VR 和 Visualization 前世今生

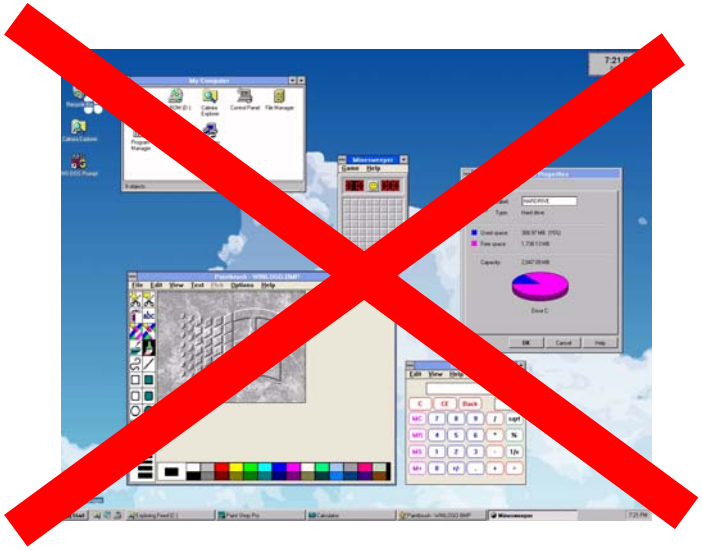
網多第三組

Outline

- VR
  - Definition
  - Relationship between VR and Computer Graphics (History)
  - VR (detail & implement concept)
  - graphicVR, photoVR, hydridVR
  - Display HW/SW
  - Challenge
- Visualization
  - Definition
  - Data visualization
  - The visualization pipeline
  - What are considered good visualizations
  - What are available
  - What are the remaining challenges

Virtual Reality

Dream



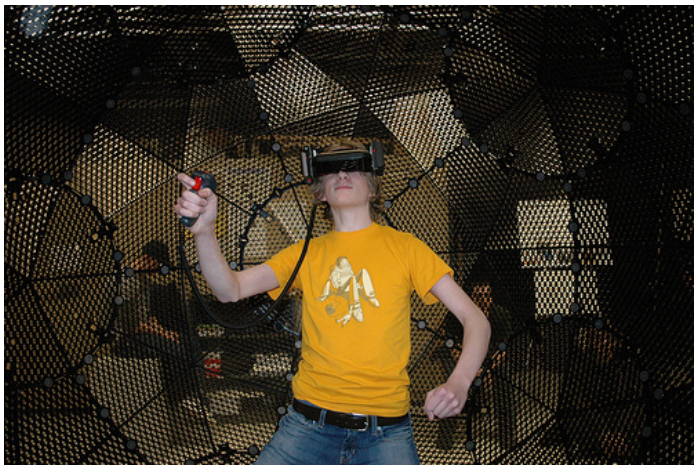
- Don’t think of that thing as a *screen*, think of it as a *window*, a window through which one looks into a *virtual world*.

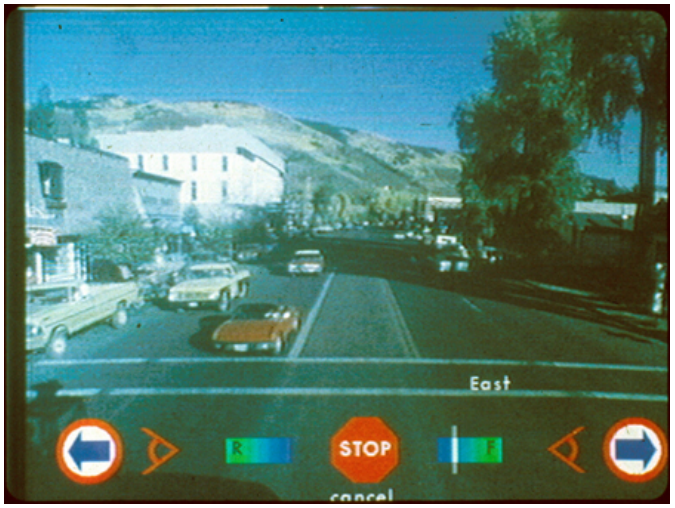
  -- Ivan Sutherland,1965, “The Ultimate Display”

Definition

- **Virtual Reality** — A computer simulation of a real or imaginary system that enables a user to **perform operations on** the simulated system and **shows the effects** in real time.

Human-System interaction





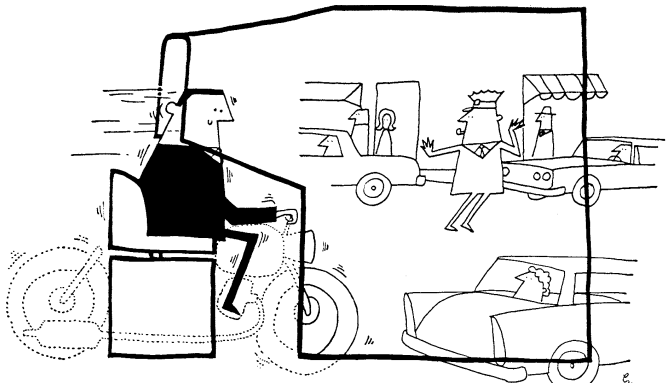
History

- 1961 “Experience Theater”
- 1968 “The sword of Damocles”
- 1977 “Aspen Movie Map“
- 1980 “Tele-immersion”

Morton Heilig

- the Hollywood-based cinematographer and part-time inventor, patented an arcade game called Sensorama.
- “Reality for a nickel" but didn't make a dime.

Sensorama



Introducing . . .

sensorama

The Revolutionary Motion Picture System that takes you into another world with

- 3–D
- WIDE VISION
- MOTION
- COLOR
- STEREO-SOUND
- AROMAS
- WIND
- VIBRATIONS

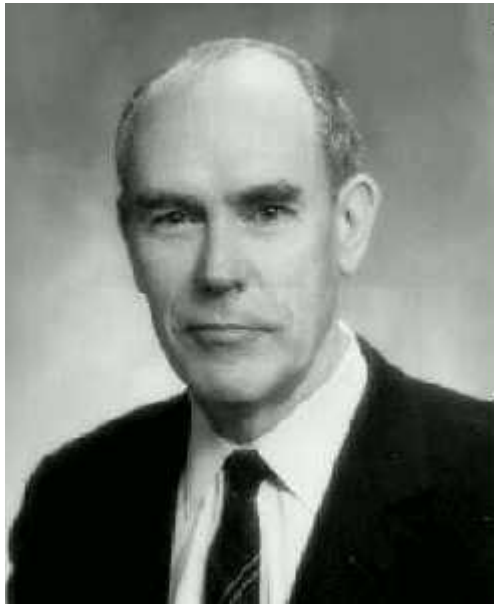
PATENTED

SENSORAMA, INC., 855 GALLOWAY ST., PACIFIC PALISADES, CALIF. 90272
TEL. (213) 459–2162

History

- 1961 “Experience Theater”
- 1968 “The sword of Damocles”
- 1977 “Aspen Movie Map“
- 1980 “Tele-immersion”

