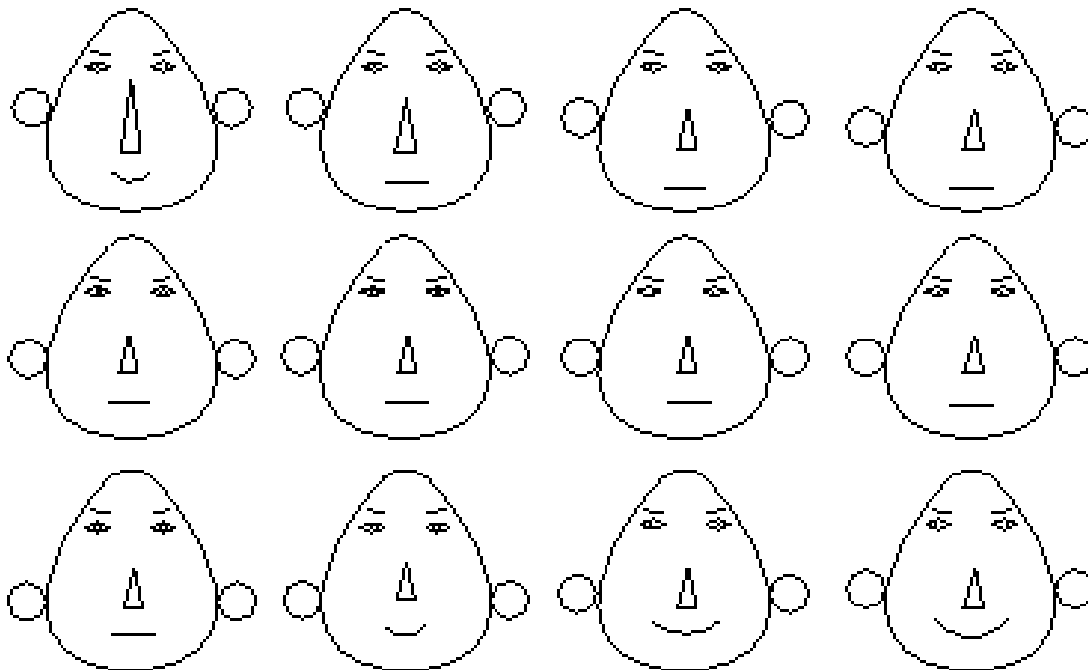
12 degrees of freedom

Chernoff Faces



20D

- http://www.epcc.ed.ac.uk/epcc-tec/documents/SciVis-course/SciVis.book_47.html

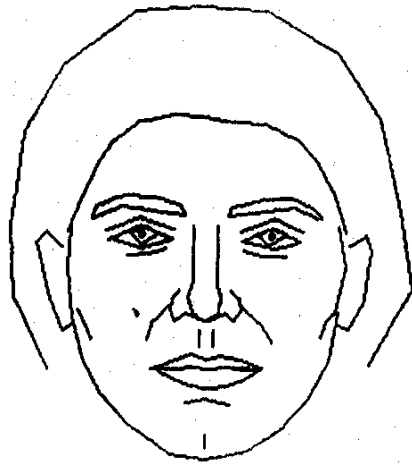


Dimension	Facial Feature
1	Face width
2	Ear level
3	Half face height
4	Eccentricity of upper ellipse of face
5	Eccentricity of lower ellipse of face
6	Length of nose
7	Position of centre of mouth
8	Curvature of mouth
9	Length of mouth
10	Height of centre of eyes
11	Separation of eyes
12	Slant of eyes
13	Eccentricity of eyes
14	Half length of eye
15	Position of pupil
16	Height of eyebrow
17	Angle of brow
18	Length of brow
19	Radius of ear
20	Nose width

Facial Representation of nD Data?

Fig.3:

A neutral nose face.



362D

- **Susan Brennan, 1985 and**

<http://www.sccg.sk/~ferko/VISFORUMABSTRACT.pdf>

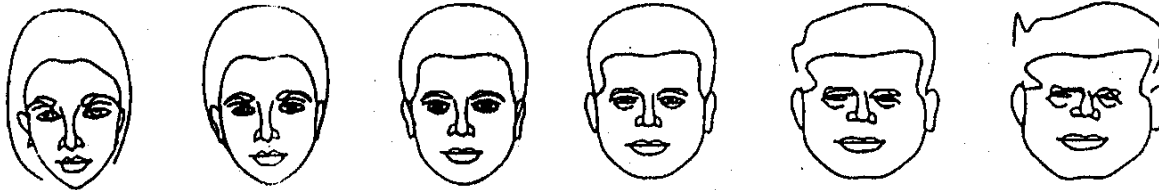


Fig.1: E. Taylor and Kennedy during changing their faces.

Fig. 4.1



Fig. 4.2



Fig. 4.3



Fig. 4.4



Fig. 4.1 - 4.4: An example of four step generation of the caricature. Figure 4.1 represents a data snapped from the real image of the former president R. Reagan.

Reagan

Fig. 4.1



Fig. 4.2



Fig. 4.3

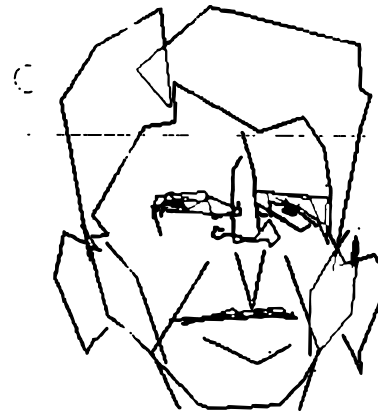


Fig. 4.4

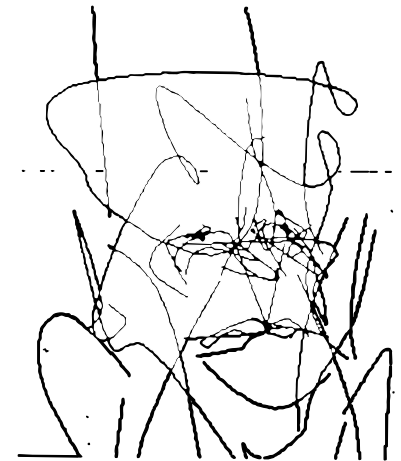
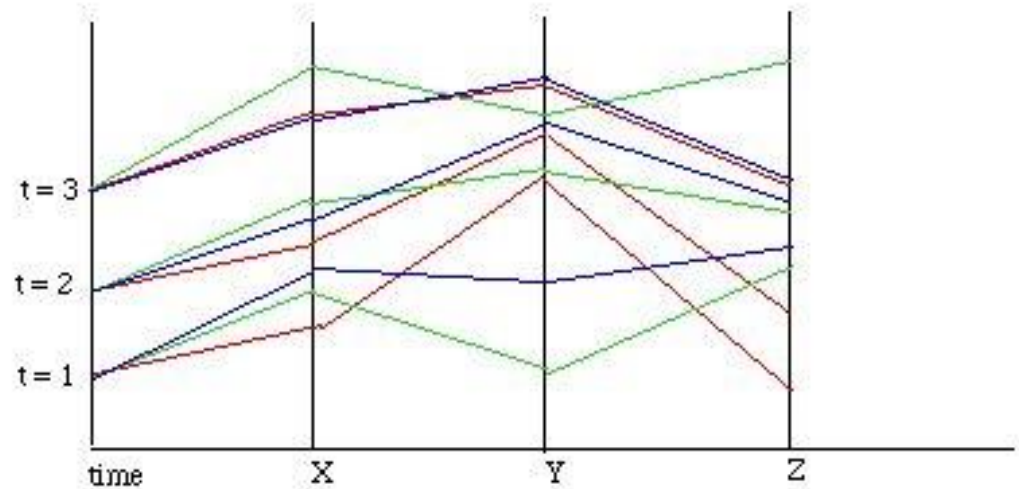


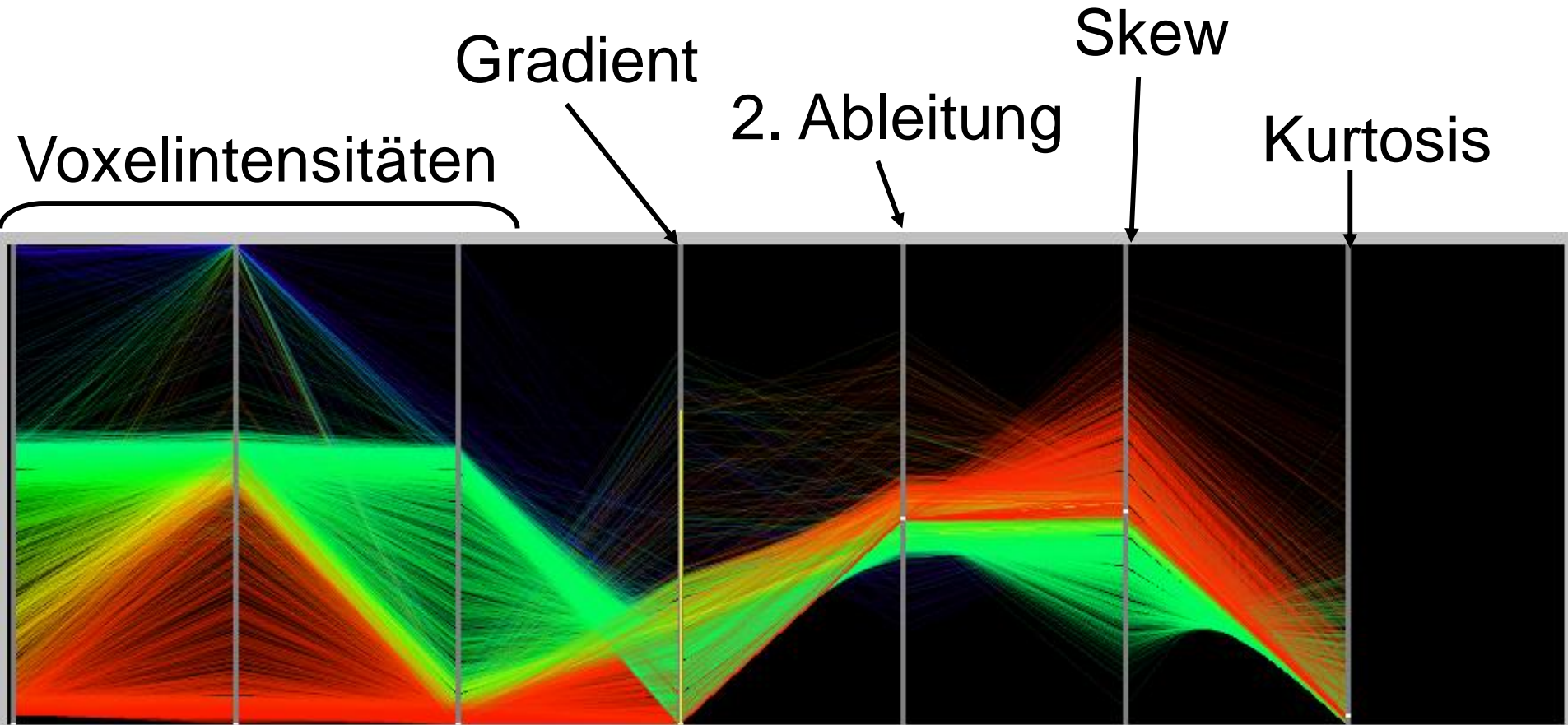
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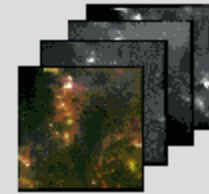
Parallel Coordinates

