Interactive Computer Graphics

Lecture 19

Scientific Visualization

Data, Process, and Image

Overview

Lecture 19

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

Introduction

Lecture 19

• 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.

3

Visualization Goals

Lecture 19

• 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

4

Visual Data Densities

Lecture 19

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

5

Visual Techniques

Lecture 19

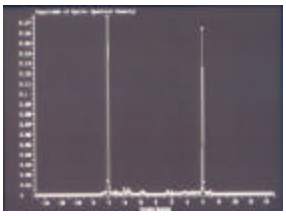
- Plots
- Pseudo-Color
- Surface Rendering
- Volume Rendering
- Glyphs
- Presentation vs. Display

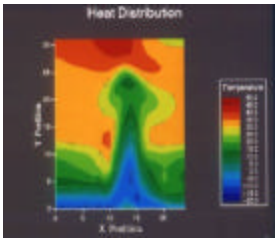
6

Visualization Techniques

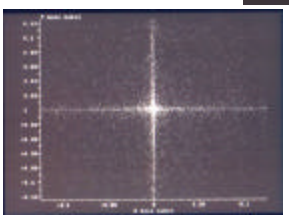
Lecture 19

Plots





Line



Contour

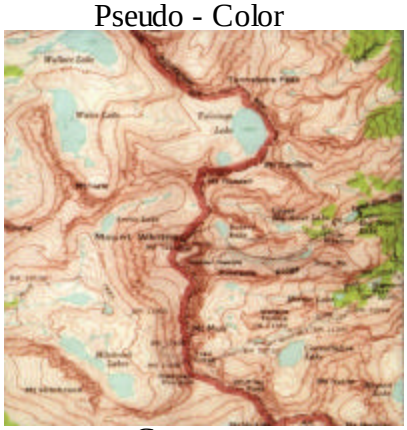
Scatter

7

Visualization Techniques

Lecture 19

Pseudo - Color



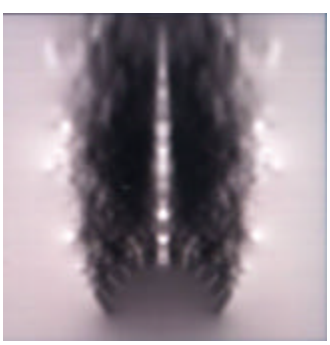
Contours

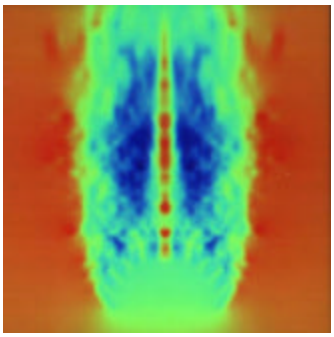
8

Visualization Techniques

Lecture 19

Pseudo - Color





Original Flow Image

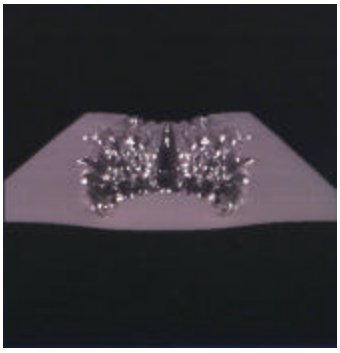
Color Mapped

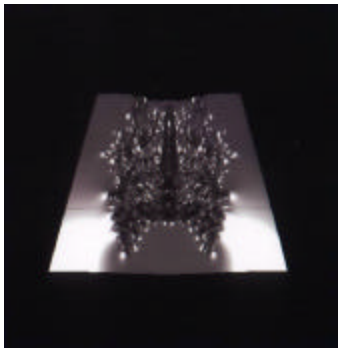