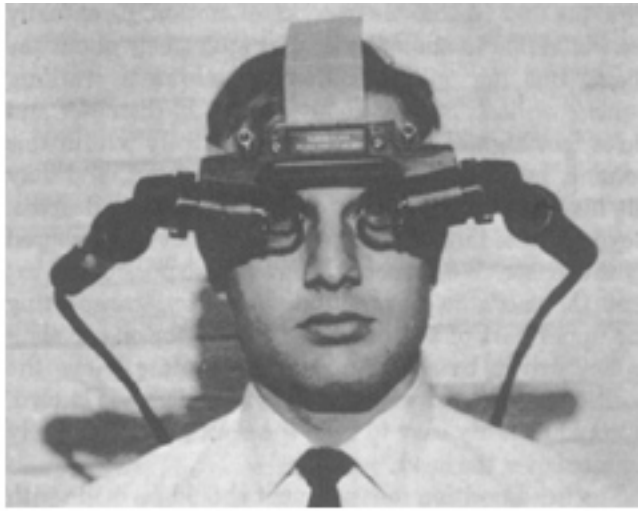
The Ultimate Display



- The ultimate display would, of course, be a room within which **the computer can control the existence of matter**. … With appropriate programming such a display could literally be **the Wonderland into which Alice walked.**

-- **Ivan Sutherland,1965, "The Ultimate Display"**

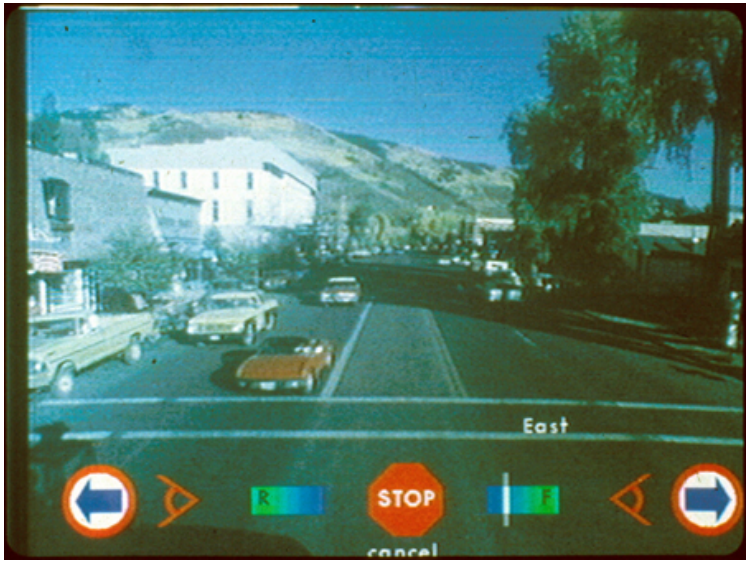
The sword of Damocles

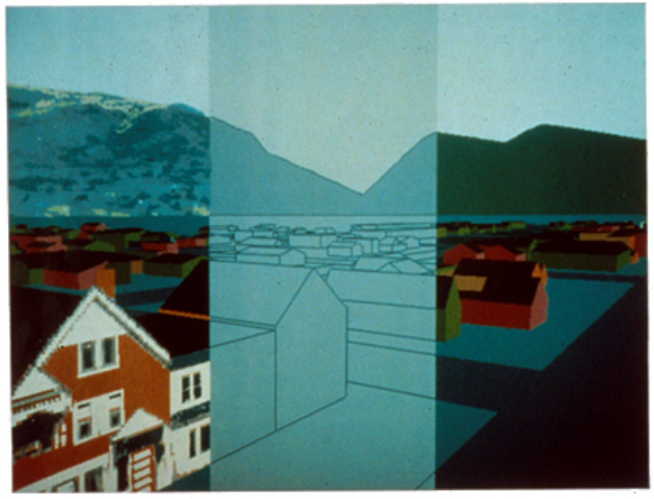


History

- 1961 “Experience Theater”
- 1968 “The sword of Damocles”
- 1977 “Aspen Movie Map“
- 1980 “Tele-immersion”

Aspen Movie Map





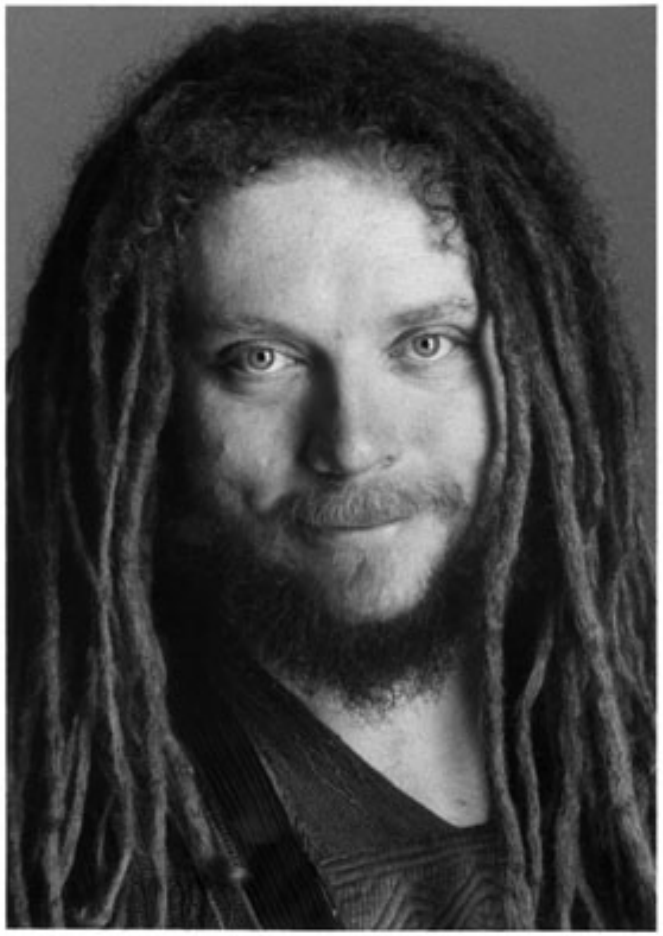
History

- 1961 “Experience Theater”
- 1968 “The sword of Damocles”
- 1977 “Aspen Movie Map“
- 1980 “Tele-immersion”

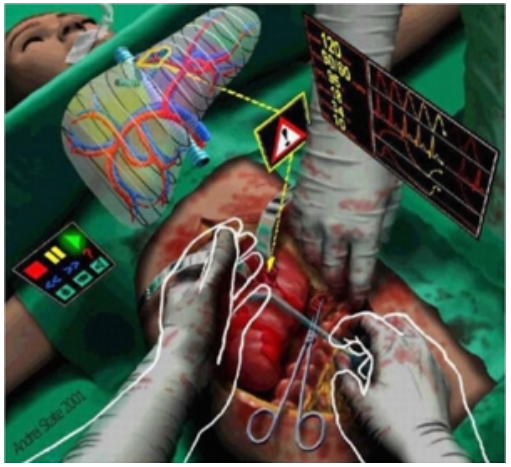
Virtual Reality

- Coin the term “Virtual Reality”.