- INSELBERG, A. DIMSDALE, B. 1990. "Parallel Coordinates: A Tool for Visualizing Multi-Dimensional Geometry," Proc. of the First IEEE Conference on Visualization. 361 (1990).
- <http://www.caip.rutgers.edu/~peskin/epriRpt/ParallelCoords.html>

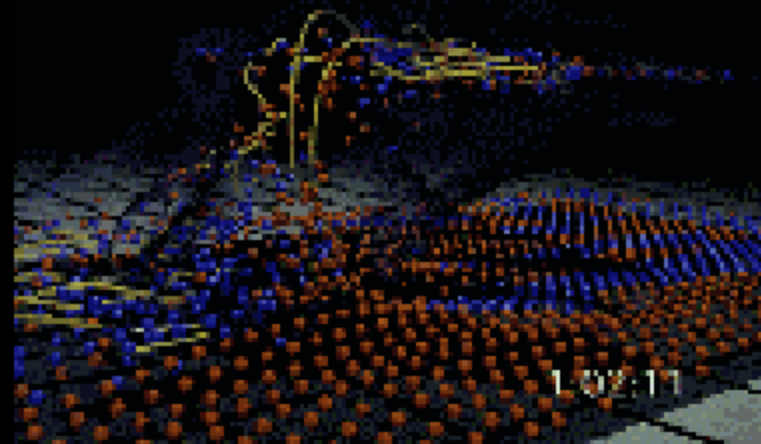
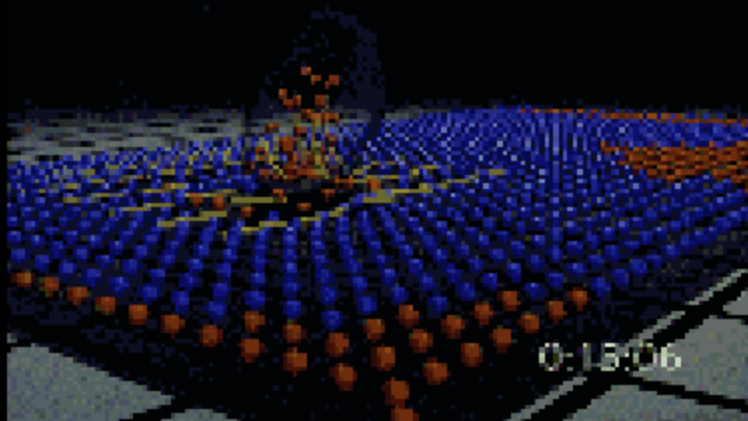


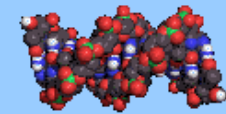
Volumendarstellung (19), Dr. Bartz



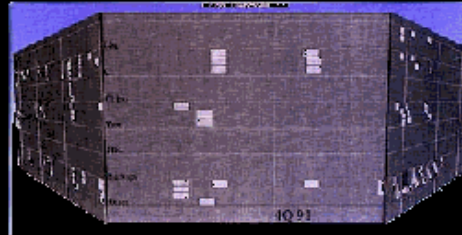
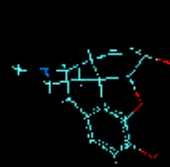


Examples of Visualization





2.4 Examples

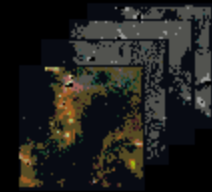


3 April, 2000

Page 19

- *Used even in movies: CSIs, Assa, Hackers 2, Amelie de Montmartre...*





Examples of Visualization

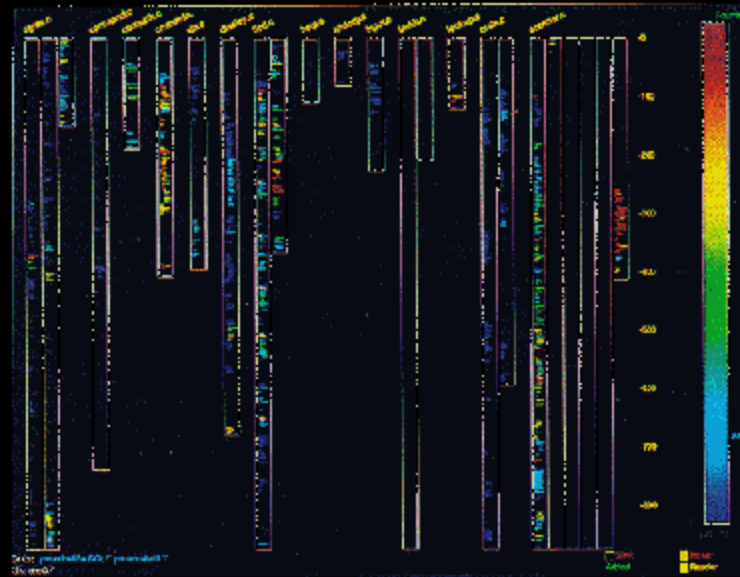
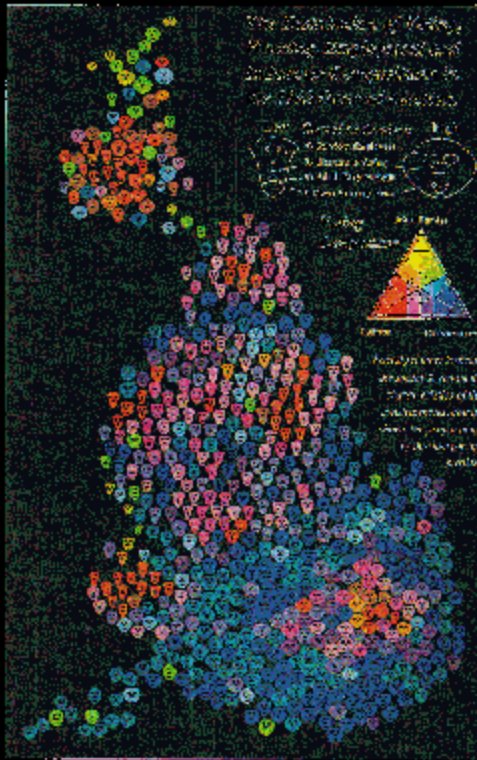


Figure 1: Seasonal profile display.

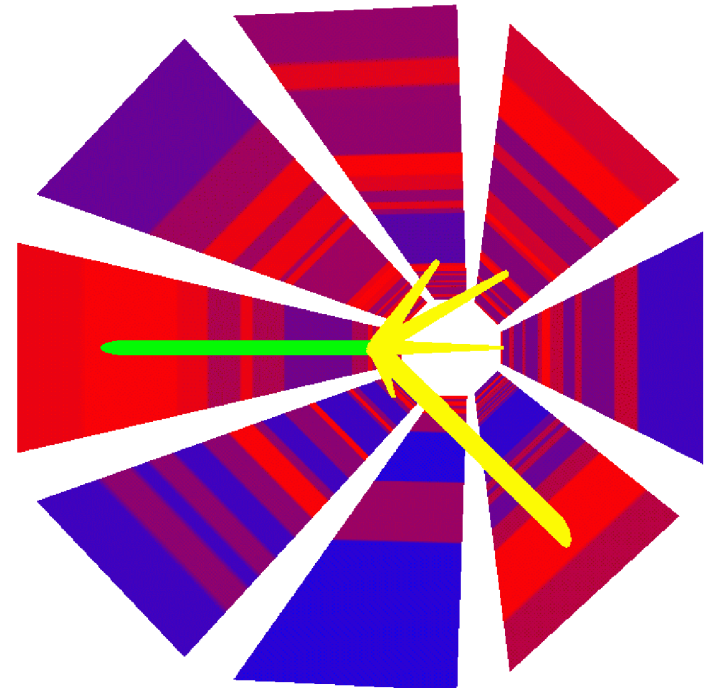
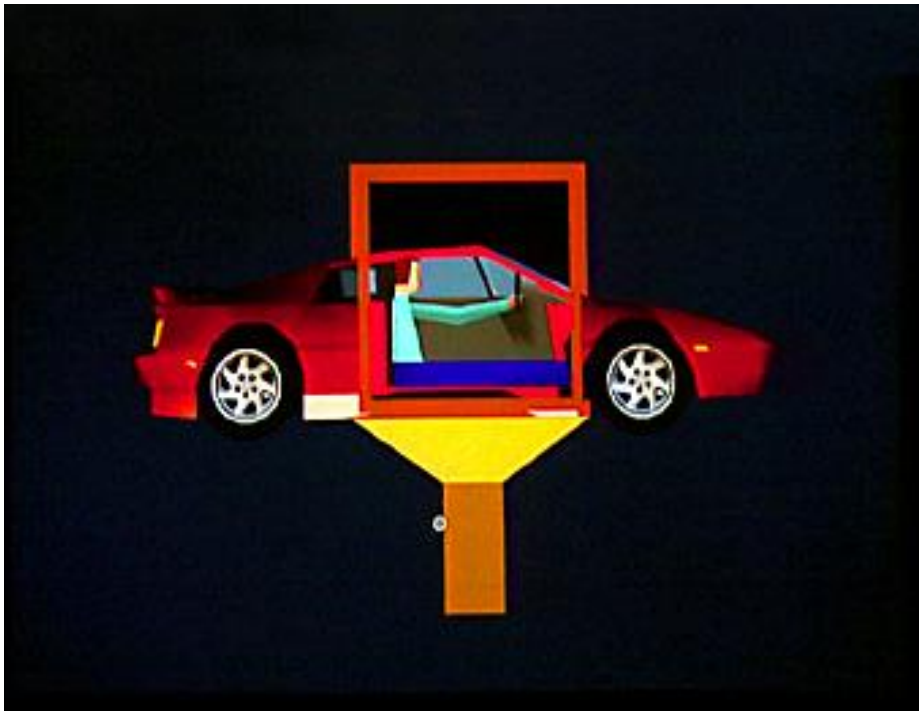
From: Visualization in Geographical Information Systems
Plate 10. Edited by H. M. Hearnshaw and D. J. Unwin, Wiley

From: S. G. Eick and J. L. Steffen,
Proc. Vis 92, IEEE Comp. Soc. Press

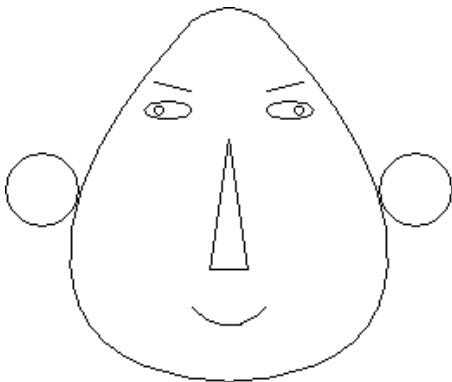


Visualization Magic...