9

Visualization Techniques

Lecture 19

Surface Rendering



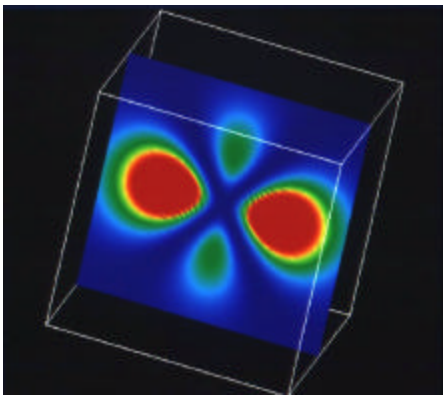


10

Visualization Techniques

Lecture 19

Volume Rendering



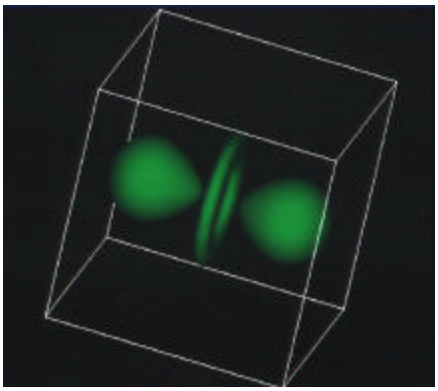
Slices

11

Visualization Techniques

Lecture 19

Volume Rendering



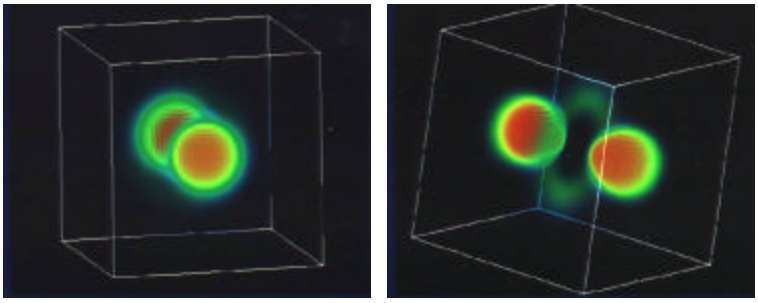
Iso-Surfaces

12

Visualization Techniques

Lecture 19

Volume Rendering



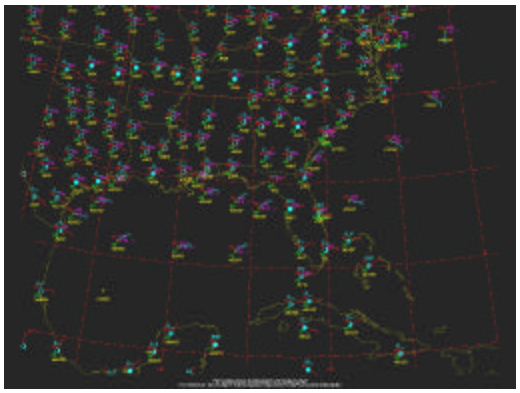
Voxels

13

Visualization Techniques

Lecture 19

Glyph



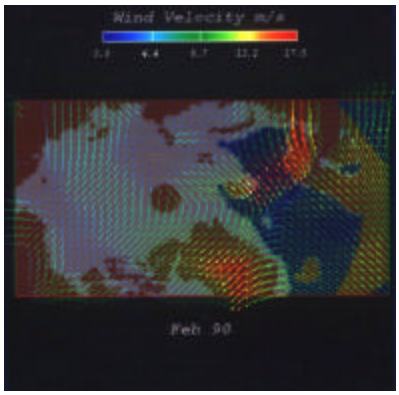
Symbols

14

Visualization Techniques

Lecture 19

Glyph



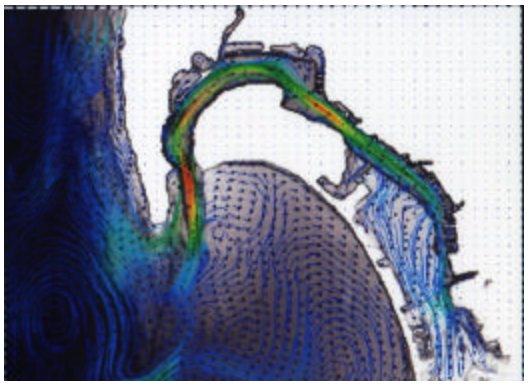
Arrows

15

Visualization Techniques

Lecture 19

Glyph



Ribbons - Streamlines - Particles

16

Visualization Techniques

Lecture 19

Presentation & Display

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

17

Visualization Tools

Lecture 19

Visualization Packages

VTK
Khoros
AVS
IDL
PV-Wave
Vis-5D

18

Visualization Tools

Lecture 19

Rendering Tools

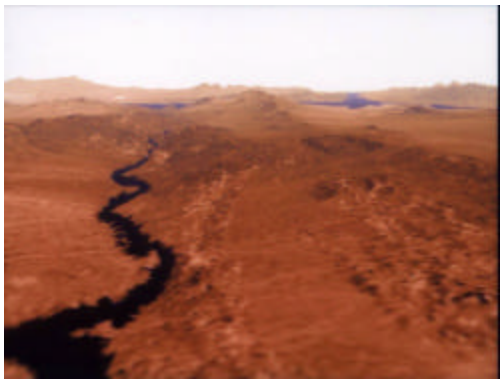
Blue Moon Ray Tracer (BMRT)
PR Renderman (Pixar)
Persistence of Vision Ray Tracer
Maya
3D - Studio Max

