Scientific Visualization

Data, Process, and Image

Overview

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

• 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.

Visualization Goals

• 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
Visual Data Densities

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

Visual Techniques

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

Lecture 19

Plots
Line
Contour
Scatter

Pseudo - Color
Contours
Visualization Techniques

Pseudo - Color

Original
Flow Image
Color Mapped

Visualization Techniques

Surface Rendering
Visualization Techniques

Volume Rendering

Slices

Iso-Surfaces
Visualization Techniques

Volume Rendering

Voxels

Glyph

Symbols
Visualization Techniques

Glyph

Arrows

Ribbons - Streamlines - Particles
Visualization Techniques

Presentation & Display

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

Visualization Tools

Visualization Packages

VTK
Khoros
AVS
IDL
PV-Wave
Vis-5D
Visualization Tools

Rendering Tools

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

PR Renderman
Visualization Tools

Lecture 19

Rendering Tools

Blue Moon Ray Tracer

Persistence of Vision Ray Tracer
Visualization Tools

Other Tools

Paint Shop Pro
Visualization Hazards

• Color Confusion
• Visual Confusion
• Visual Integrity
• Rendering Effects

Color Confusion

Color Complexity
Visualization Hazards

Lecture 19

Color Confusion

Eye Response, Color Meaning, Bad Color Maps

Visual Confusion

Optical Illusions
Visualization Hazards

Visual Integrity

Bar Chart Lies

Partial Information
Visualization Hazards

Rendering Effects

Final Report vs. Investigation

Final Report:

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

Investigation:

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

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

References

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