- Founded **VPL** (Virtual Programming Language) **Research**, the first company to sell VR products.



Tele-immersion



- Tele-Immersion is a new medium that enables a user to share a virtual space with remote participants.

VR variety

- Graphics VR
  - 又稱 Geometry-based VR，場景中的所有物件都是實際存在的 3D Model，使用者可以任意視角與路徑來觀看
- Image VR
  - 利用適當的軟、硬體設備產生 360°的環場影像，使用者可在定點以任意角度觀看場景。
- Hybrid VR
  - 結合幾何式與影像式的虛擬實境發展環境，以汰除兩者之缺點，並結合兩者之優點爲目標。

Graphic VR

Image VR

Sony patent

- On April 7th, 2005 Sony went public with the information that they had filed for and received a patent for the idea of the non-invasive beaming of different frequencies and patterns of ultrasonic waves **directly into the brain** to recreate all five senses

Dream

- The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such room would be fatal. With appropriate programming such a display could literally be the Wonderland into which Alice walked.

-- Ivan Sutherland,1965,“The Ultimate Display”

“The Wonderland into which Alice walked”

Information Visualization

Visualization

Merriam-Webster Online

Main Entry: **vi·su·al·i·za·tion**

Pronunciation: `"vi-zh&-w&-l&-'zA-sh&n, "vi-zh&-l&-, "vizh-w&-l&-`

Function: *noun*

1 : formation of mental visual images

2 : the act or process of interpreting in visual terms or of putting into visible form

3 : the process of making an internal organ visible by the introduction (as by swallowing, by an injection, or by an enema) of a radiopaque substance followed by roentgenography

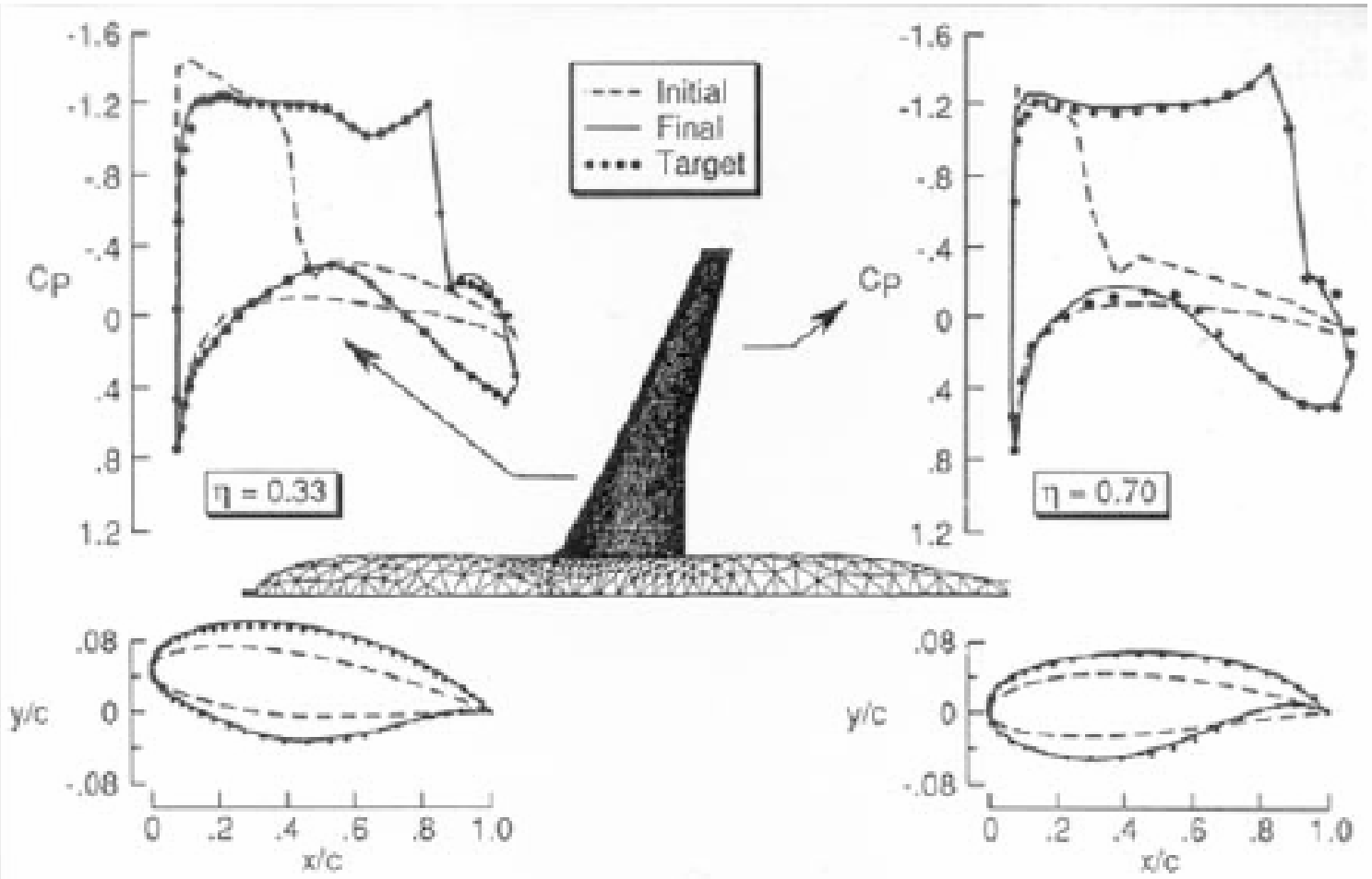
Visualization is…

- A way of communication
- A way of stimulation
- A cognitive process involving memory, thought, and reasoning
- To use vision to think—Card, Mackinlay, and Shneiderman
- An external aid in problem solving