- **Magic Mirror by Jerome Grosjean et al.**
- **Magic Tunnel by Bernhard Reitinger et al.**

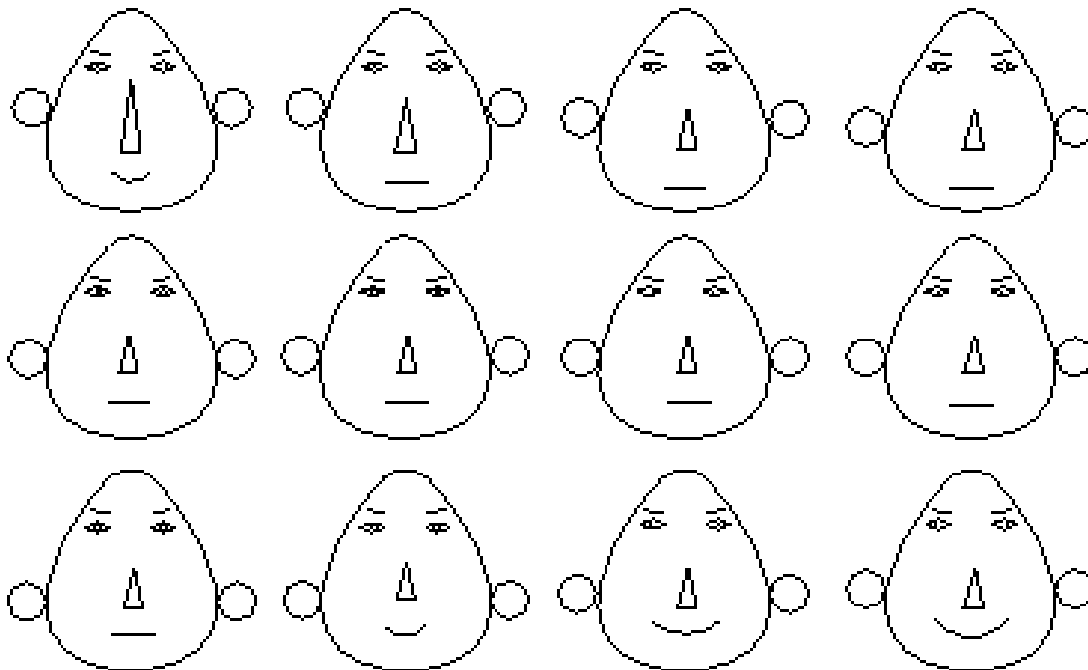


Chernoff Faces



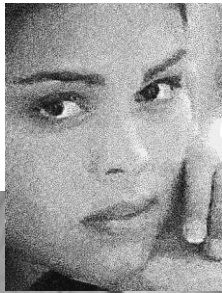
20D

- http://www.epcc.ed.ac.uk/epcc-tec/documents/SciVis-course/SciVis.book_47.html

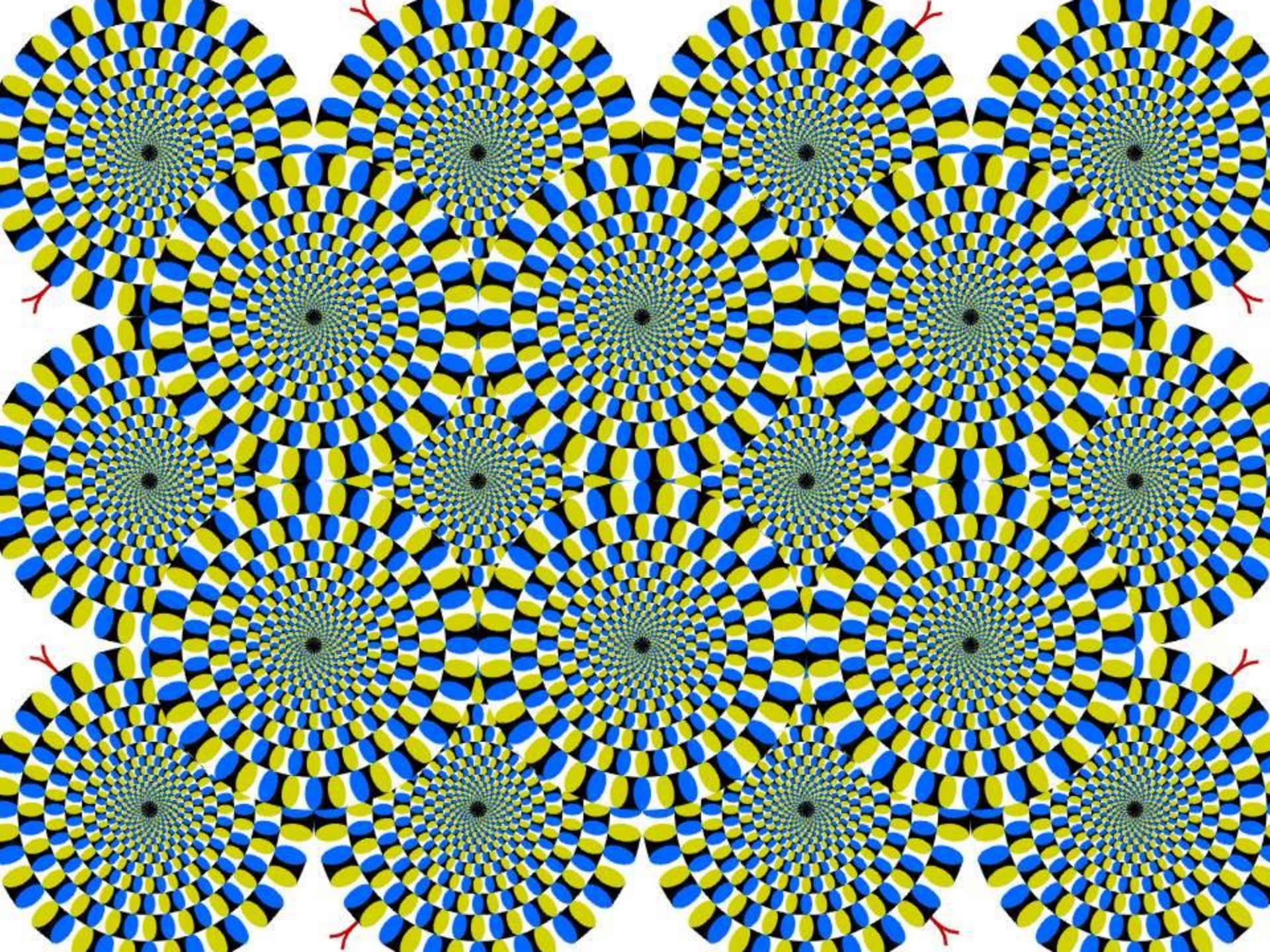


Dimension	Facial Feature
1	Face width
2	Ear level
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5	Eccentricity of lower ellipse of face
6	Length of nose
7	Position of centre of mouth
8	Curvature of mouth
9	Length of mouth
10	Height of centre of eyes
11	Separation of eyes
12	Slant of eyes
13	Eccentricity of eyes
14	Half length of eye
15	Position of pupil
16	Height of eyebrow
17	Angle of brow
18	Length of brow
19	Radius of ear
20	Nose width

NPR Visualization



- <http://mrl.nyu.edu/projects/image-analogies/artistic.html> (SIGGRAPH 2001)





• Final Fantasy

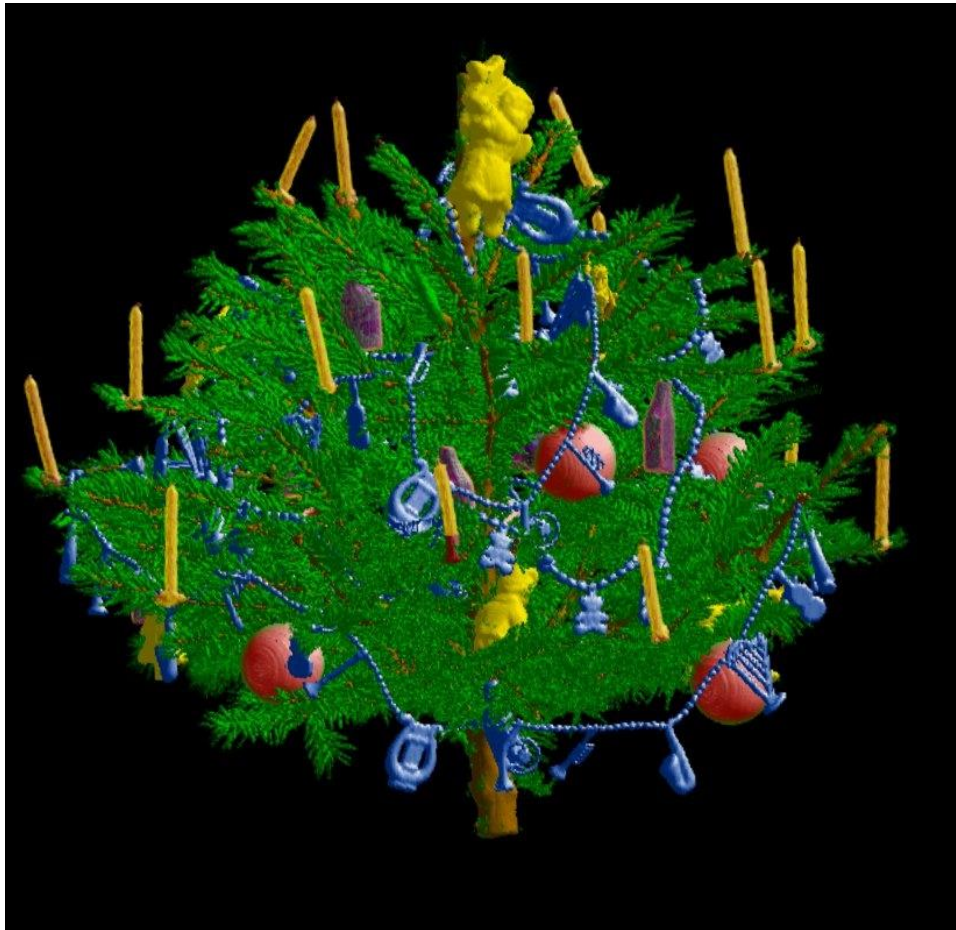


IMAGINATION/VR

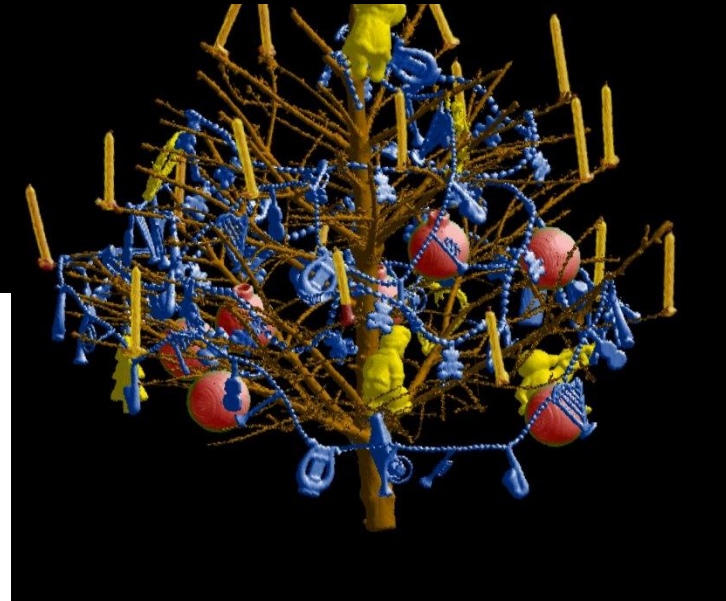
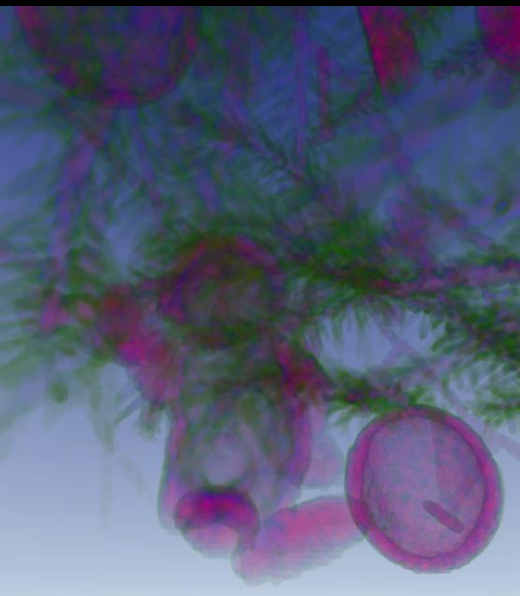
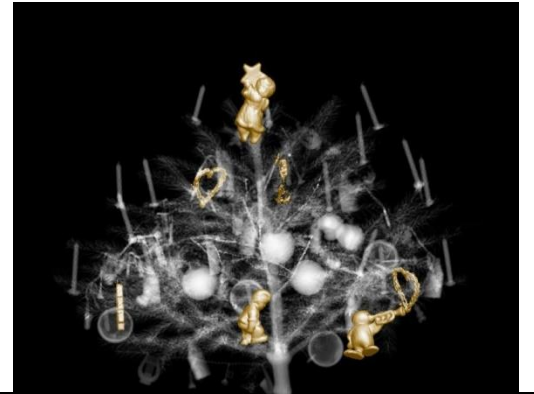
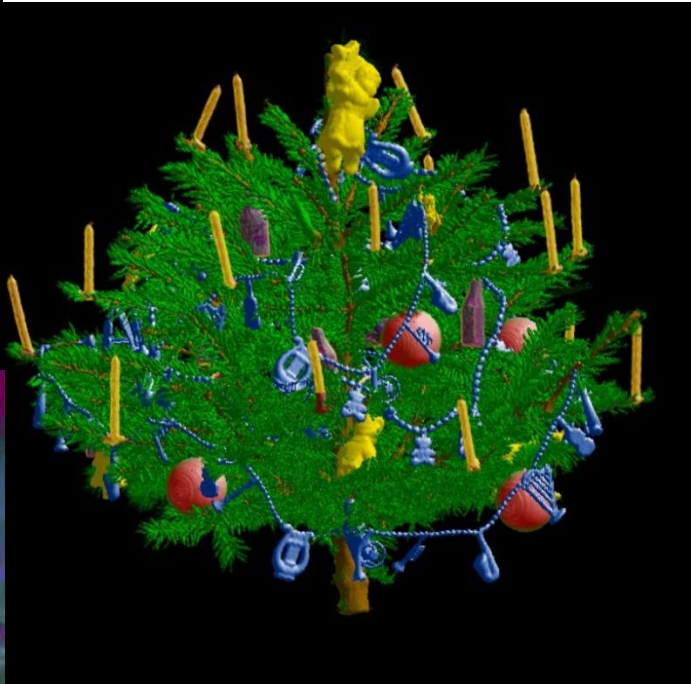