19

Visualization Tools

Lecture 19

Rendering Tools



PR Renderman

20

Visualization Tools

Lecture 19

Rendering Tools

Blue Moon Ray Tracer

21

Visualization Tools

Lecture 19

Rendering Tools

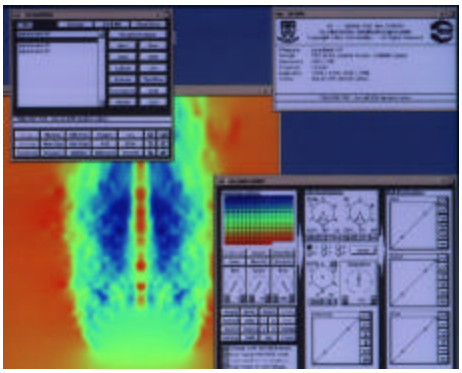
Persistence of Vision Ray Tracer

22

Visualization Tools

Lecture 19

Other Tools



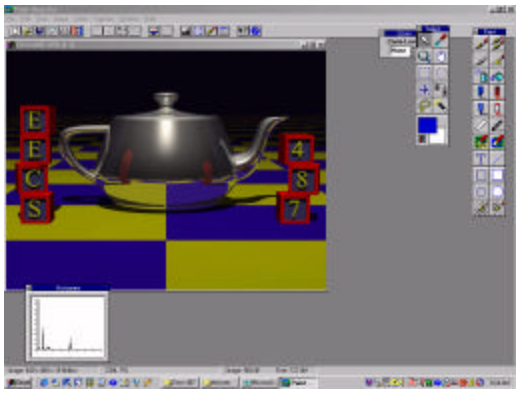
XV

23

Visualization Tools

Lecture 19

Other Tools



Paint Shop Pro

24

Visualization Hazards

Lecture 19

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

25

Visualization Hazards

Lecture 19

Color Confusion

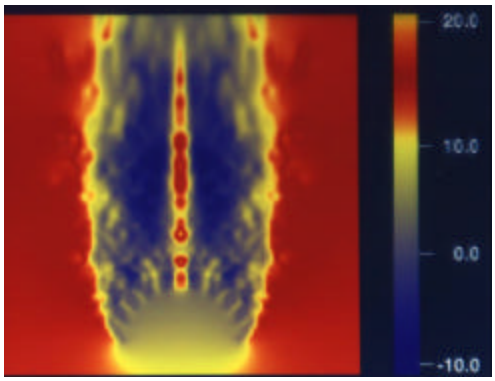
Color Complexity

26

Visualization Hazards

Lecture 19

Color Confusion



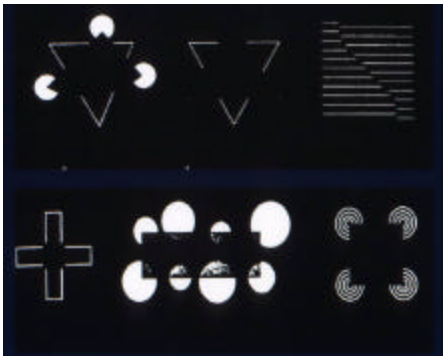
Eye Response, Color Meaning, Bad Color Maps

27

Visualization Hazards

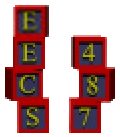
Lecture 19

Visual Confusion



Optical Illusions

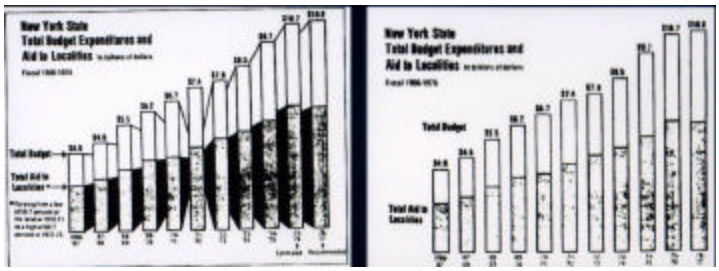
28



Visualization Hazards

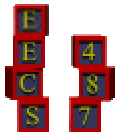
Lecture 19

Visual Integrity



Bar Chart Lies

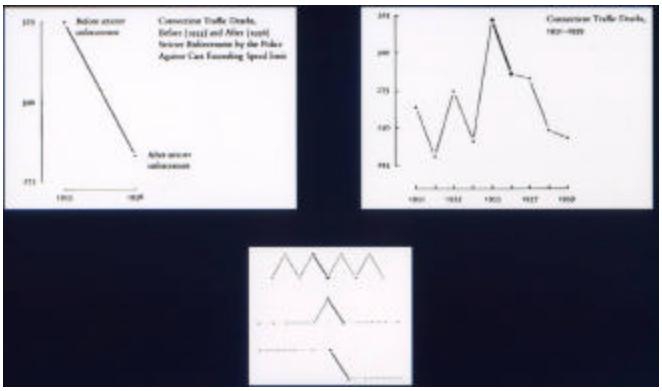
29



Visualization Hazards

Lecture 19

Visual Integrity



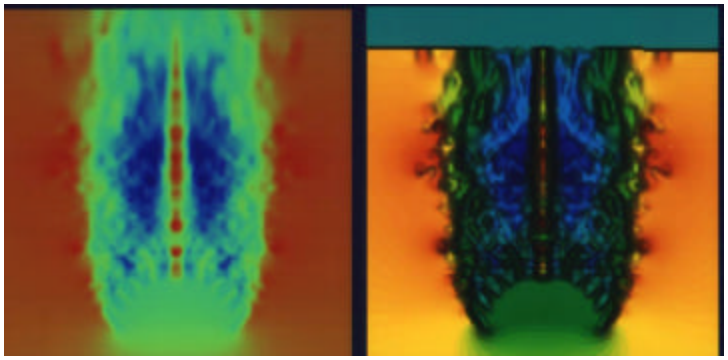
Partial Information

30

Visualization Hazards

Lecture 19

Rendering Effects



31

Final Report vs. Investigation

Lecture 19

Final Report:

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

Investigation:

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

32

Conculsions

Lecture 19

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

33