Scientific Vizualization

By Nick Gnedin

Overview

- Visualizing Scientific Data
- Existing Tools
- Introduction to IFrIT

Visualizing Scientific Data

Scientific Data

We usually deal with two classes of data:

- Regular data on a grid
- Particle data

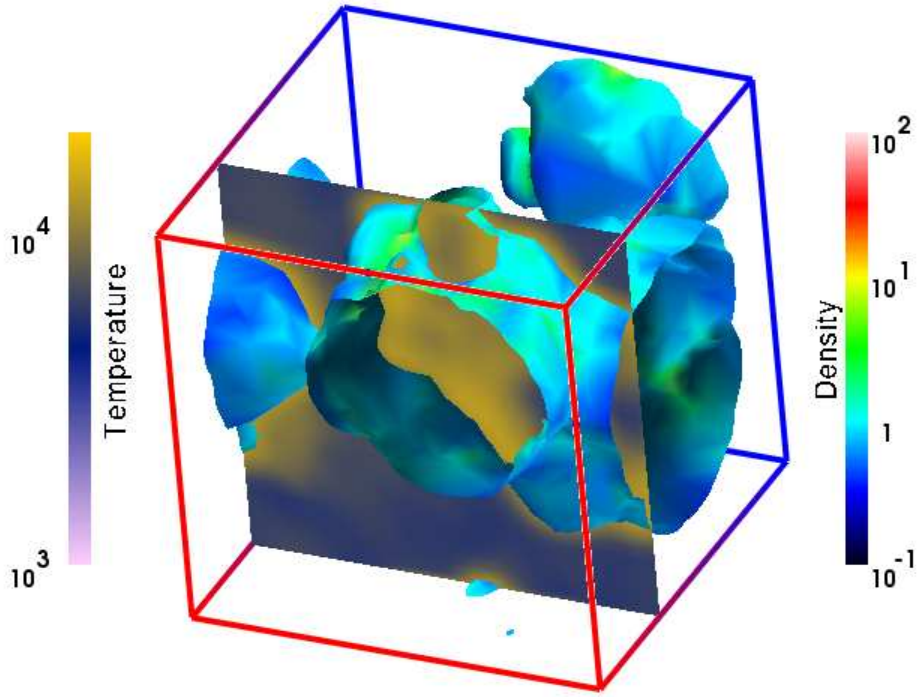
The latter is rarely used in industry, so we have to improvise

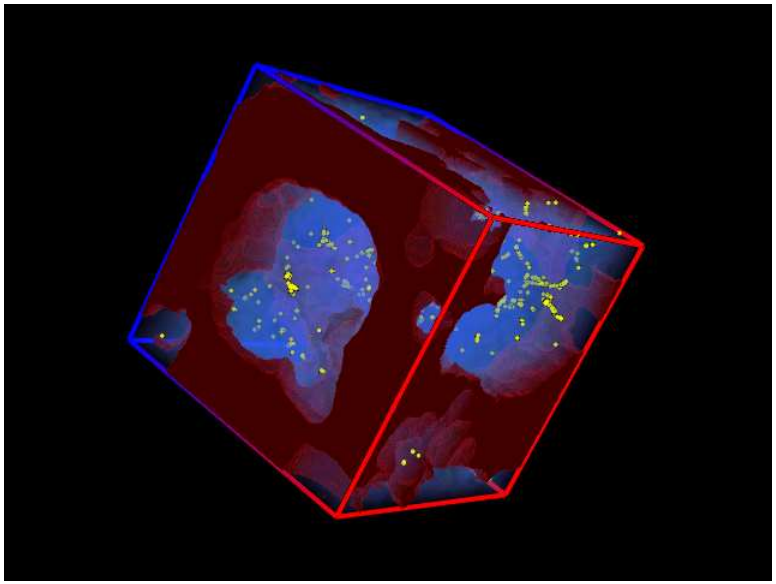
Grid Data

- The grid does not have to be regular (AMR is ok)
- Grid data consist of cells that fill in all the volume of interest with no overlap
- Grid data can be:
  - Scalar (several scalar variables per cell)
  - Vector field
  - Tensor (rank 2) field
  - …