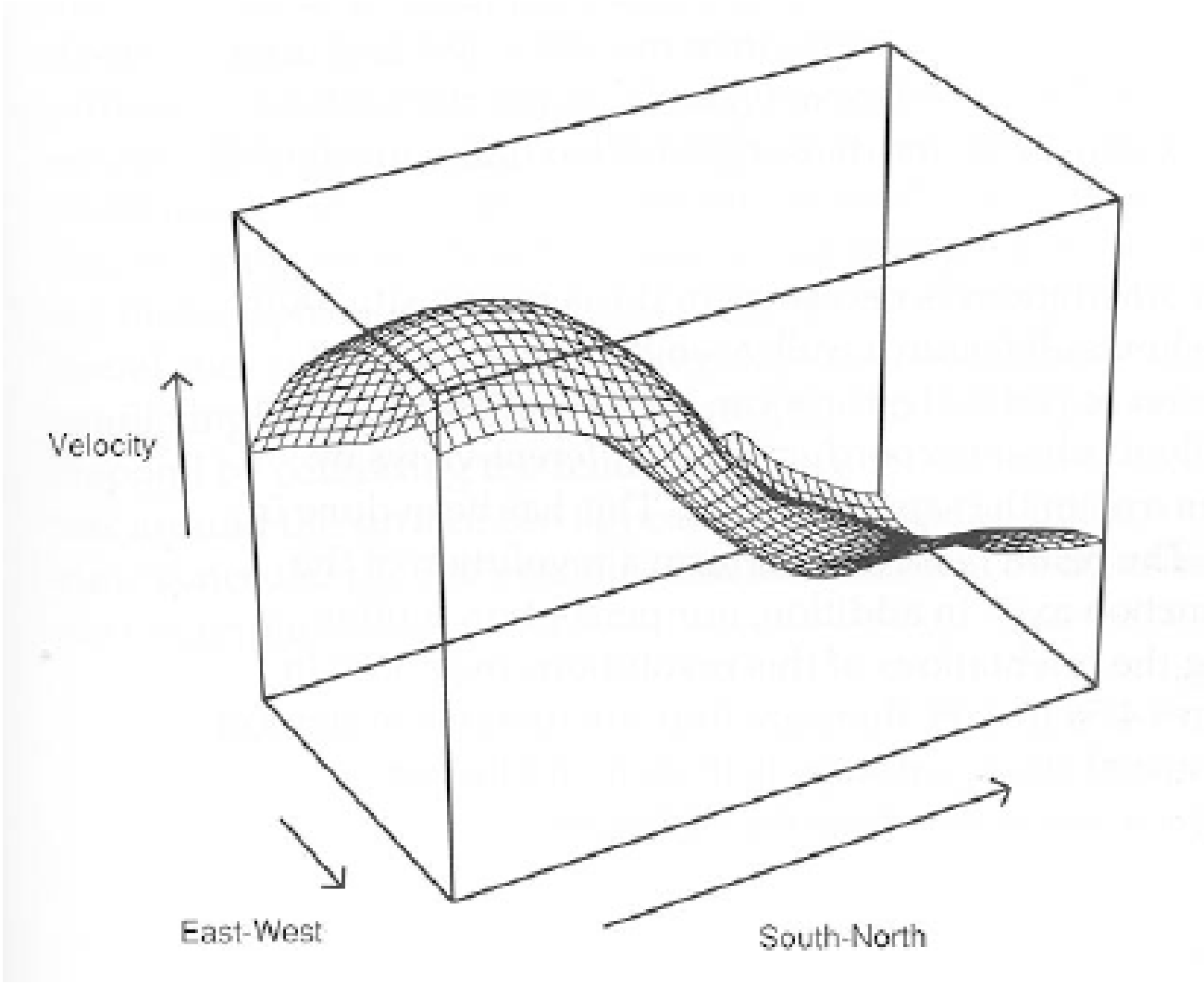
- The use of **computer** generated, interactive, visual representations of data to amplify cognition

Outline

- Data visualization
  - Historic perspective and now
  - Why has visualization dawn new attention?
- The visualization pipeline
- What are considered good visualizations?
- What are available?
- What are the remaining challenges?

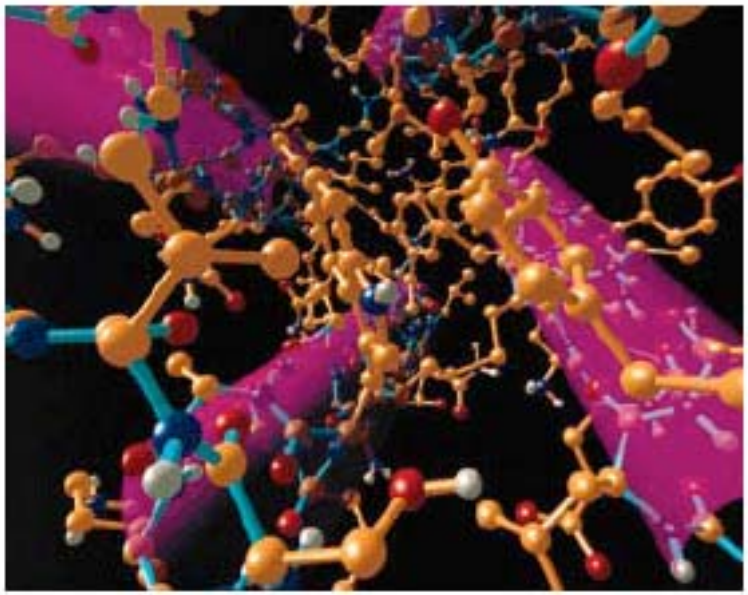


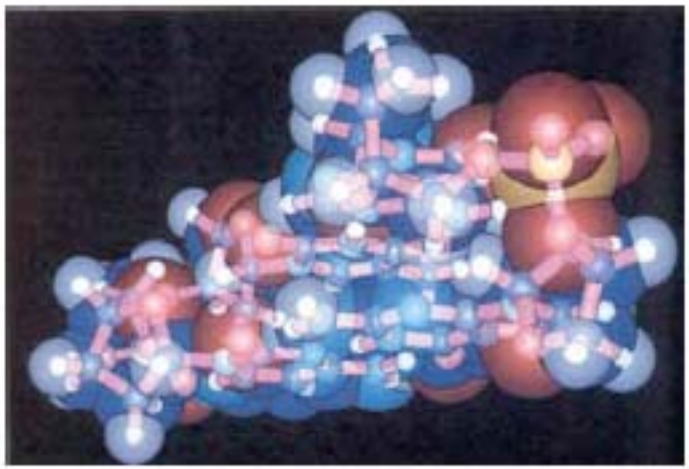
Wing design results for low-wing transport at Mach 0.77.

