



Scientific Visualization

Data, Process, and Image

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- Introduction
- Goals
- Visual Data Densities
- Visualization Techniques
- Visualization Tools
- Visualization Hazards
- Conclusions
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Introduction

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- Scientific Visualization is a tool that allows us to communicate with our data.
- Visual exploration is a natural human process.
- Computer graphics and high speed computers bring depth, motion, and interaction to our visual exploration.

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Visualization Goals

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- Show the Data.
- Induce the viewer to think about the data
- Present large quantities of data at high spatial densities
- Make large data sets manageable and coherent
- Show fine detail while maintaining an overall perspective
- Create the visual environment with a reasonable and clear purpose
- Provide clear labels and reference points

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Visual Data Densities

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Images

- Computer Screen 1.3 Million Pixels
- 35mm Slide 25 Million Pixels
- Human eye 150 Million Pixels

Text

- Best Seller 5000 - 15000 Characters per Page
- Phone Book 10000 - 18000 Characters per Page
- Reference Book 28000+ Characters per Page

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Visual Techniques

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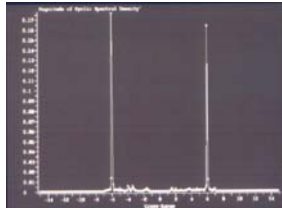
- Plots
- Pseudo-Color
- Surface Rendering
- Volume Rendering
- Glyphs
- Presentation vs. Display

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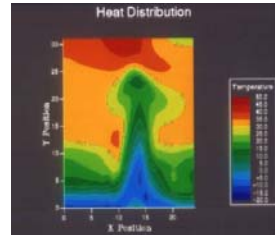
Visualization Techniques

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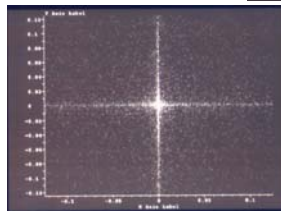
Plots



Line



Contour

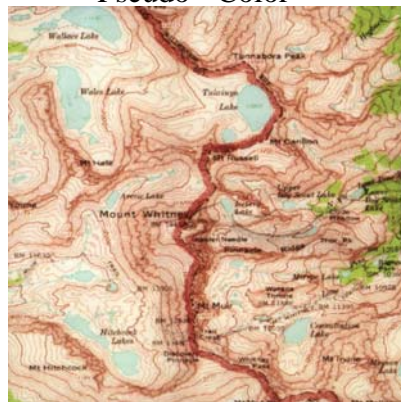


Scatter

Visualization Techniques

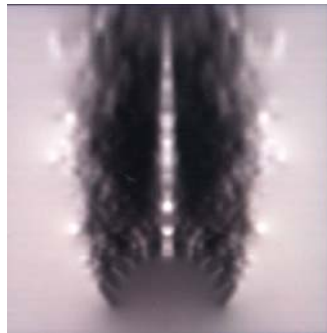
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Pseudo - Color

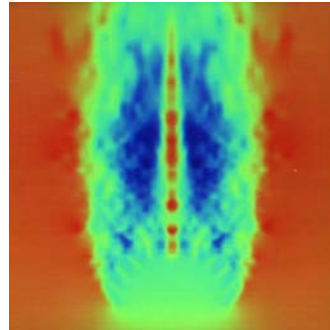


Contours

Pseudo - Color



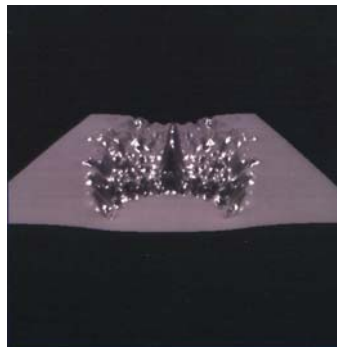
Original



Color Mapped

Flow Image

Surface Rendering

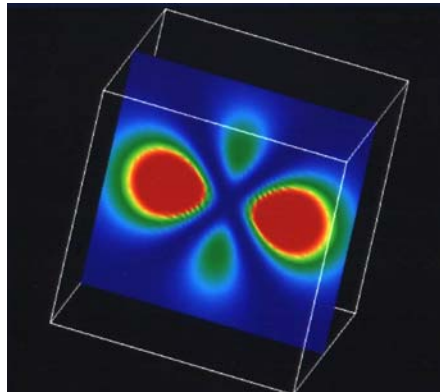




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Volume Rendering



Slices

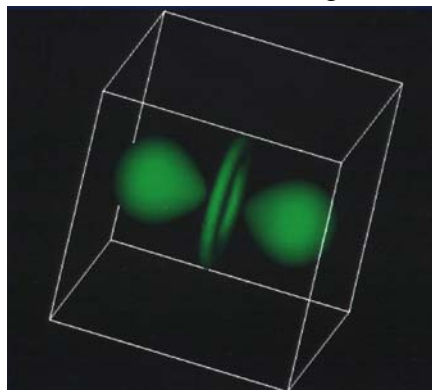
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Volume Rendering