Visualizing Scalar Data

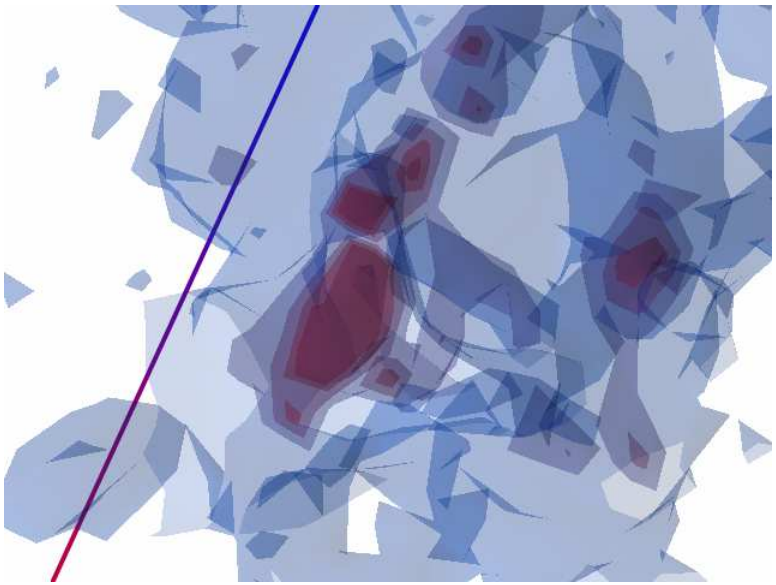
- Place a 2D surface and color it by a scalar value
- Volume rendering (a-la fog)

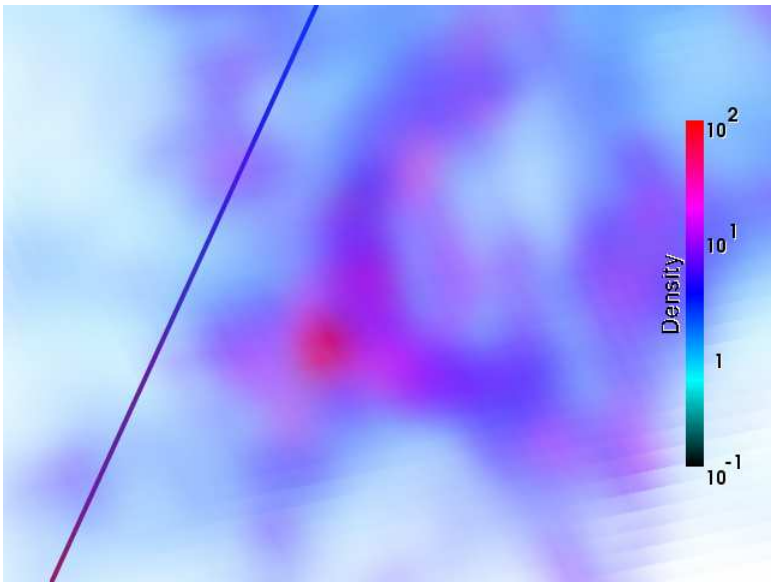




Visualizing Scalar Data (2)

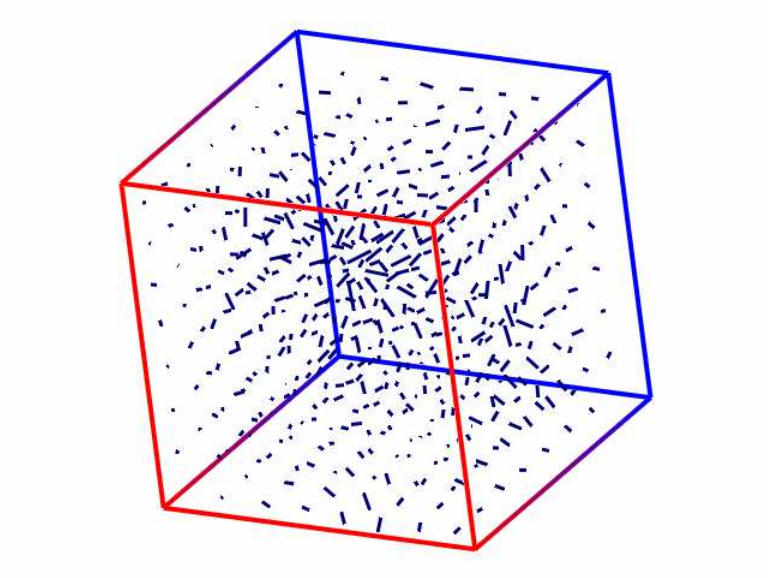
- Several translucent isosurfaces may serve as an approximation to volume rendering