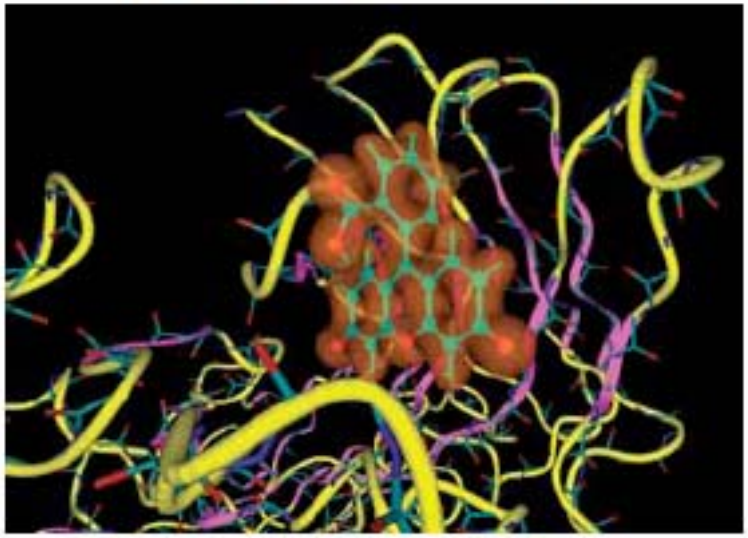

Velocity
East-West
South-North

Data Visualization (primitive)

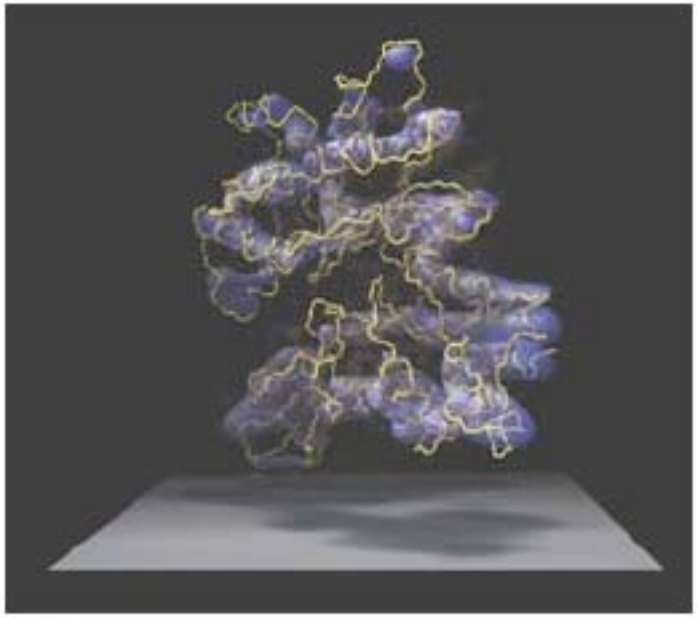
Streamlines





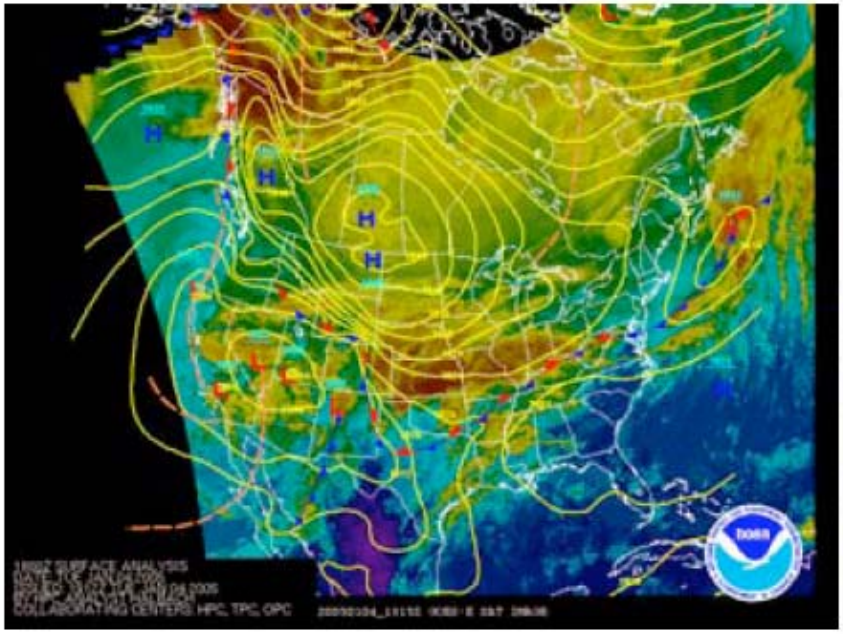


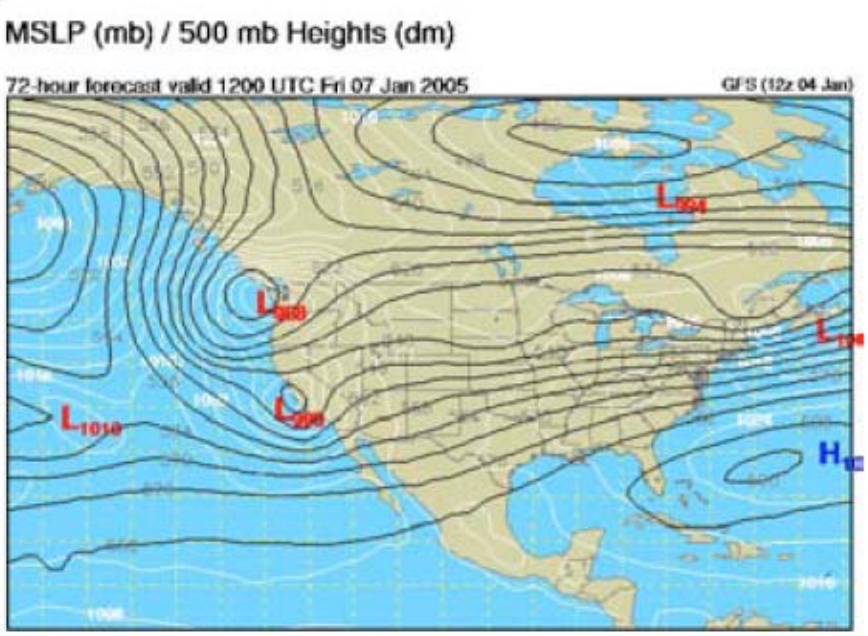
SDSC



LBL

Weather Visualization





Visualization draws new attention!

- The advances of computer hardware and computing technology
- Increasing use of computers
- Increasing data resolution
- Increasing data complexity
- The desire to integrate the computer visualization process into the loop of scientific discovery