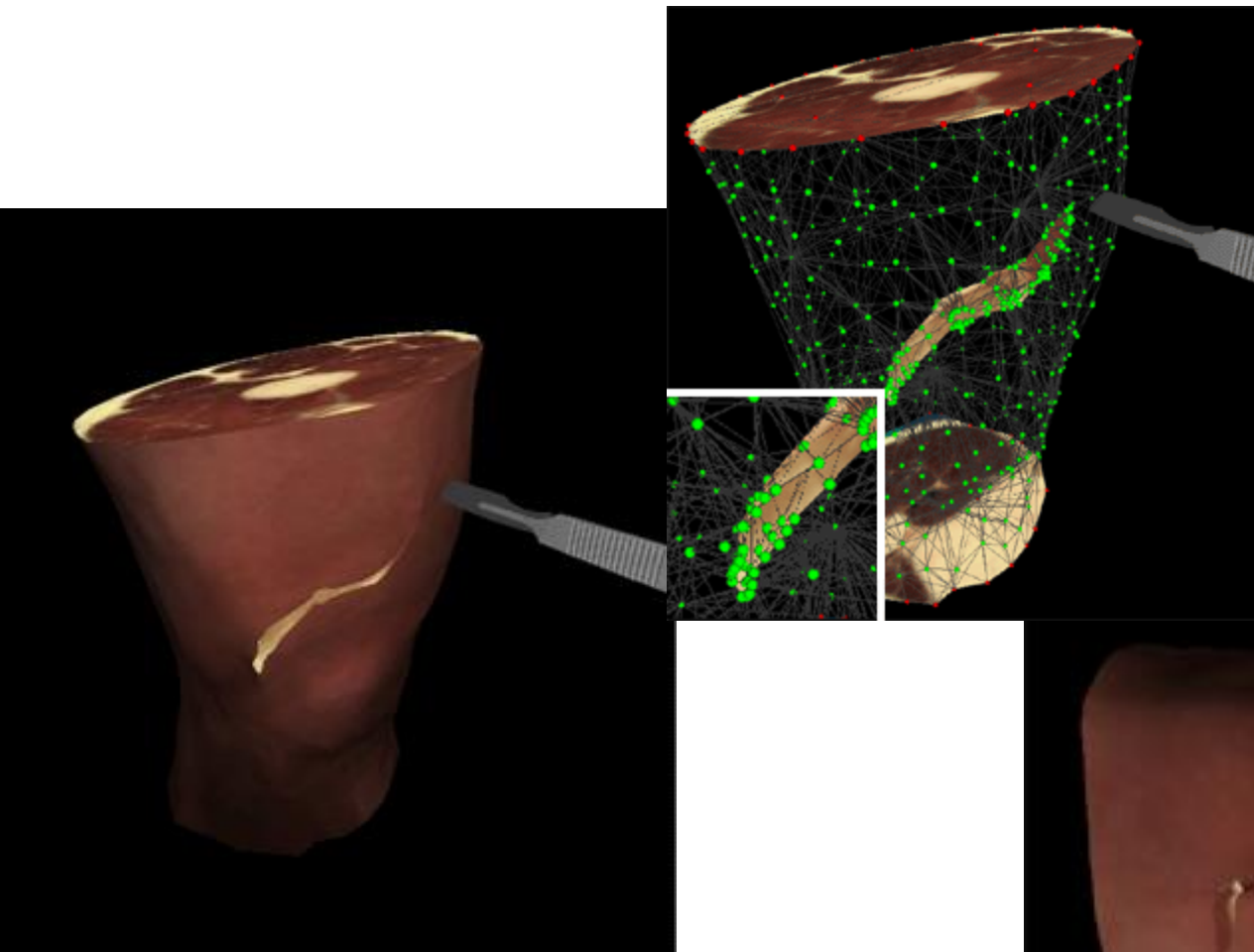
Xmas Tree in Heaven

- **Christmas Tree Awarded Case Study, TU Vienna**



Xmas Tree in Heaven





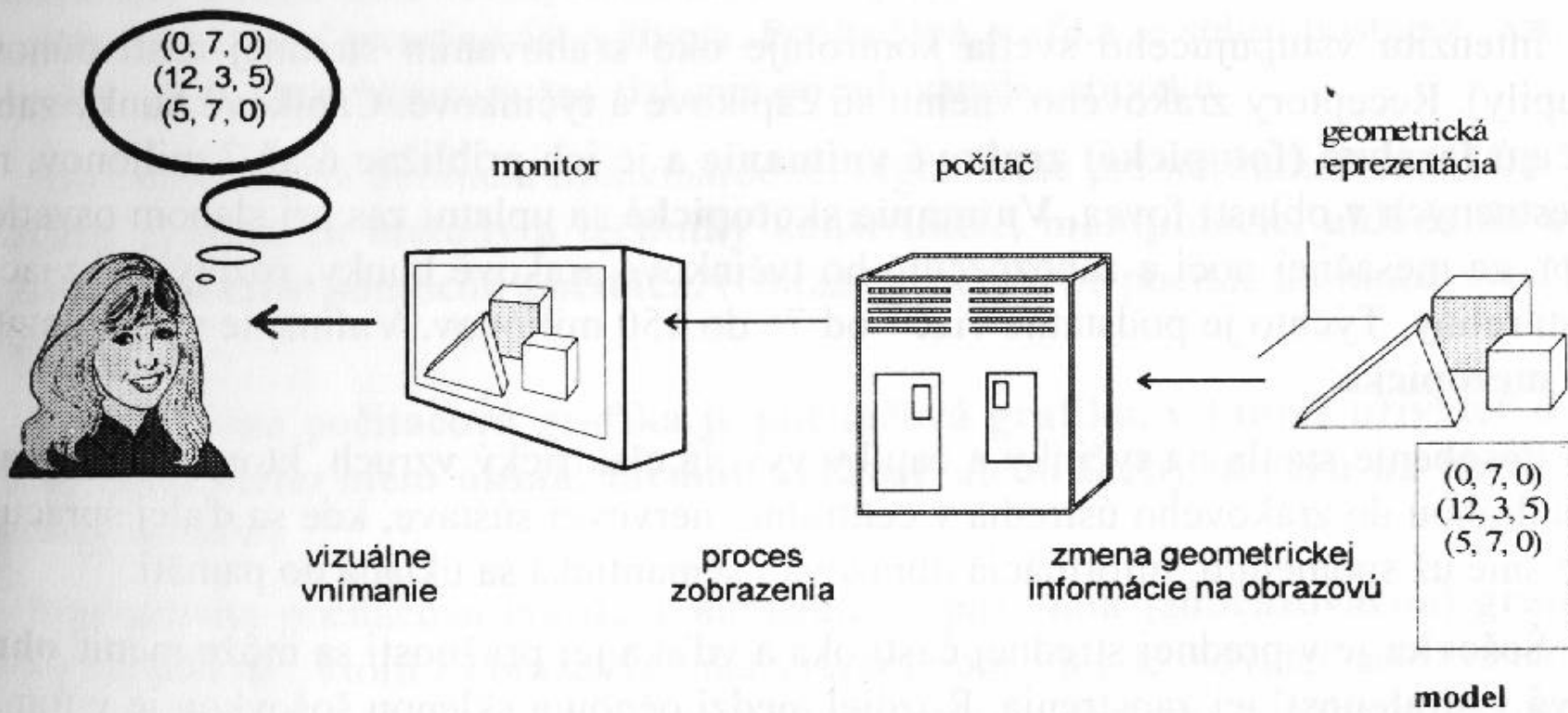
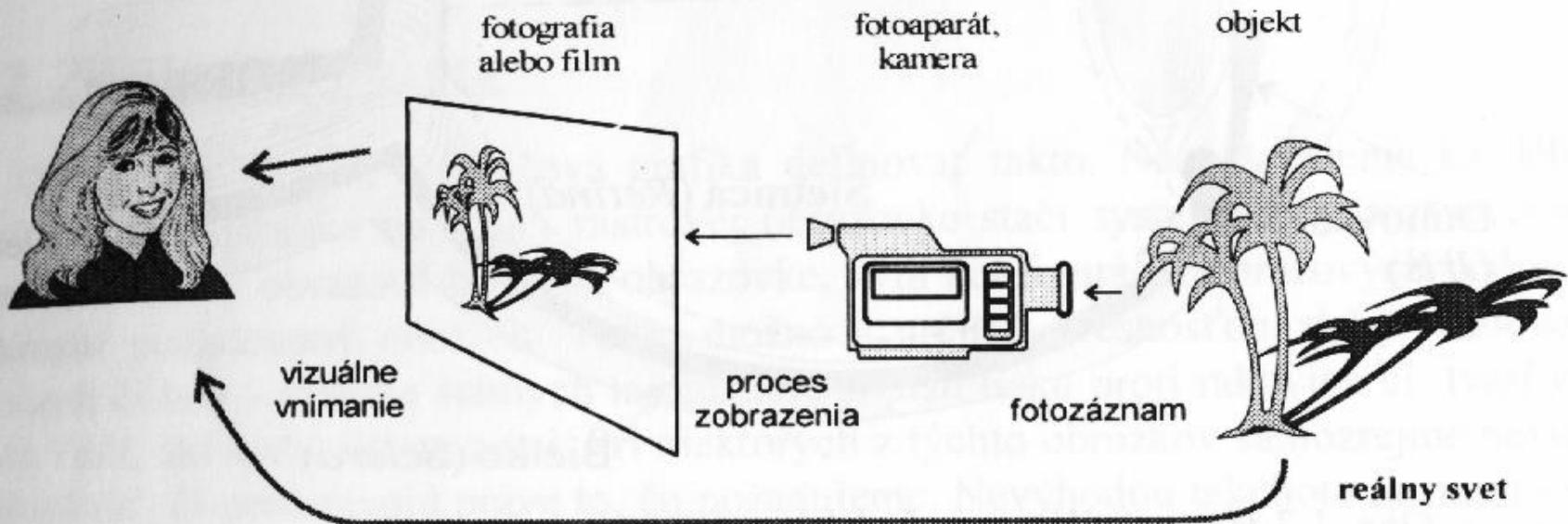
Compare Reality - Synthesis