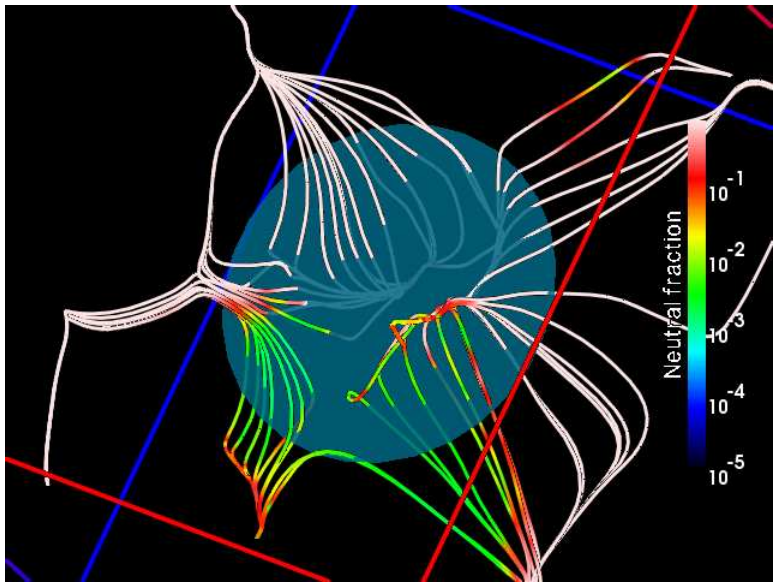




Visualizing Vector Data

- Vector glyph (rarely useful in 3D)
- Streamlines

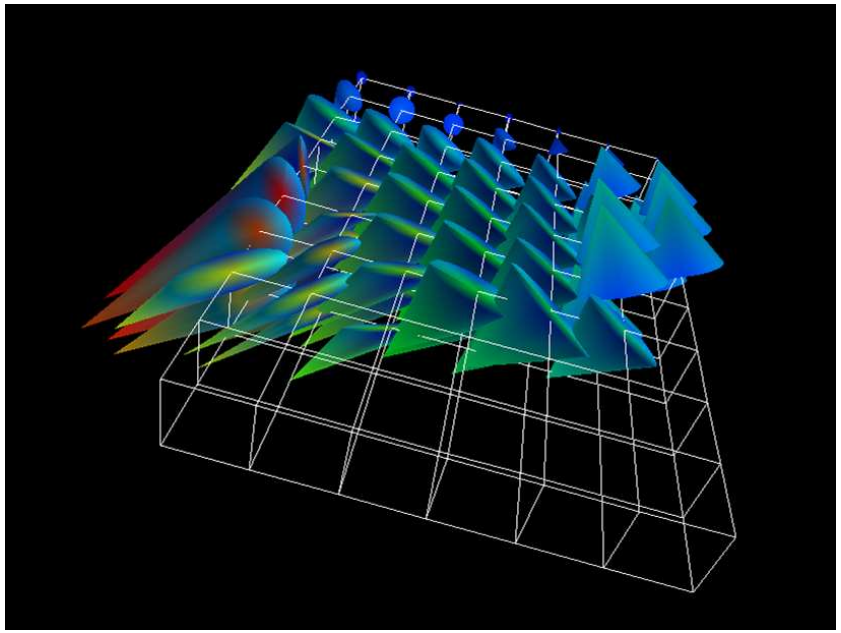




Visualizing Tensor Data

- Tensor glyph
- Tensor splats

(do not go there yet)