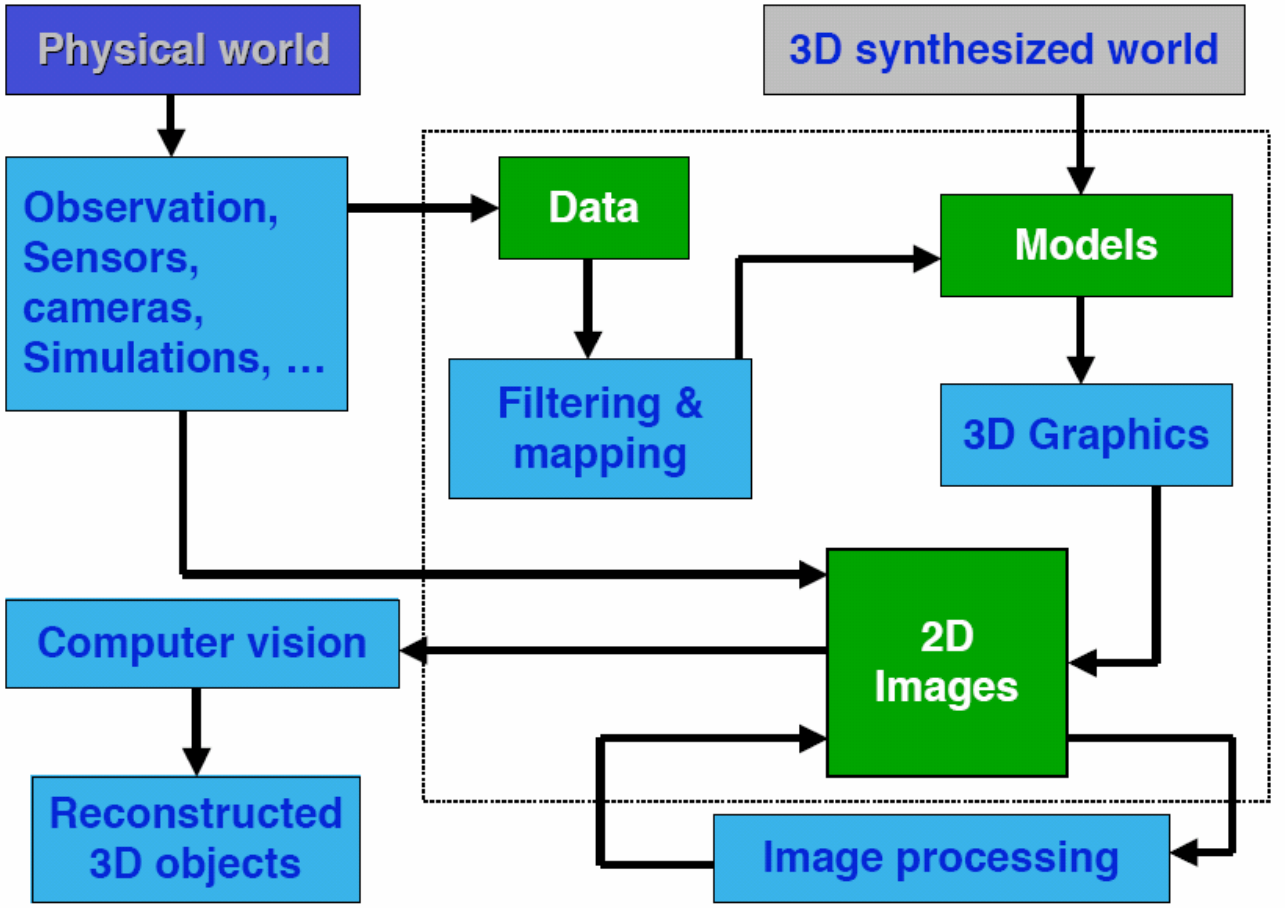
Reading: *Visualization - Expanding Scientific and Engineering Research Opportunities*, T. DeFAnti, M. Brown, b. McCormick, IEEE Computer, August 1989

Visualization Now!

Interactively browse, explore, analyze, present, communicate with visual representations of data generated from numerical simulations, data acquisition devices, or laboratory experiments.

- New methods on conventional data
- New methods for large & complex data
- Advanced user interfaces
- A new computing paradigm

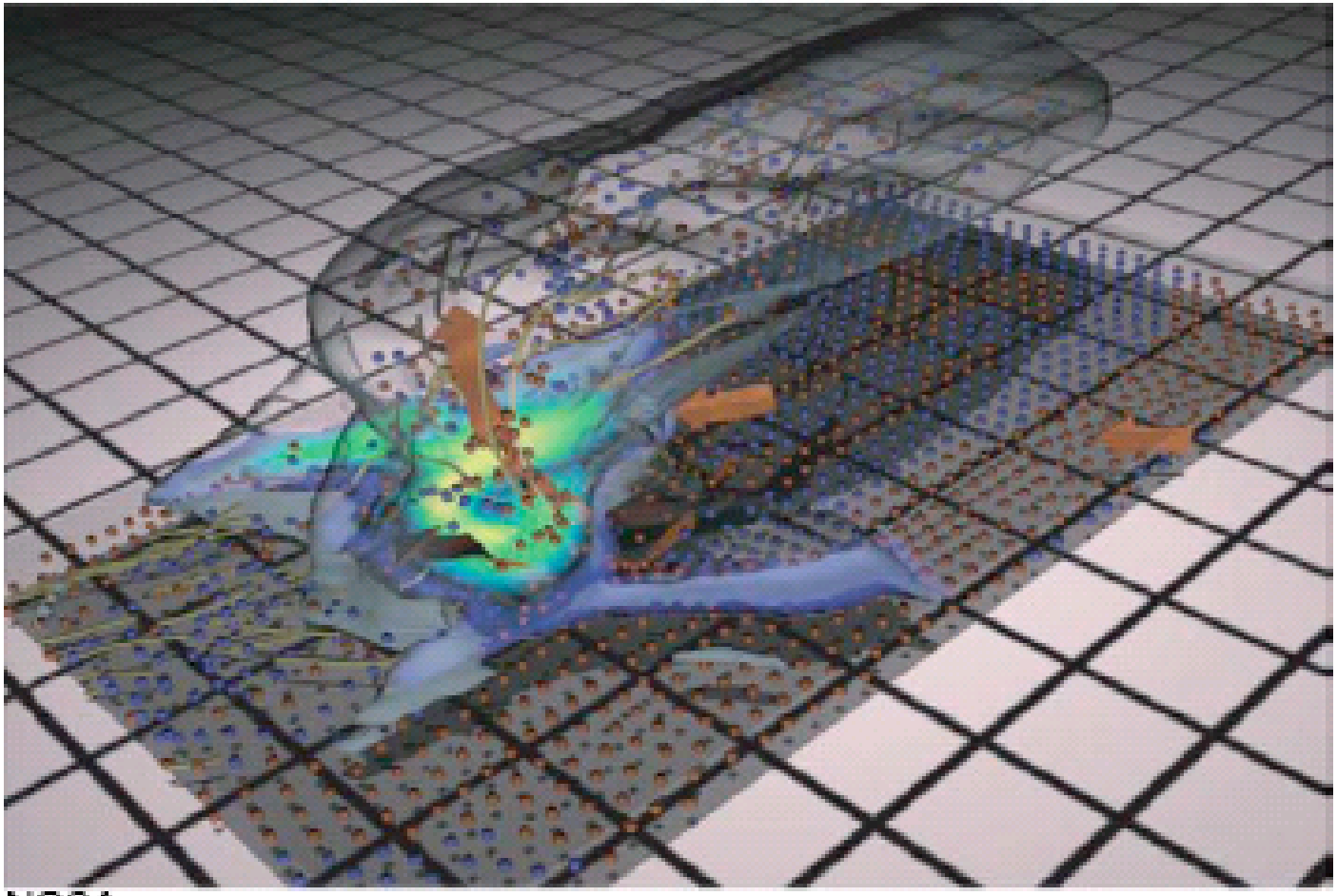
Visualization Process



What are good visualization?