Photograph



Rendering using the deterministic method



CG Functional Unit

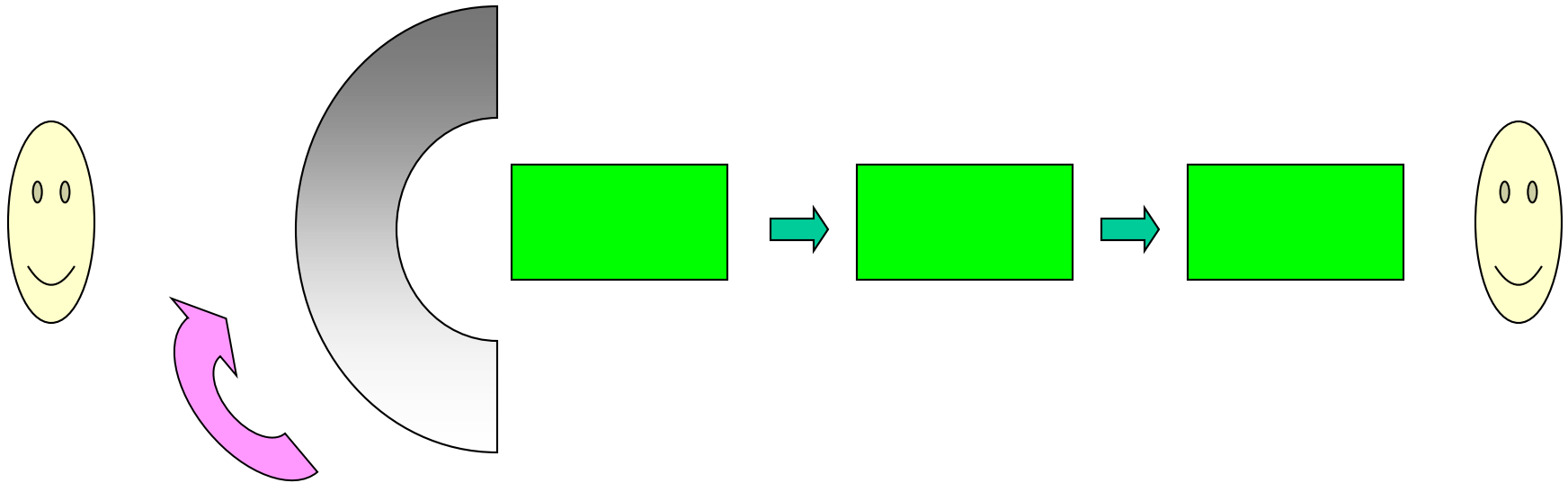
- **known model**
- **wireframe or surface representation:** geometric transformations, visibility calculations, interpolations and raster manipulations
- **photorealistic quality:** the lighting and rendering equations solved to simulate the illumination, shading, shadows, natural and synthetic textures and colors
- **viewing:** (parallel or perspective projections) create the image space
- **animation:** kinematic & dynamic data compute/capture, hierarchy of motions, interpolations in the scene and in the resulting sequence of frames (fps)

Photography ~ computer graphics

- **ISO: Computer graphics:** methods & techniques for construction, manipulation, storage and displaying pictures using computer.
- [Dobkin97]: Computer graphics is a radiometrically weighted counterpart of computational geometry
- 8D (x, y, z, t) (r, g, b, transparency)
- Schnellkurs

Serious Unambiguous Messages

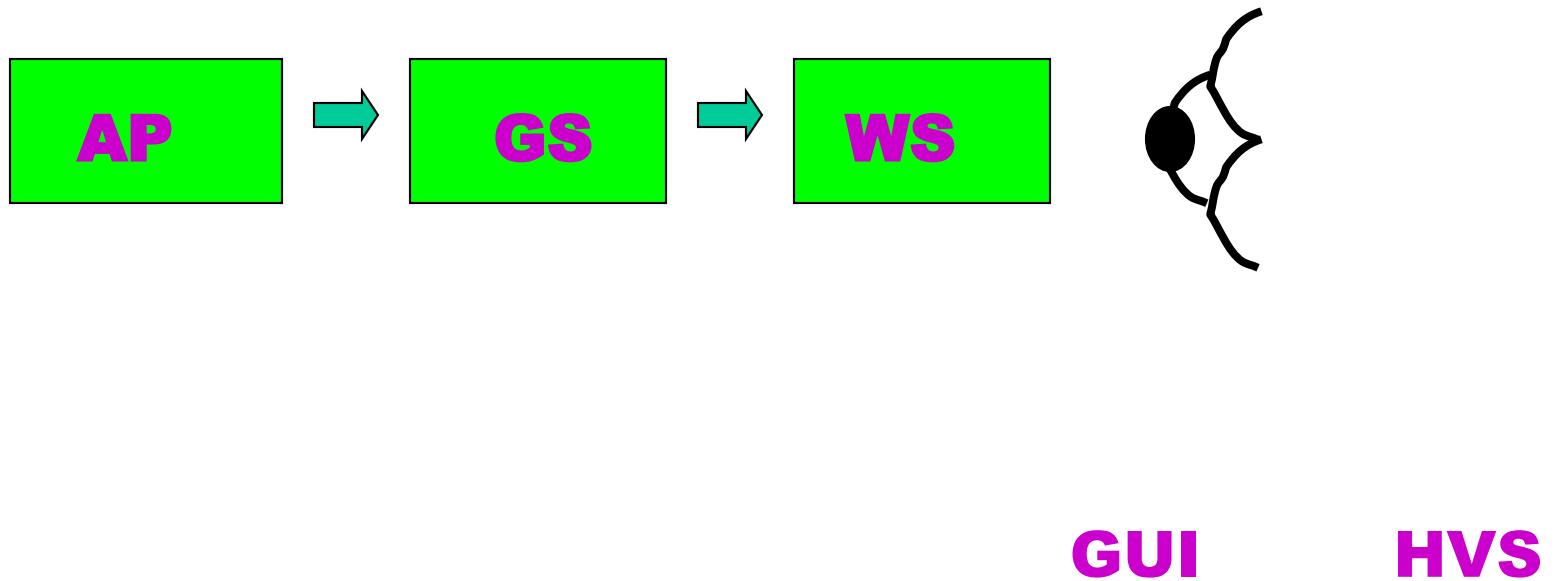
- White box... Black Box: known to unknown
- Problem, model, algorithm, software, results...



- Knowledge++ (electric circuits... CFD... Big Bang/humor theory)
- Labyrinth and Mouse (standard brainstorming creatology)

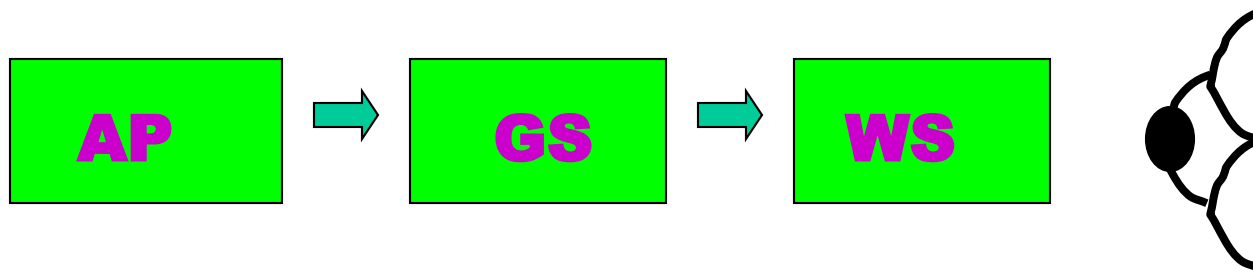
On Model of a Human Being

- Problem – Application Program - Solution



On Model of a Human Being

- Application Programmer - GS Author - User



- Triple Schizophrenia in
- Computer Graphics Reference Model (ISO)

Science

- Discovery

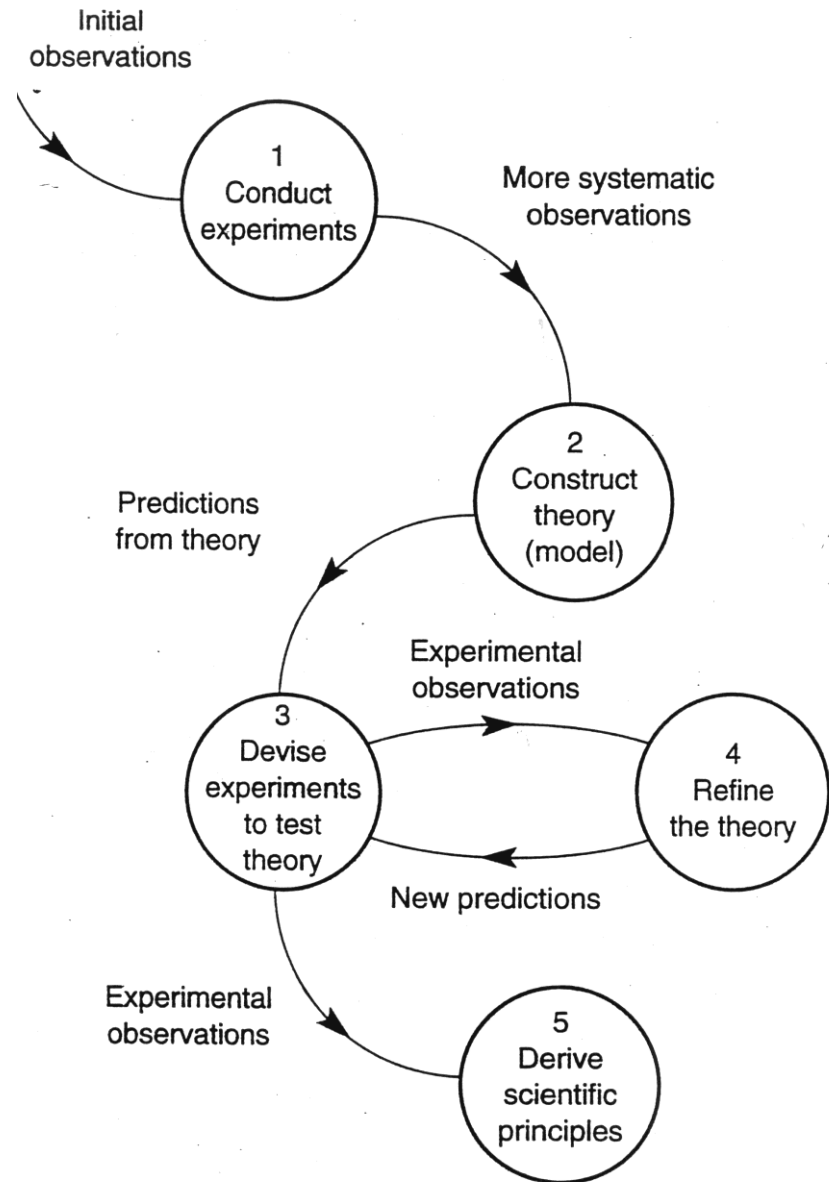


Figure 1.1 The nature of scientific analysis.