Iso-Surfaces

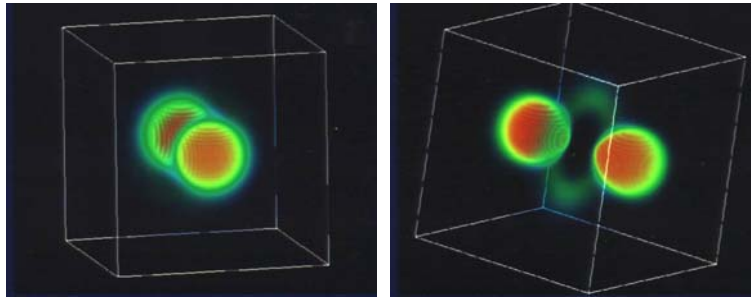
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Volume Rendering



Voxels

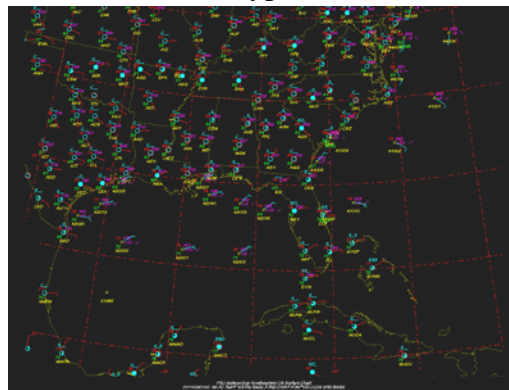
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Glyph



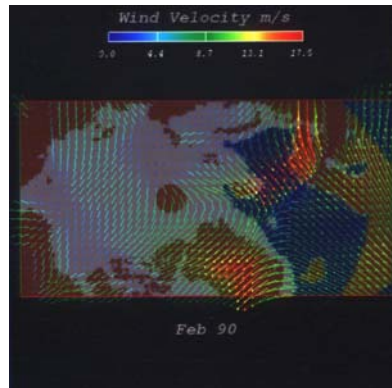
Symbols

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Glyph



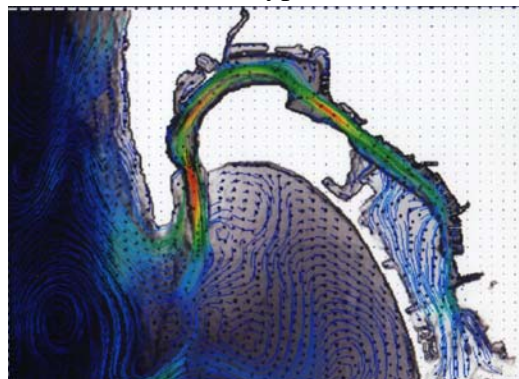
Arrows

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Glyph



Ribbons - Streamlines - Particles

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Visualization Techniques

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Presentation & Display

- Flicker
- Animation
- Stereo
- Interaction
- Display Screen vs. Hardcopy

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Visualization Tools

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Visualization Packages

VTK
Khoros
AVS
IDL
PV-Wave
Vis-5D

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Visualization Tools

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Rendering Tools

Blue Moon Ray Tracer (BMRT)
PR Renderman (Pixar)
Persistence of Vision Ray Tracer
Maya
3D - Studio Max

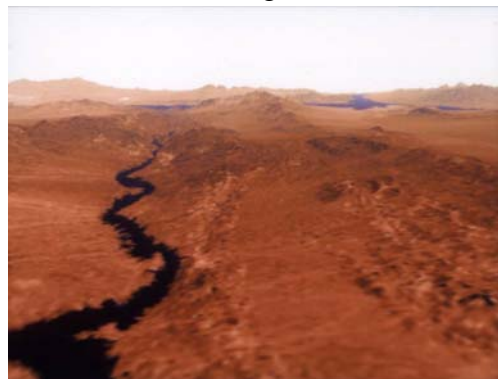
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Rendering Tools



PR Renderman

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Rendering Tools



Blue Moon Ray Tracer

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Rendering Tools



Persistence of Vision Ray Tracer

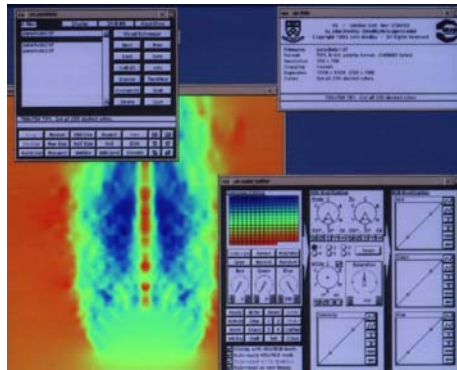
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Visualization Tools