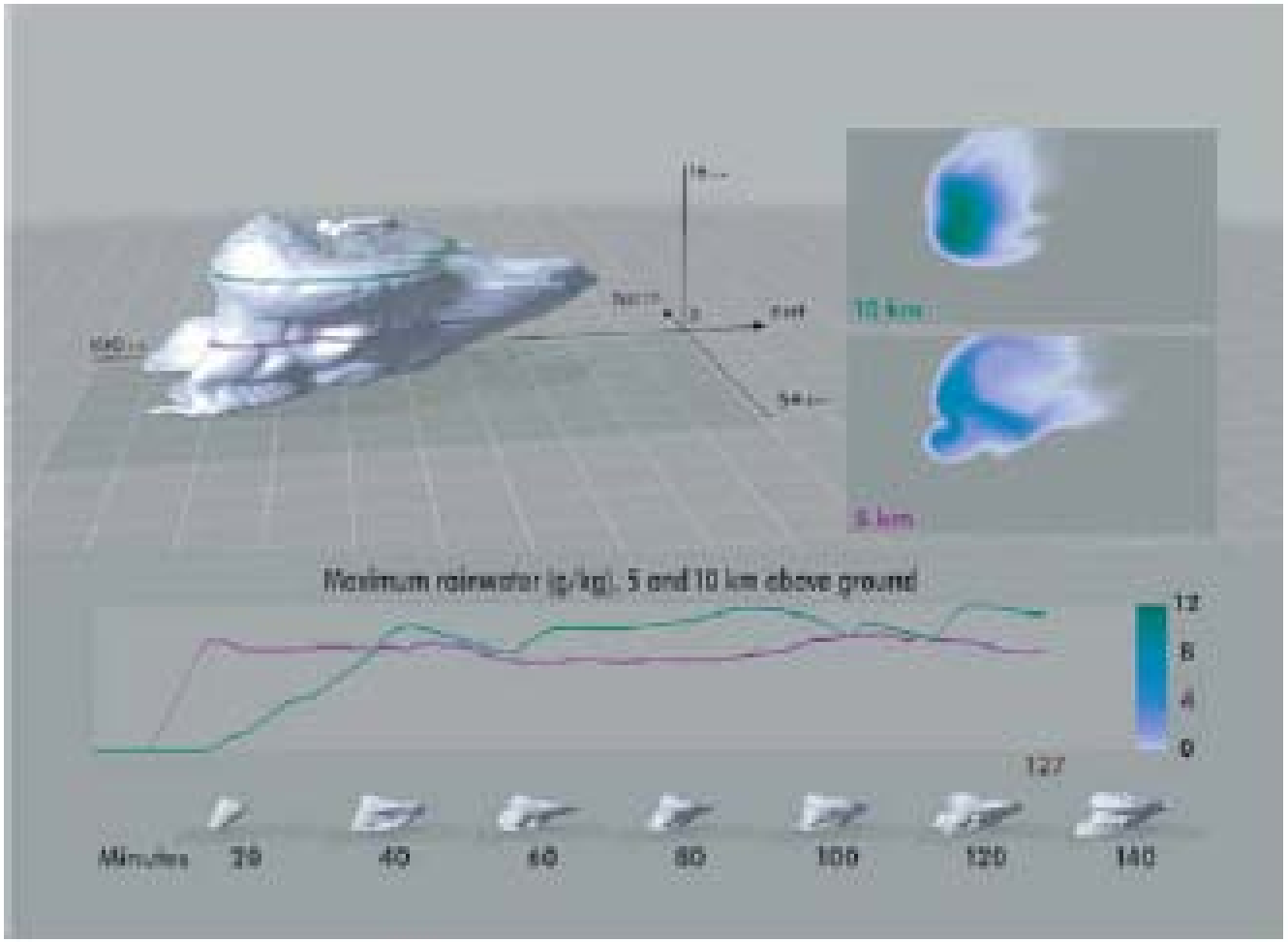
- Correct
- Concise
- Self-explaining
- Use the right visual language
- Provides insights
- Economical