Design

- Invention

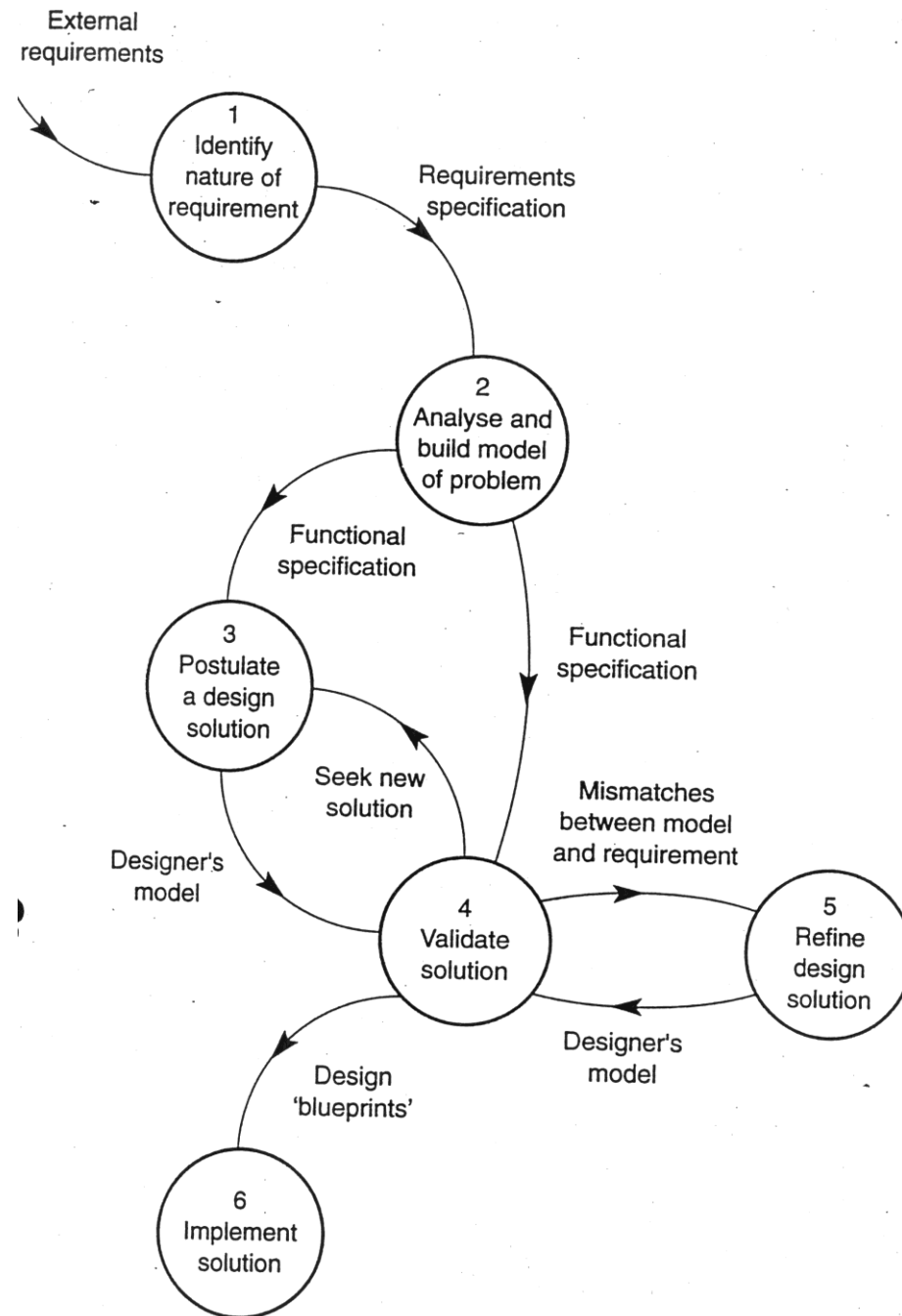


Figure 1.2 A model of the design process.

SIGGRAPH Slide Show



1991 SIGGRAPH Educators' Slide Set

Editor
Steve Cunningham
California State University Stanislaus



S I G G R A P H • 9 1

ShutterBug Credits

Produced by Tom Williams and H. B. Slegel, with the assistance of
M. W. Mantle

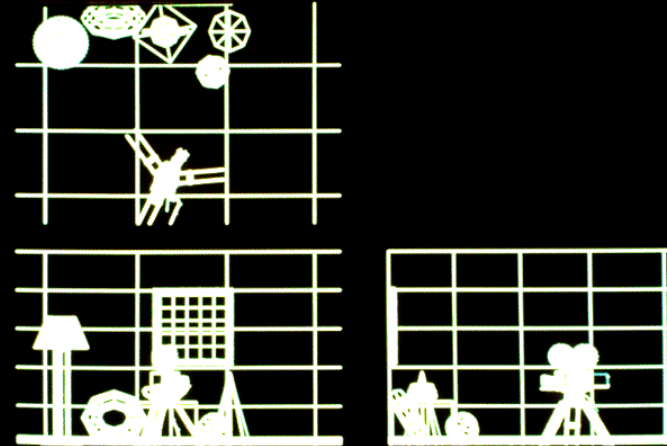
All Images rendered with PhotoRealistic RenderMan 3.2

Copyright Pixar, 1990

Produced for Computer Graphics, Principles and Practice, Second
Edition, by Foley, van Dam, Felner, and Hughes

Copyright Addison-Wesley, 1990

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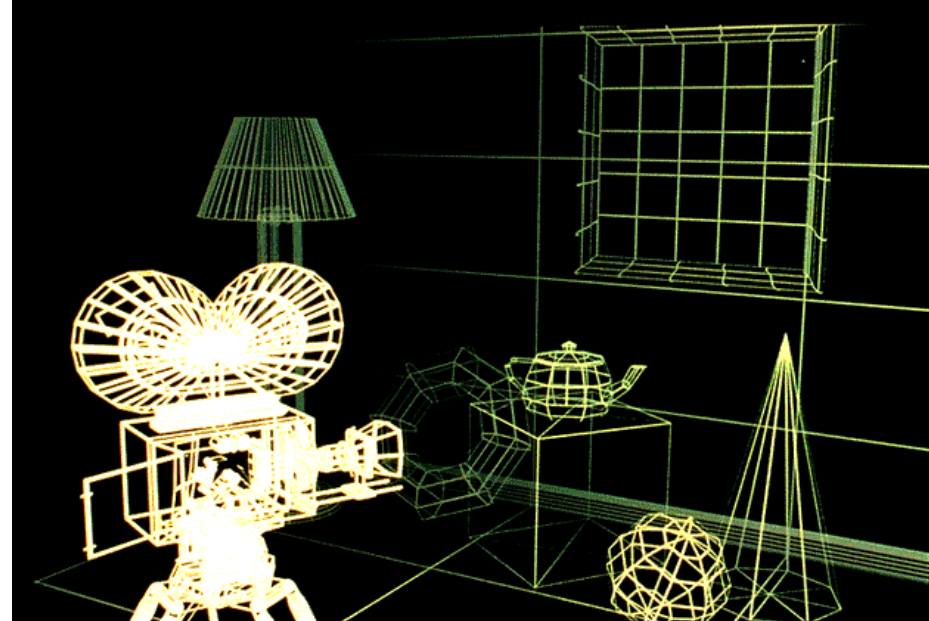
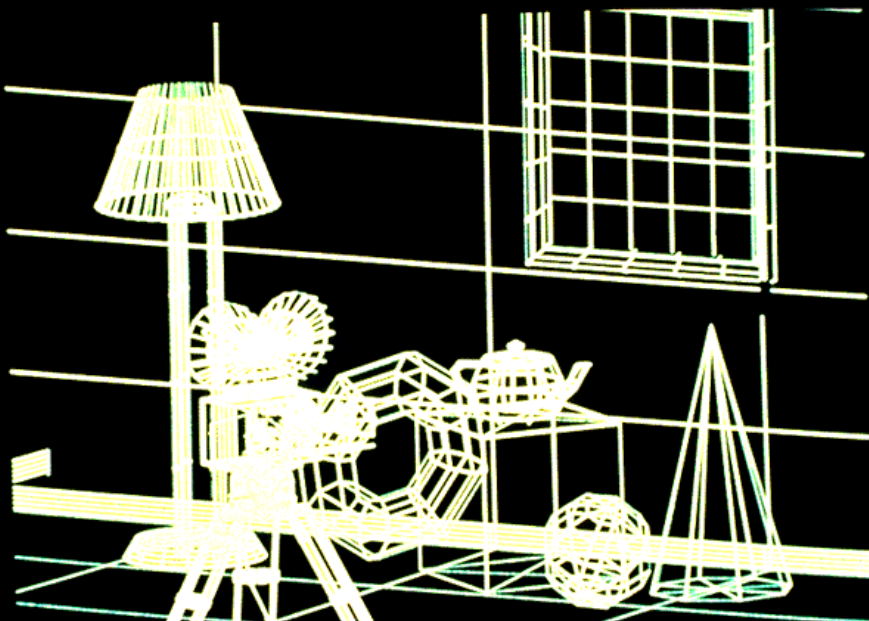
The Shutterbug Rendering Progression