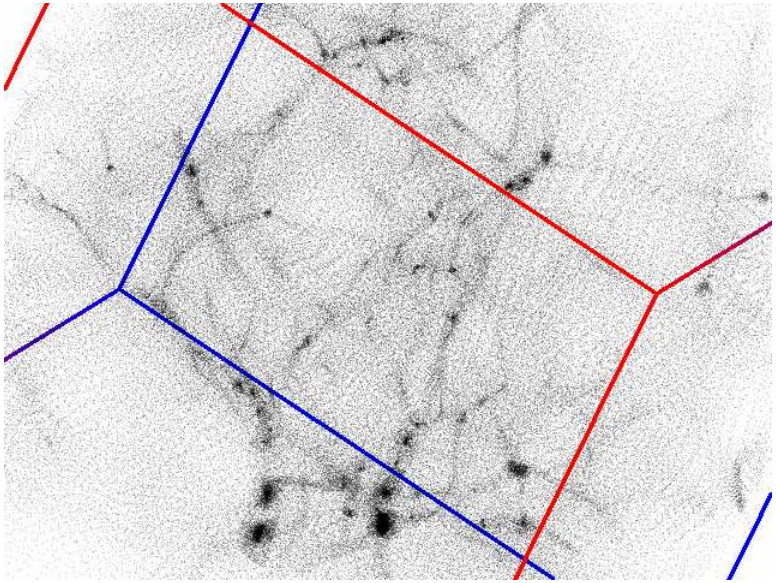


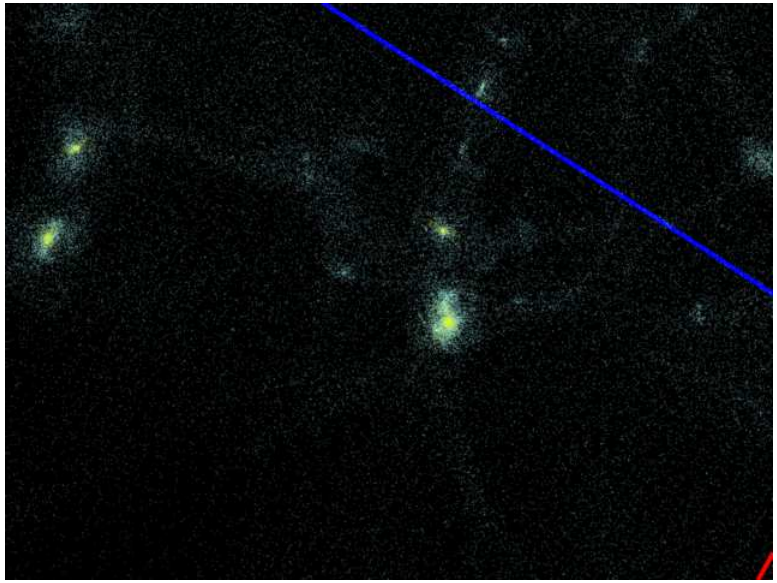
Particle Data

- If you do not know what particle data are, what have you been doing the last 3 weeks???

Visualizing Particle Data

- Not much can be done with particles…



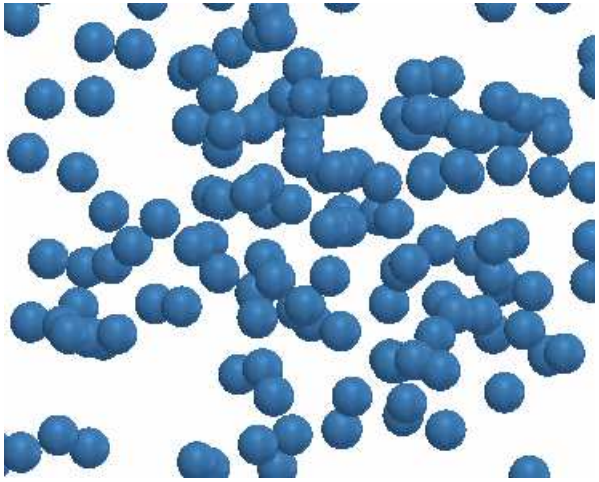


Visualizing Particle Data (2)

- Particles can be visualized as OpenGL points
  - Points in OpenGL have size
  - Antialiased points appear as circles, non-antialiased points appear as squares

Visualizing Particle Data (3)

- We can also represent particles as 3D objects, but it will be slow even for a few hundred particles (many verticies + many polygons for every particle)



Existing Tools

OpenGL and SciViz

- The good thing about OpenGL is that it does not need to be used directly for scientific visualization
- There exists a number of *Toolkits* build on top of OpenGL:
  - **VTK** (Visualization ToolKit, Kitware)
  - Open Inventor (SGI)
  - OpenGL Performer (SGI, not free)
  - IDL (RSI, not free)
  - MatLab (not free)

Tools (Just A Few)

- Amira (www.amiravis.com)
- AVS (www.avs.com)
- EnSight (www.ensight.com)
- IRIS Explorer (www.nag.co.uk/welcome_iec.asp)
- ParaView (www.paraview.org)
- VisIt (www.llnl.gov/visit)

Today we will talk about

- IFrIT (home.fnal.gov/~gnedin/IFRIT)