Thunderstorm Visualization



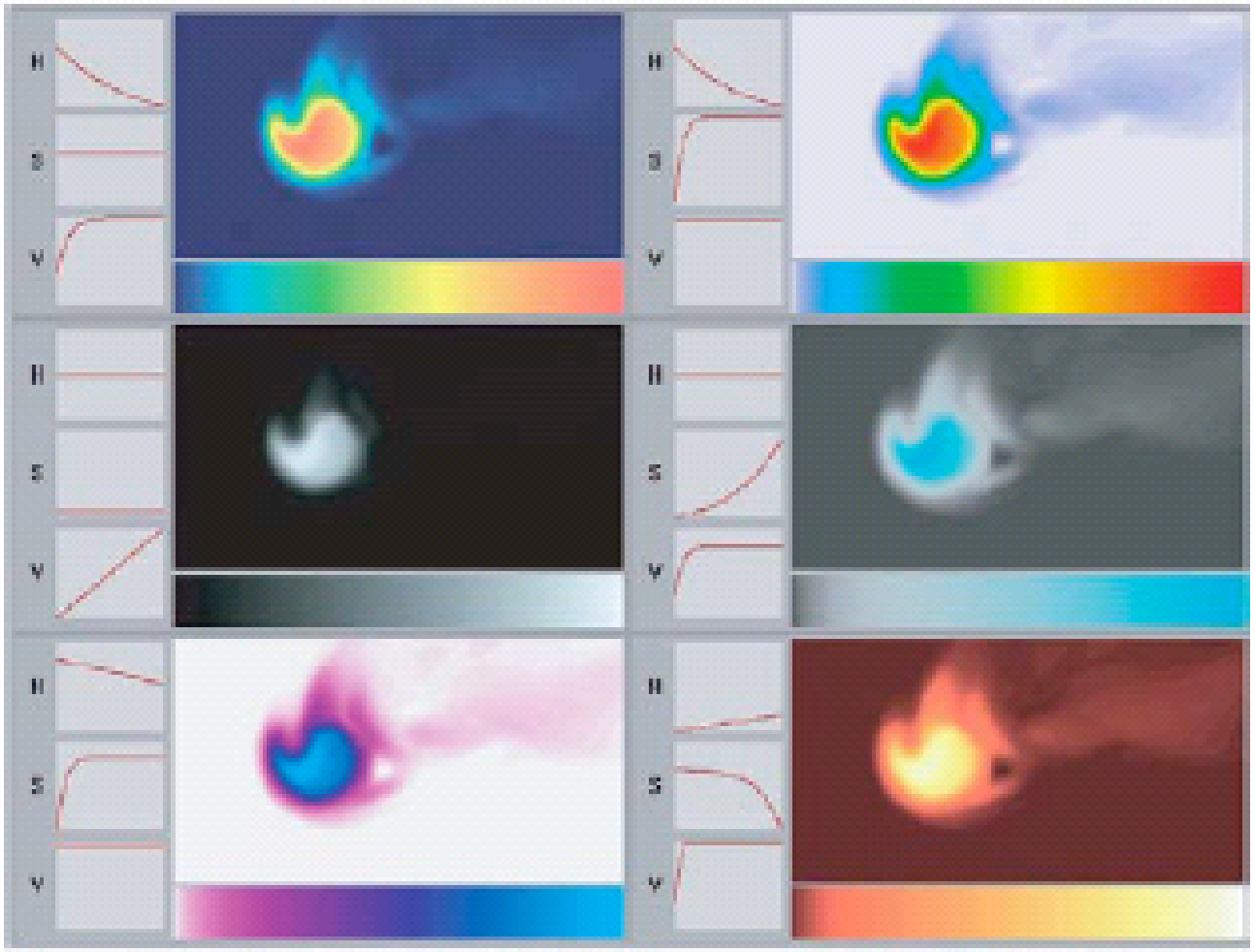
NCSA

Redesigned Storm Visualization



After the Storm: Considerations for Information Visualization
Polly Baker, Colleen Bushell

Redesigned Storm Visualization



After the Storm: Considerations for Information Visualization
Polly Baker, Colleen Bushell

Classification of Vis. Software

- Mathematical (numerical)

  Maple, Mathematica, Matlab, SPSS, …
- Scientific Visualization (spatial)

  AVS, IBM Data Explorer, IDL, Ensight, Fieldview,
- Information Visualization (symbolic)

  Web, databases, stock market, …

What are available?

- Graphics libraries

  Xlib, OpenGL, Java 3D, Direct3D
- Presentation graphics packages

  Gnuplot, Techplot, Harvard Graphics, Powerpoint
- Turnkey visualization software

  Fieldview, EnSight, FAST, Matlab, …
- Application Builders

  AVS, IBM Data Explorer, Visualization Toolkit (VTK), …
- Research prototypes

Challenging Visualization Prob.

- Large data
- Multivariate & multidimensional data
- Multi-modality data visualization
- Tensor data
- Comparative visualization
- Semantic interaction with data
- Probing and measurement
- Recording, sharing, reuse
- …

The Trends

- Distributed & remote, wireless
- Collaborative
- Large format display
- Automatic data analysis & visualization
- Hardware-accelerated
- Perception-guided
- Integrated

Citation

- Wikipedia, Answer.com
- UCDavis, Kwan-Liu Ma

The End

- Thank you for paying attention!!

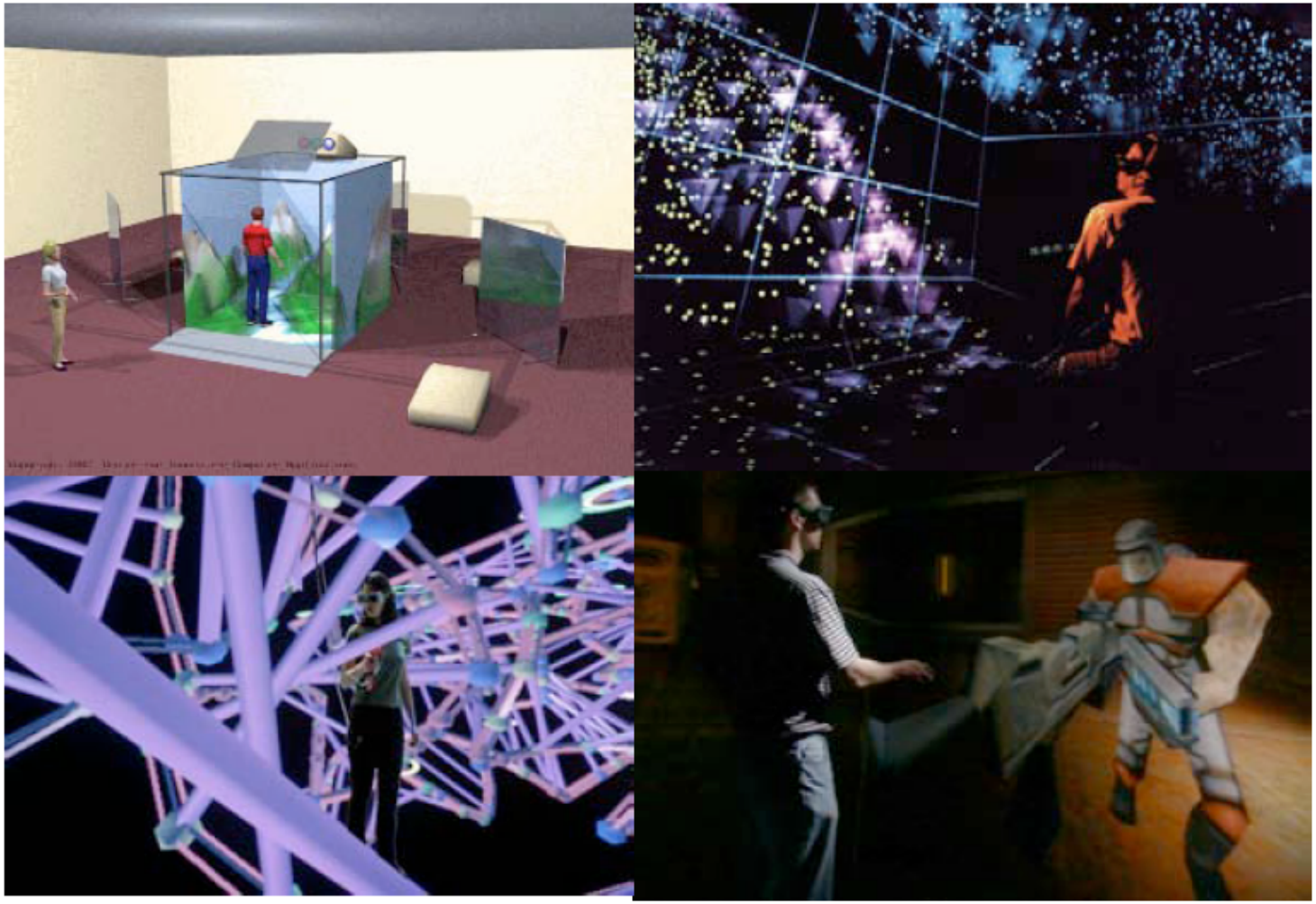
“The Wonderland into which Alice walked”

key

- what(def) why(feature) what(detail, basic) app, research
- XX之父 --- “一則軼事”
- 兩個點 per 10 min
- Eg. research team

Hybrid VR

Displays Hardware

- HMDs
- surround projection
- panoramic projection
- workbench

CAVE VR Environment