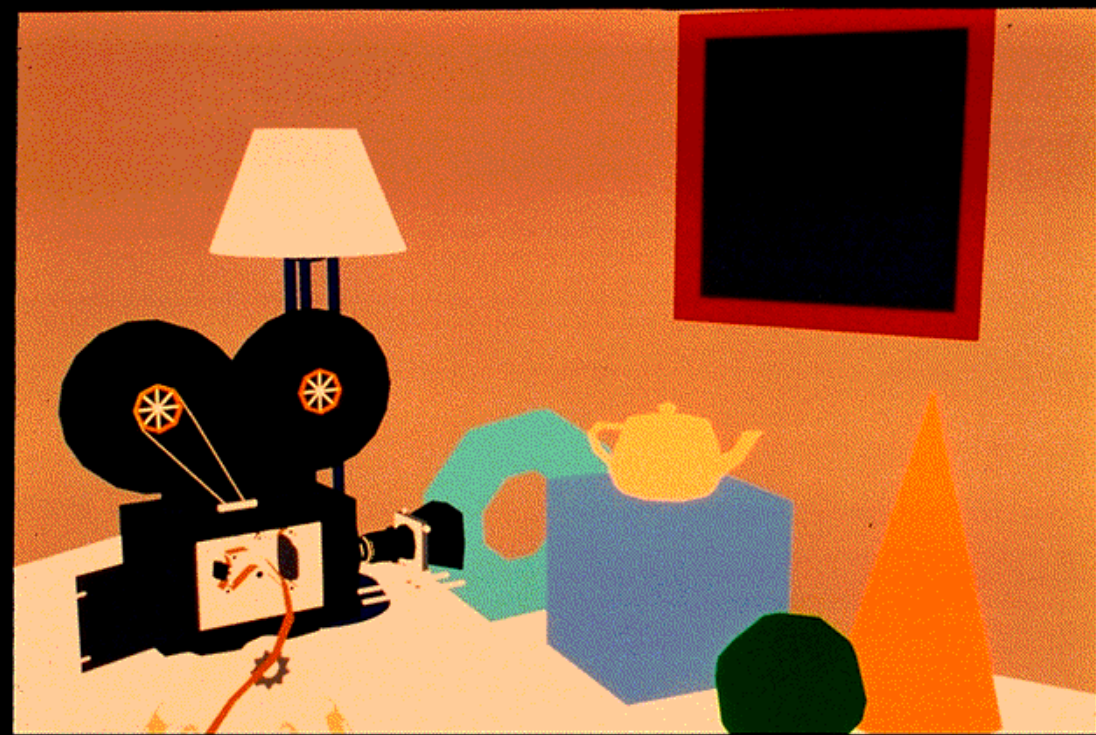
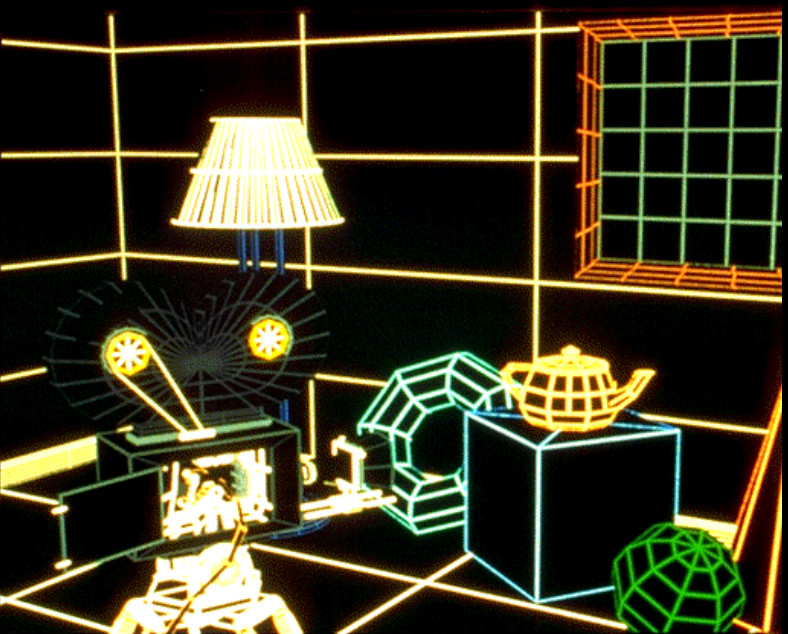
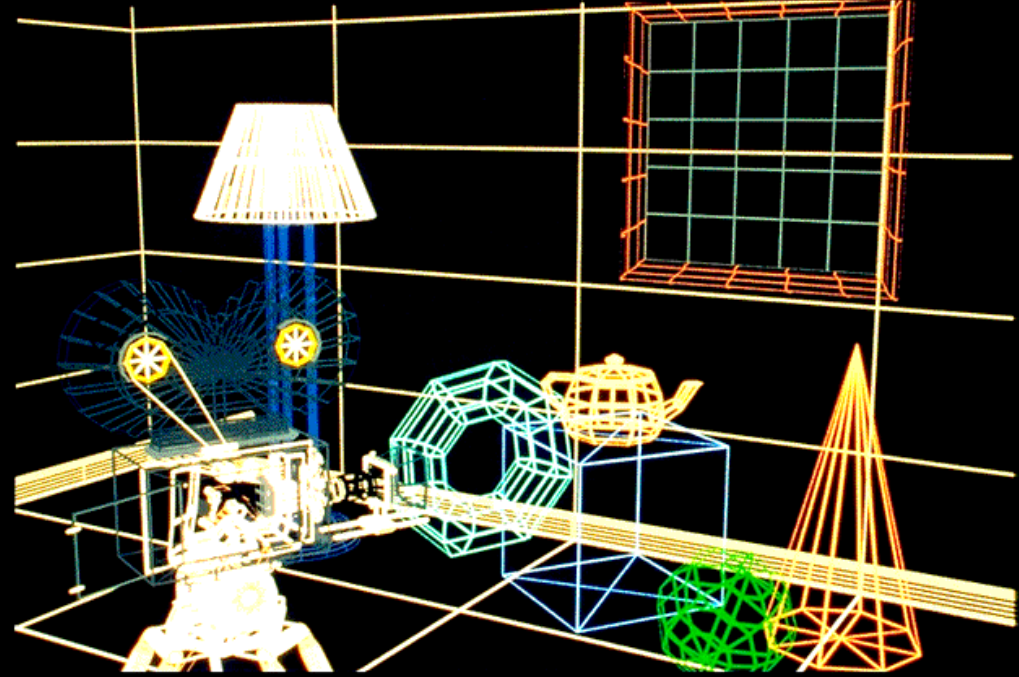
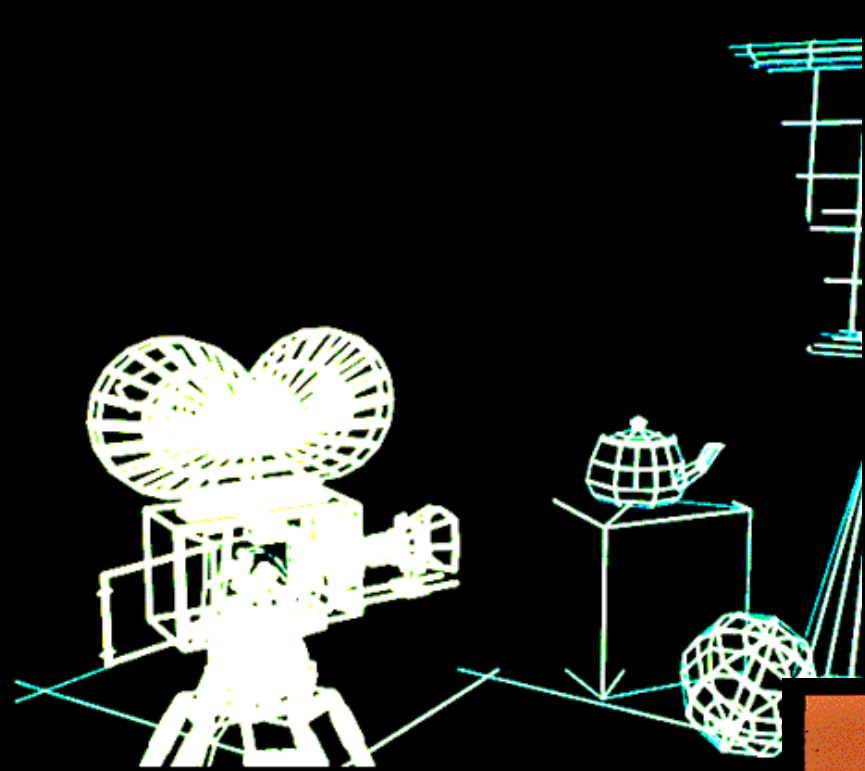
This sequence illustrates the progressive refinement of rendering algorithms.

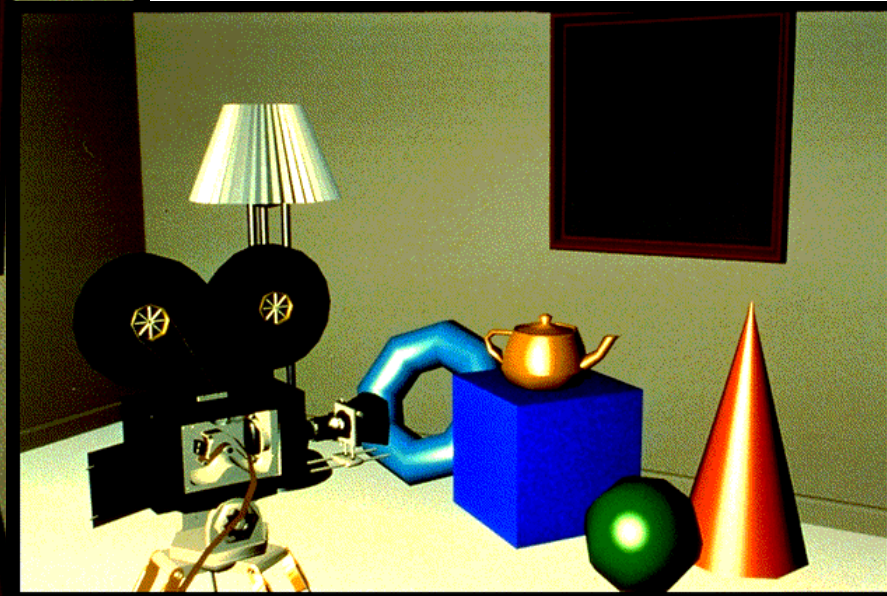
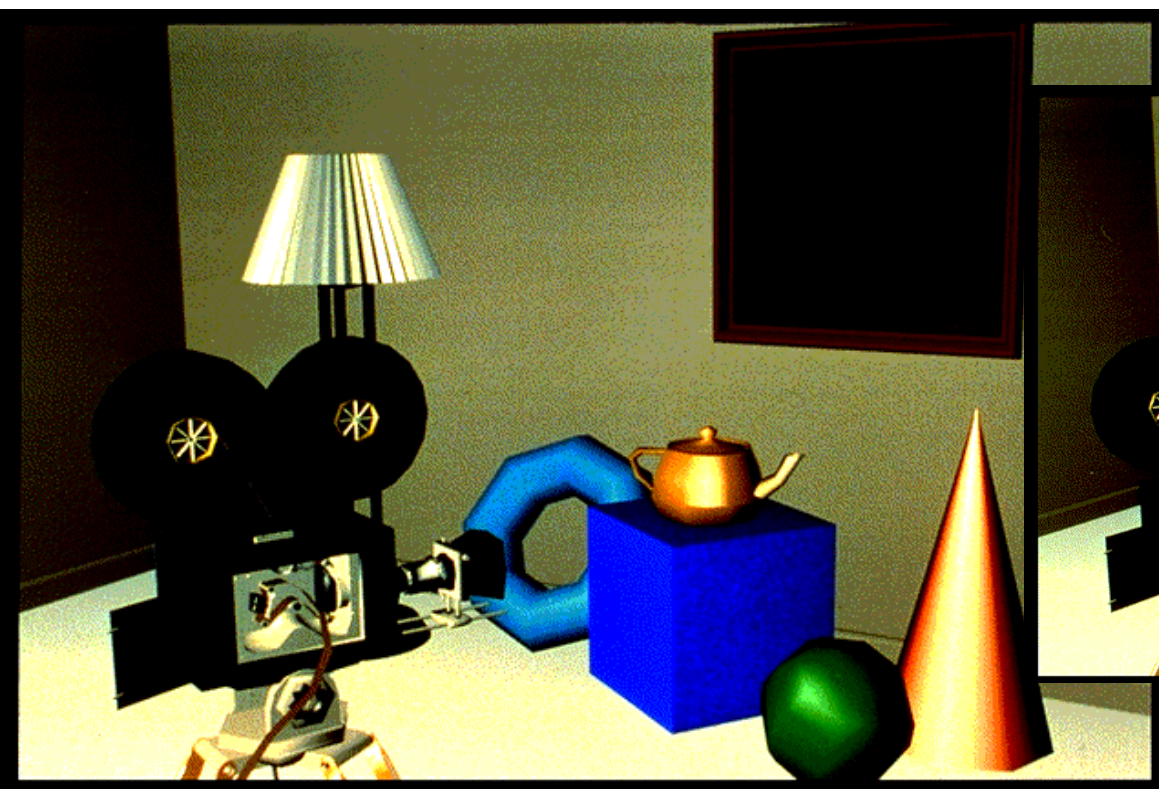
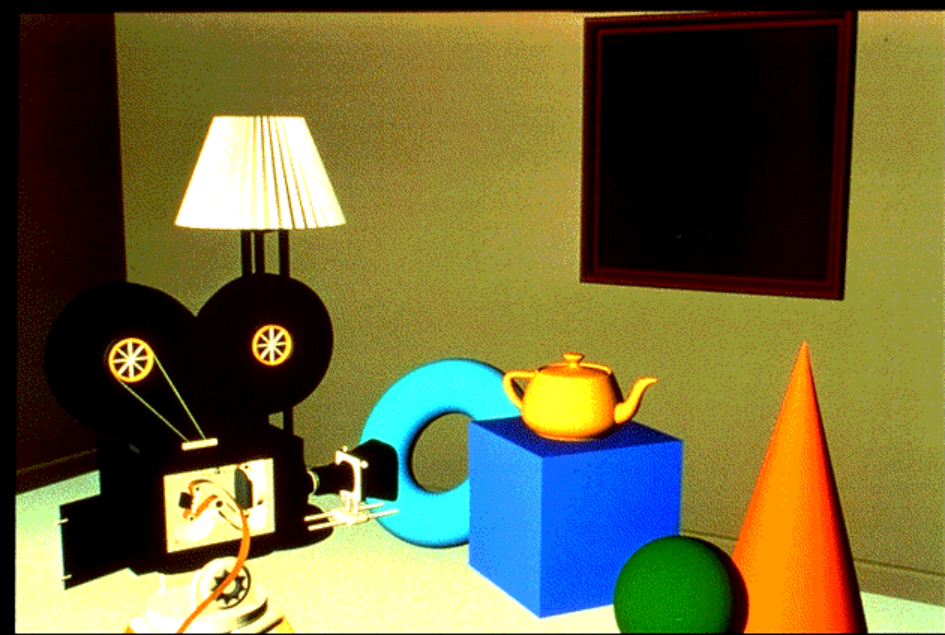
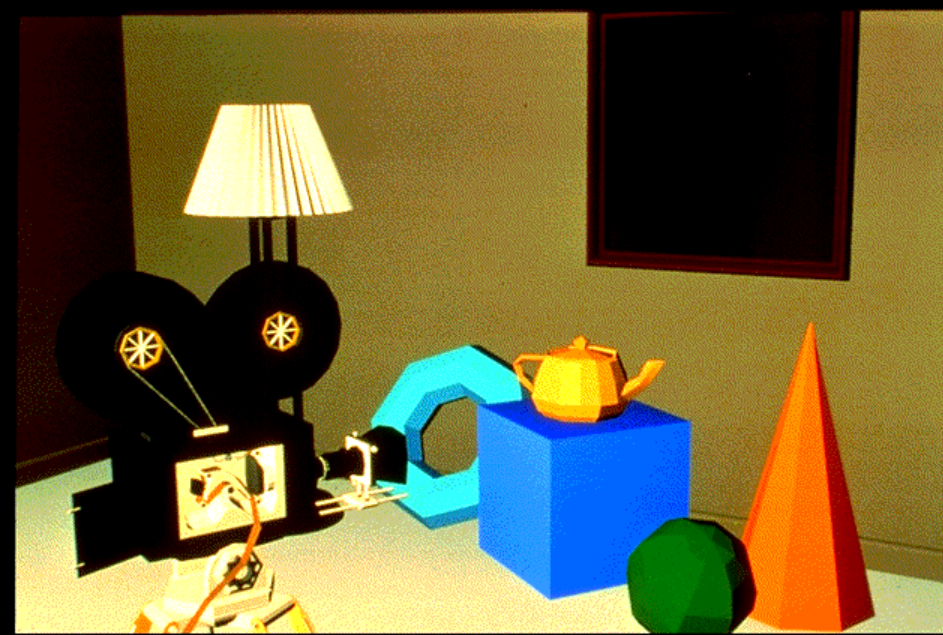
The images range from wire frames to photo-realistic renditions including reflections and shadows.