The Videocard, Stupid

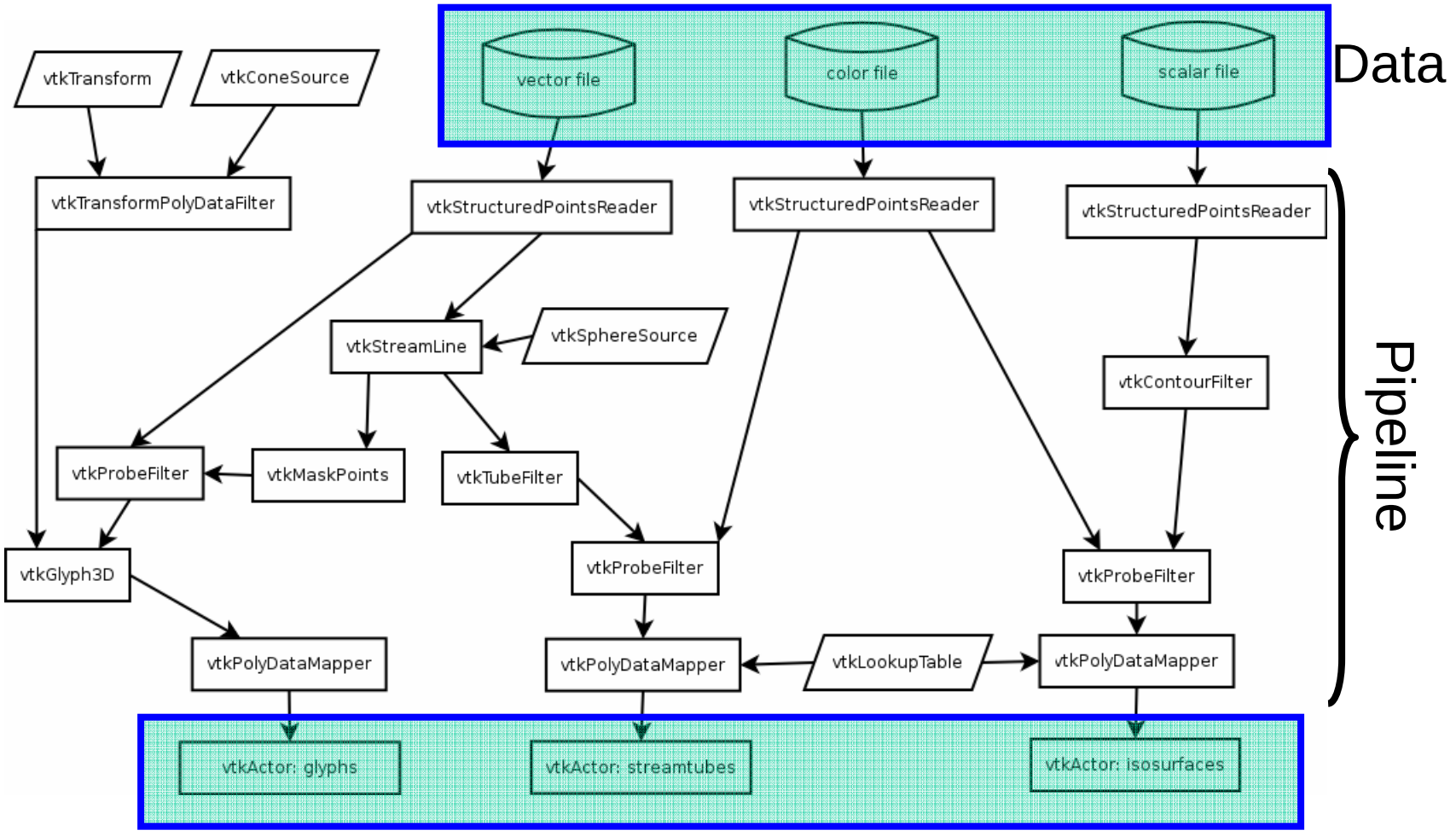
- At the end of all things, the visualization performance depends on the videocard
  - Gaming (desktop) videocards (NVIDIA GeForce, ~ $200)
  - Professional (workstation) videocards (NVIDIA Quadro, $2,000)

The Videocard, Stupid (2)

- Main brands:
  - NVIDIA (GeForce, Quadro)
  - ATI (Radeon, FireGL)
  - 3DLabs (Wildcat)
- The crucial parameter is video memory (latest models have up to 1GB)
- Laptops are **NOT** good visualization machines
- For Unix/Linux, choose NVIDIA
  (for other platforms choose NVIDIA too)

Introduction To IFrIT

Visualization: from data to image



Different Visualization Approaches

Amira:

User

Also user

Software

IFrIT:

User

Software

Software

IFrIT

- Stands for Ionization Front Interactive Tool
- Uses VTK for visualization and Qt toolkit for GUI = truly multi-platform (is free and works on Windows, Solaris/Linux/Aix, Mac)
- Includes support for AMR visualizations via HART extension
- Will include GADGET and ENZO extensions soon

home.fnal.gov/~gnedin/IFRIT