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Other Tools



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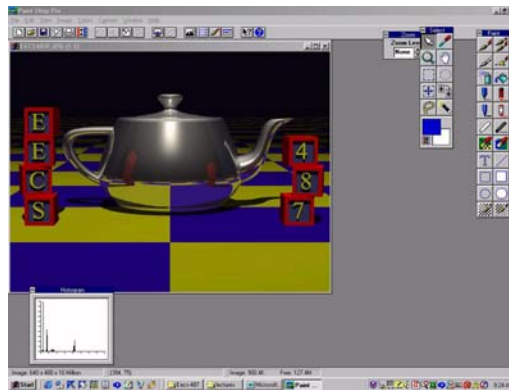
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Visualization Tools

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Other Tools



Paint Shop Pro

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Visualization Hazards

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- Color Confusion
- Visual Confusion
- Visual Integrity
- Rendering Effects

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Visualization Hazards

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Color Confusion



Color Complexity

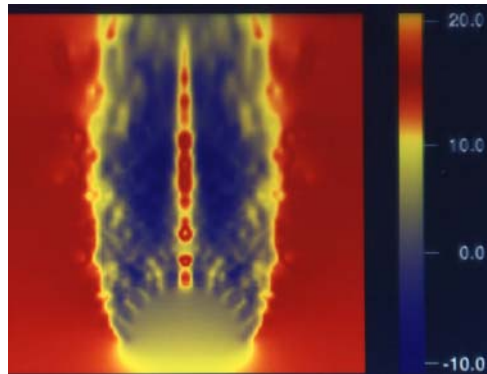
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Visualization Hazards

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Color Confusion



Eye Response, Color Meaning, Bad Color Maps

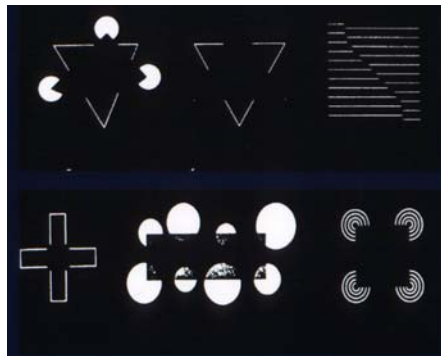
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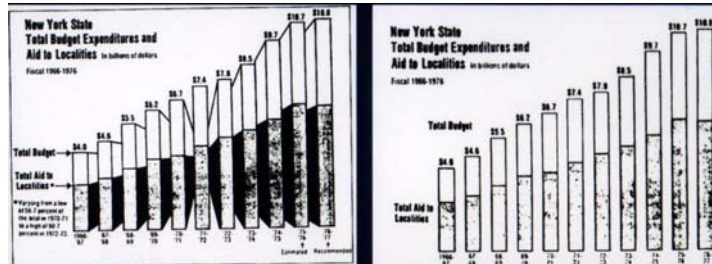
Visual Confusion



Optical Illusions

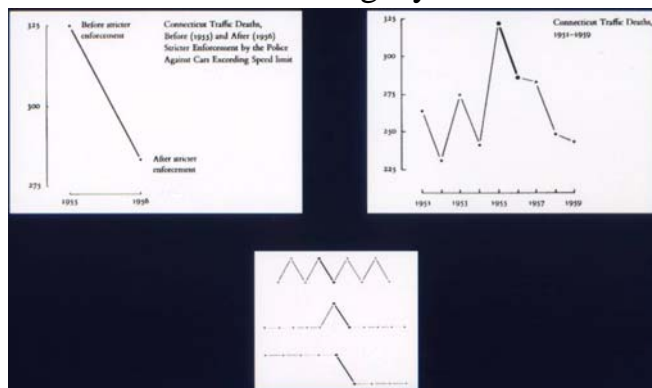
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Visual Integrity



Bar Chart Lies

Visual Integrity



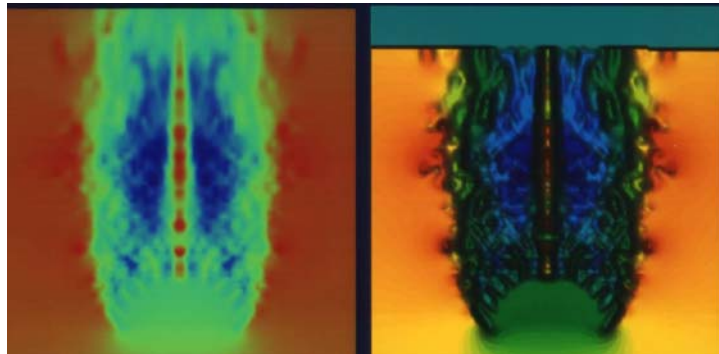
Partial Information



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Rendering Effects



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Final Report vs. Investigation

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Final Report:

- Clean Presentation
- Anti-Aliased Images (No Jaggies)
- High Resolution

Investigation:

- Fast Response
- Display Data Sampling (Aliasing)
- Lower Resolution and Limited Colors

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Conclusions

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- Good Visualizations are Designed
- Know Your Audience
- Know Your Visual Purpose
- Be Aware of the Hazards

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References

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