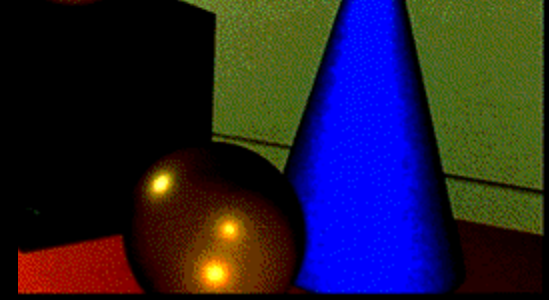
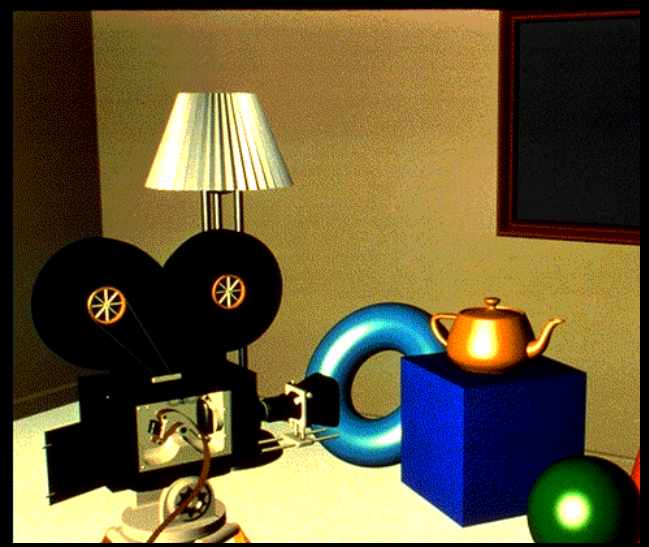
The rendering algorithm affects the quality and information conveyed by the image, independent of the underlying three-dimensional model.

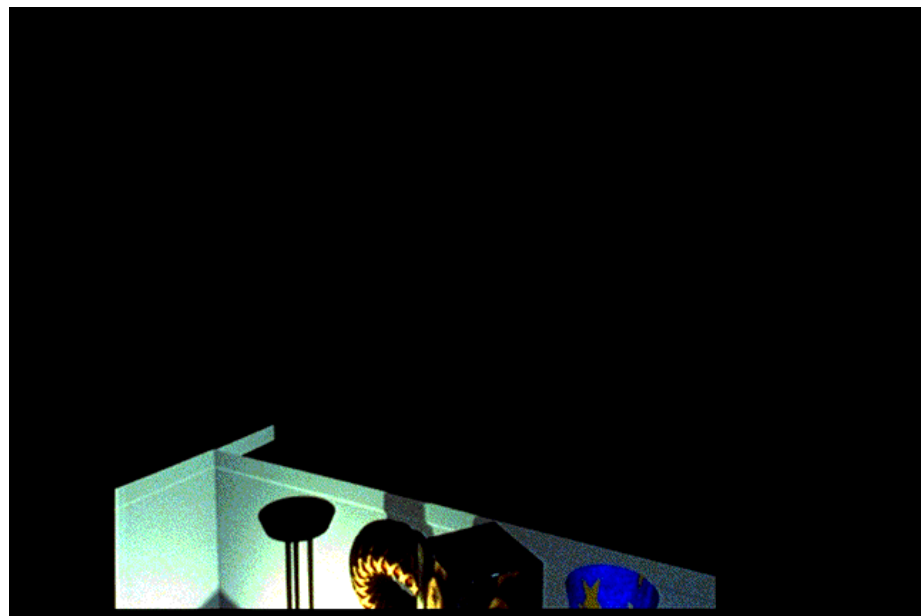
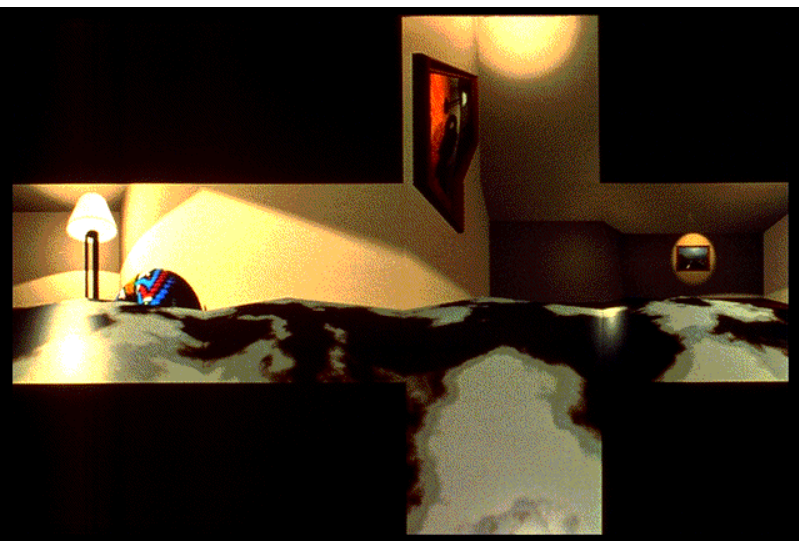
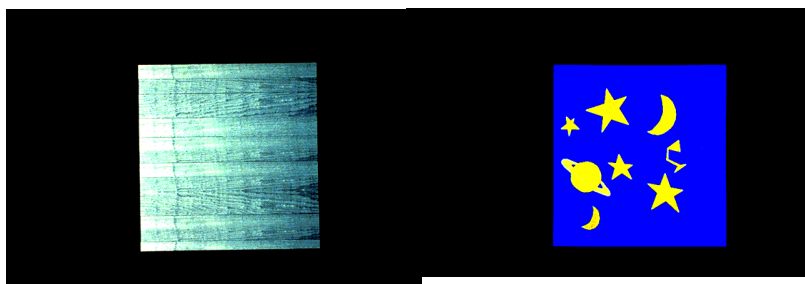
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Conclusions... partial

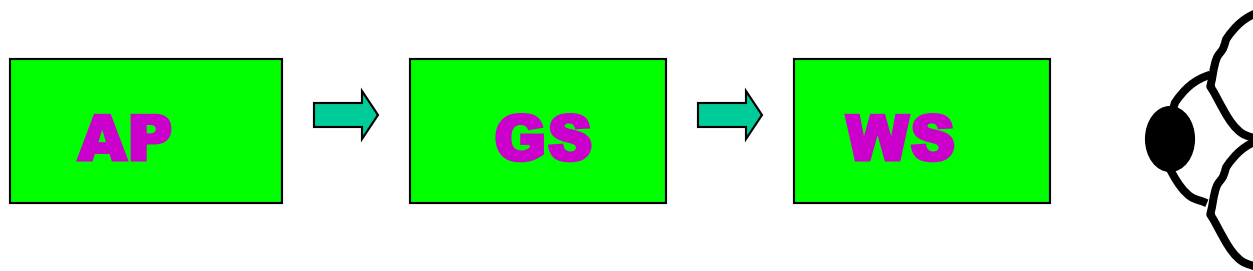
- **Humor is undefined at all**
- **We have just the general theory from Bakhtin and a formal model... and a lot of practical joy**
- **How to encode ambiguities - our proposed solution based on the bisociation idea by A. Koestler**
- **Significant part of web communication**
- **Bakhtinian understanding: laughter culture**

Conclusions... partial

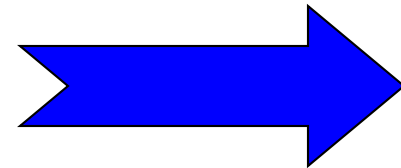
- **AH, AHA, HAHA**
- **Laughter culture in the sense of Bakhtin lives in cyberspace and we shall overcome with folklore in the neverending fight with nonhumanity and stupidity**
- **Visualization metaphors**
- **Computer graphics reference model**

On Model of a Human Being

- Controlled Error: Model, Algorithm... Solution



- Computer Graphics \gg Visualization
 $\varepsilon \rightarrow 0$ \gg $\varepsilon \rightarrow \text{infinity}$



Conclusions...

- Your web page, www.sccg.sk/~ferko
- pg.netgraphics.sk, cvicenia ~ hands-on
- www.sccg.sk/~pg1
- Computer graphics reference model
- Visual information processing
motivation and methodology
- Thank You for Your attention



Úvod do počítačovej grafiky ako marketingového nástroja pre managerov

Andrej FERKO

Comenius University Bratislava

25. septembra 2017, FMFI UK